International Economics

Lecture Notes (Work in Progress)

June 25, 2025

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Preface

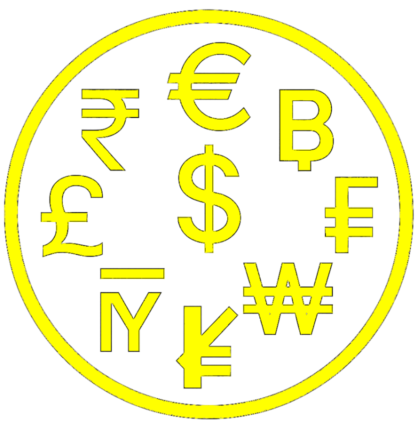
About the notes

A PDF version of these notes is available here.

Please note that while the PDF contains the same content, it has not been optimized for PDF format. Therefore, some parts may not appear as intended.

- These notes aims to support my lecture at the HS Fresenius but are incomplete and no substitute for taking actively part in class.
- These notes are actually an expert of my lecture notes on **Economics**.
- This is work in progress and some sections are preliminary.
- I appreciate you reading it, and I appreciate any comments.
- This is work in progress so please check for updates regularly.
- For making an appointment, you can use the online tool that you find on my private homepage: https://hubchev.github.io/
- The logo of this book shown in Figure 1 represents ten important currencies.

Figure 1: Logo



About the author

I am a Professor of *International Economics and Data Science* at HS Fresenius, holding a Diploma in Economics from the University of Regensburg and a Doctoral Degree (summa cum laude) from the University of Trier. I completed postgraduate studies at the Interdisciplinary Graduate Center of Excellence at the Institute for Labor Law and Industrial Relations in the European Union (IAAEU) in Trier. Prior to my current position, I worked as a research assistant to Prof. Dr. Dr. h.c. Joachim Möller at the University of Regensburg, a post-doc at the Leibniz Institute for East and Southeast European Studies (IOS) in Regensburg, and a freelancer at Charles University in Prague.

Figure 2: Prof. Dr. Stephan Huber

Throughout my career, I have also worked as a lecturer at various institutions, including the TU Munich, the University of Regensburg, Saarland University, and the Universities of Applied Sciences in Frankfurt and Augsburg. Additionally, I have had the opportunity to teach abroad for the University of Cordoba in Spain, the University of Perugia in Italy, and the Petra Christian University in Surabaya, Indonesia. My published work can be found in international journals such as the Canadian Journal of Economics and the Stata Journal. For more information, please visit my private homepage at hubchev.github.io and read my CV.

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Teaching principles

I believe in the ***K**eep **I**t **S**imple and **S**traightforward* principle (KISS), which emphasizes simplicity and clarity in all aspects of learning and teaching. This, however, does not imply that the content of the book easy to understand. Success still requires logical thinking and a strong work ethic. Those who struggle with this may find it difficult to pass my courses.

In the following sections, I will introduce various mathematical economic models and concepts that provide a structured framework for understanding economics. Familiarity with these concepts is necessary for understanding current literature and analyzing complex scenarios in international trade.

Economic models are based on transparent assumptions and usually consist of a set of equations that explain theories of economic behavior. A robust model should provide valuable insights into the behavior of rational actors and the workings of the economy.

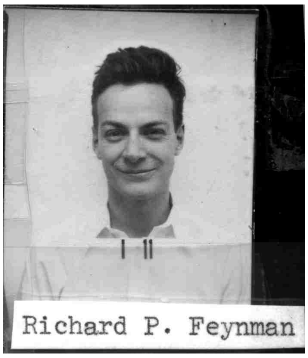
Unfortunately, students sometimes feel overwhelmed by these models because of their reliance on math and rigorous logical reasoning. There is often a perception that there are simpler ways to convey these arguments. While this may occasionally be true, I firmly believe that the formal approach to introducing international economics is most beneficial in the long run. Allow me to back up this belief:

- The narrative method, characterized by storytelling and bullet points, is a quick way to convey information on a variety of topics. However, it also has its drawbacks: students can easily get caught up in intuitive anecdotes without developing critical thinking or recognizing the underlying driving forces. As a result, they memorize information only for exams and forget it shortly thereafter.

- Unlike anecdotes, formal models are not inherently true; however, they can provide deeper insights into a topic than narratives. In Huber (2025, p. 2.1 From anecdote to insight), I discuss the advantages and disadvantages of anecdotes from an epistemological perspective in greater detail.
- Compared to anecdotes, formal models usually offer more flexibility. Once students understand the underlying logic of a model and can interpret and evaluate its implications, they can apply their understanding to different circumstances or topics. In contrast, anecdotes often provide a narrow perspective on a problem, making it difficult to draw general conclusions.
- A mathematical economic model functions much like a proof of an argument in that it accurately describes the assumptions under which the argument holds. In contrast, narratives often obscure the underlying assumptions and premises of an argument.
- Formal argumentation is the norm in economic research. Familiarity with basic concepts therefore enables students to understand the current literature, conduct research and solve problems in their professional lives.
- Understanding an economic model means grasping the underlying relationships, which promotes retention. In essence, formal models promote students' independent thinking and reasoning rather than mere repetition of the teacher's words.

How to prepare for the exam

Figure 3: Richard P. Feynman's Los Alamos ID badge



Source: *https://en.wikipedia.org/wiki/File:Richard_Feynman_Los_Alamos_ID_badge.jpg*

Richard P. Feynman (1918-1988) was a team leader at the Manhattan Project (see Figure 3) and won the Nobel Prize in 1965 in physics. He once said:

> "I don't know what's the matter with people: they don't learn by understanding; they learn by some other way – by rote, or something. Their knowledge is so fragile!" (Feynman, 1985)

Of course, the key to learning is understanding. However, I believe that there is no understanding without practice, that is, solving problems and exercises by yourself with a pencil and a blank sheet of paper without knowing the solution in advance. Thus, I recommend the following:

- Attend lectures and and take the opportunity to ask questions and actively participate in class.
- Study the lecture notes and work on the exercises.
- Review the material regularly each week. Learning in small increments is more effective than last-minute cramming.
- Test yourself with past exams that you find in the appendix.
- If you have the opportunity to form a study group, make use of it. It is great to help each other, and it is very motivating to see that everyone has problems sometimes.
- If you have difficulties with some exercises and the solutions shown do not solve your problem, ask a classmate or contact me.

I am convinced that following my recommendations is the best method for students to

- maximize leisure time and minimize the time needed to prepare for the exam, respectively,
- getting long-term benefits out of the course,
- improve grades, and
- have more fun during lecture hours.

About the structure of these notes

I present international economics divided into three major branches:

Monetary international economics: This chapter explicitly considers the meaning of the international financial transaction.

International trade: This chapter is concerned with the determination of relative prices and real incomes in international trade abstracting from the intervention of money. That means trade is considered as an exchange of goods with no financial transactions involved. Of course, this assumption is unrealistic. However, it helps to understand the driving forces of real-world problems.

Trade policy: This chapter is about how international economics is taken into action to build the world we live in.

Moreover, in an appendix I offer solutions to the exercises, some microeconomic and mathematical preliminaries, and some past exams.

Recommended literature

My lecture notes are not a substitute for comprehensive textbooks. They are concise and may not fully explain all economic phenomena. To gain a deeper understanding, or if you're unfamiliar with the economic principles covered, I recommend reading a textbook for basic explanations of the concepts I use. Below, and within each chapter, are sources that might be helpful for further study.

Economic textbooks: Any major economics textbook can be used to complement this lecture. I personally recommend Mankiw (2024), Blanchard & Johnson (2013), and the open source textbook Shapiro et al. (2022) but you can also use Parkin (2012), Case et al. (2019), and Krugman & Wells (2018). While it is always nice to have a more recent textbook, basically older copies are just as fine (and much cheaper). Also, there are good books that are freely available online such as Shapiro et al. (2022), Anon (2020), Goodwin (2012), and Klein & Bauman (2010).

International economic textbooks: Of course, this lecture cannot cover all aspects of international economics. It os more like a curated collection of crucial concepts to grasp the fundamentals of global trade. For a deeper dive, I suggest exploring a standard international economics textbook of your preference. Here are some books, I recommend: Suranovic (2012), Suranovic (2016), Krugman et al. (2017), Feenstra & Taylor (2017), Pugel (2015), Carbaugh (2016), and Marrewijk (2012).

Part I

MONETARY INTERNATIONAL ECONOMICS

Chapter 1

Monetary international economics

Students learn to...

- ...interpret exchange rates and relate their changes to the relative prices of countries' goods.
- ...predict the impact of exchange rate changes on business decisions and national economies.
- ...understand the linkage between interest rates and inflation in open economies.
- ...explain the interest rate parity condition and the purchasing power parity assumption.
- ...interpret and evaluate the balances of trade and

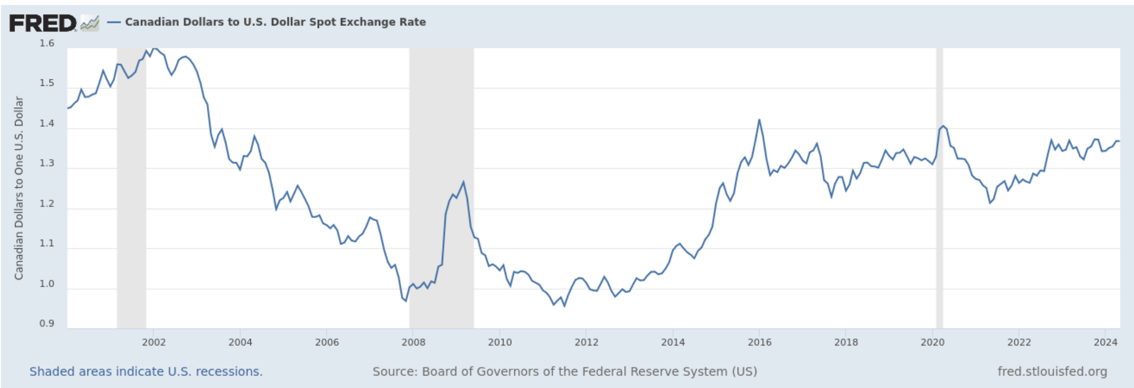
1.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 1.1. Exchange rates over time

Figure 1.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
   a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000 \text{ USD} \cdot 1.6 \frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} \approx 2318.84 \text{ USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.
   i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.
   ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000 \text{ USD} \cdot 1.38 \frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6 \text{ CAD}.$$

Finally, you convert the CAD back to USD

i) at the rate 1.38 CAD per USD:

$$1407.6 \text{ CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} = 1020 \text{ USD}.$$

ii) at the rate 1.42 CAD per USD:

$$1407.6 \text{ CAD} \cdot \frac{1}{1.42} \frac{\text{USD}}{\text{CAD}} \approx 991.27 \text{ USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 1.2. Our relations are not good

Figure 1.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a “strong” Turkish Lira and a “weak” Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump’s decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

1.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn’t a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of “it depends” arguments because it is challenging to make convincing cases based on intricate relationships.

[1]The total value added of a country in a given period
[2]The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency
[3]The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.

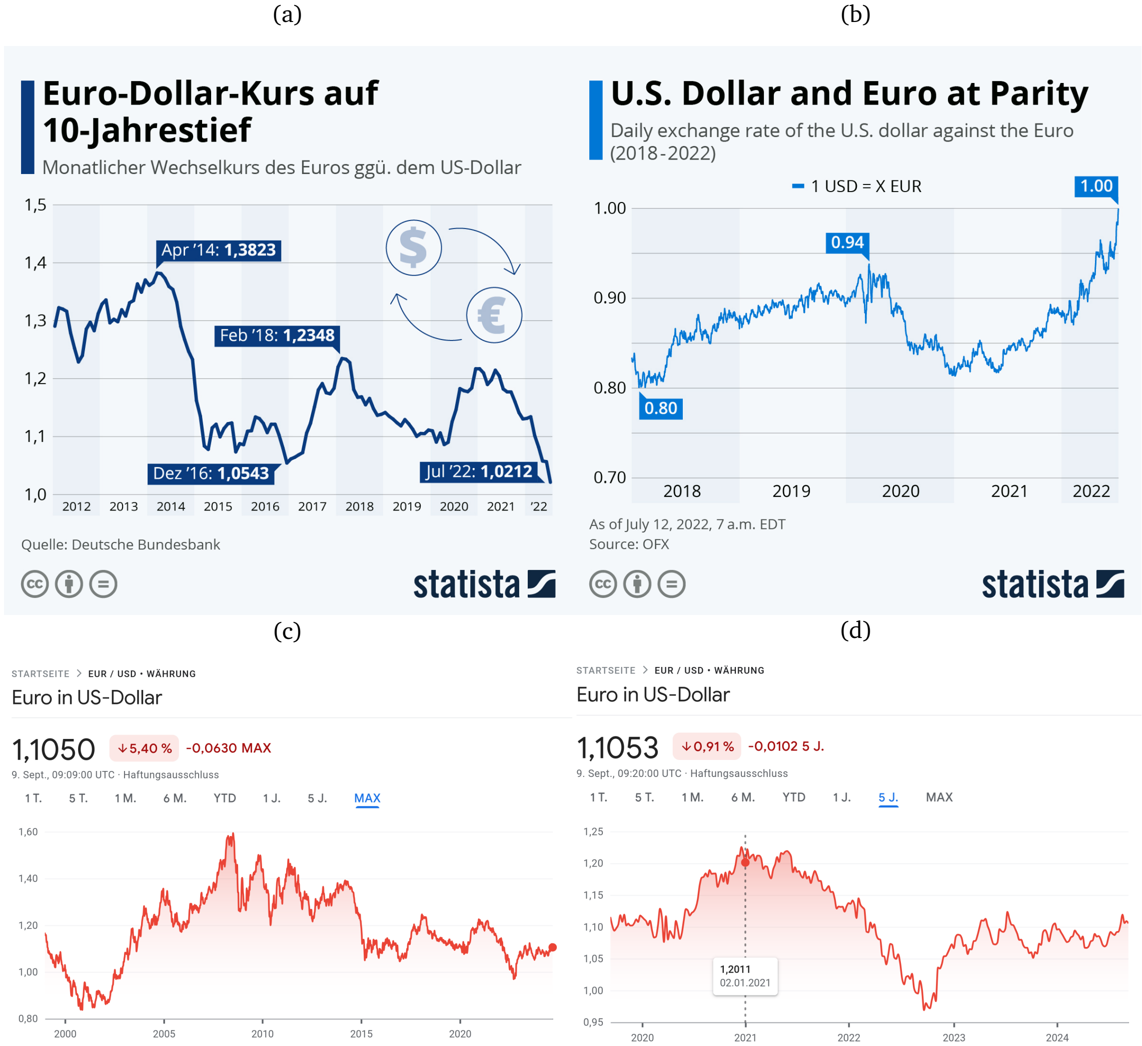
- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

Exercise 1.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 1.3: Euro to Dollar



Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)

$$E^{€}_{\$} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 1.4. Exchange currencies

Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.

b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.

c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?

d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:

$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:

$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:

$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:

$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

1.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **ℹ Relative prices**
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{₺}{€}} = E^{\frac{€}{₺}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 1.4: One wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 1\frac{₺}{€} = 1₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1₺ \cdot 1\frac{\text{wine}}{₺} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{₺}} = 0.5$ and $E^{\frac{₺}{€}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 1.5: Two wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 2\frac{₺}{€} = 2₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2₺ \cdot 1\frac{\text{wine}}{₺} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **ℹ Exchange rates and relative prices**
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

1.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

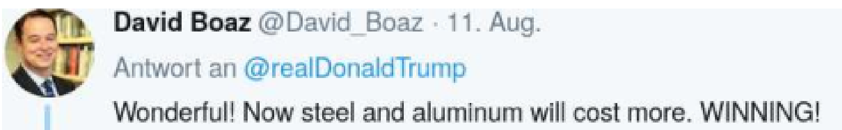
1.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 1.6: *Who wins in the end?*



Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers."*

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

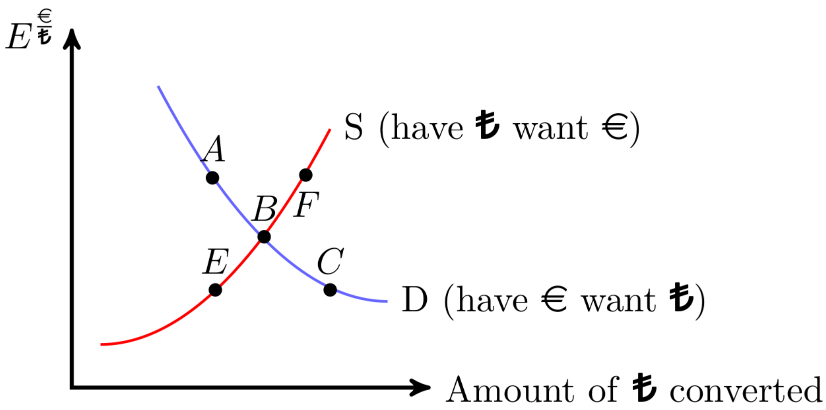
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

1.1.5 The FOREX

1.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 1.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{€}{₺}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{€}{₺}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{€}{₺}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{€}{₺}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 1.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

1.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 1.8: Players on the foreign exchange market

1.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

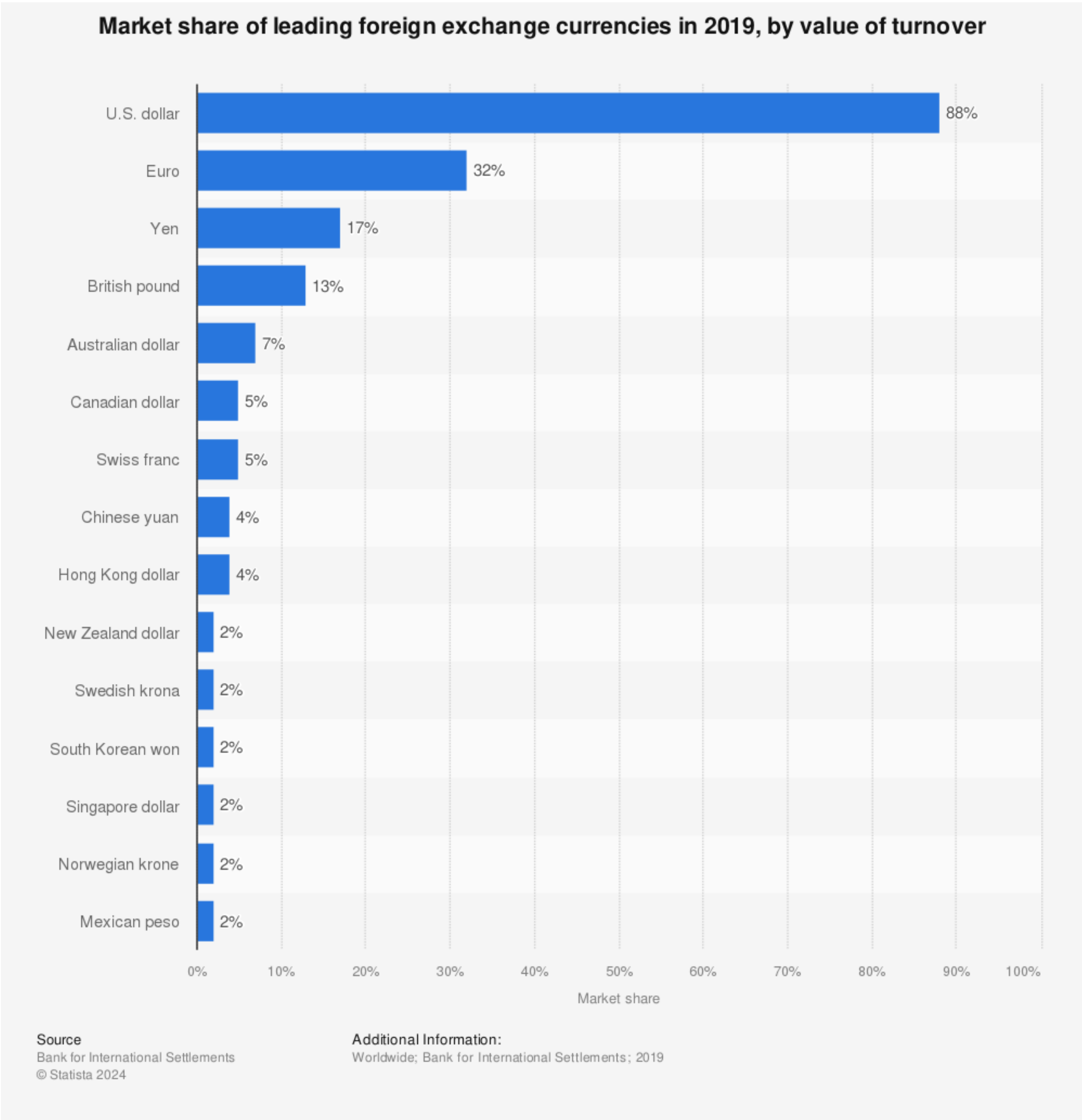
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

1.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 1.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 1.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 1.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56 \text{ EUR}}{4.75 \text{ USD}} \cdot \frac{6.57 \text{ USD}}{6.50 \text{ CHF}} = \frac{29.9592 \text{ EUR}}{30.875 \text{ CHF}} \approx 0.9703 \frac{\text{EUR}}{\text{CHF}}$$

and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305 \frac{\text{CHF}}{\text{EUR}}.$$

That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.

d) For 100 Euro we get

$$100 \text{ EUR} \cdot \frac{4.75 \text{ USD}}{4.56 \text{ EUR}} \approx 104.16 \text{ USD}$$

and these can be converted to

$$104.16 \text{ USD} \cdot \frac{6.50 \text{ CHF}}{6.57 \text{ USD}} \approx 103.05 \text{ CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in \$ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09 \text{ USD}}{130 \text{ RUB}} = 0.016 \frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65 \text{ CAD}}{5.08 \text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75 \text{ USD}}{4.56 \text{ EUR}}}_{\approx 1.0416} \approx 1.36 \frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05 \text{ CAD}}{5.08 \text{ USD}} \approx 0.76 \frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 1.6. International arbitrage

Table 1.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	\$2
Switzerland	\$6
United States of America	\$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have \$100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.
b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 1.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	\$4	EUR 2
Switzerland	\$4	CHF 6
United States of America	\$4	-

Now, calculate and elucidate the following exchange rates:
- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

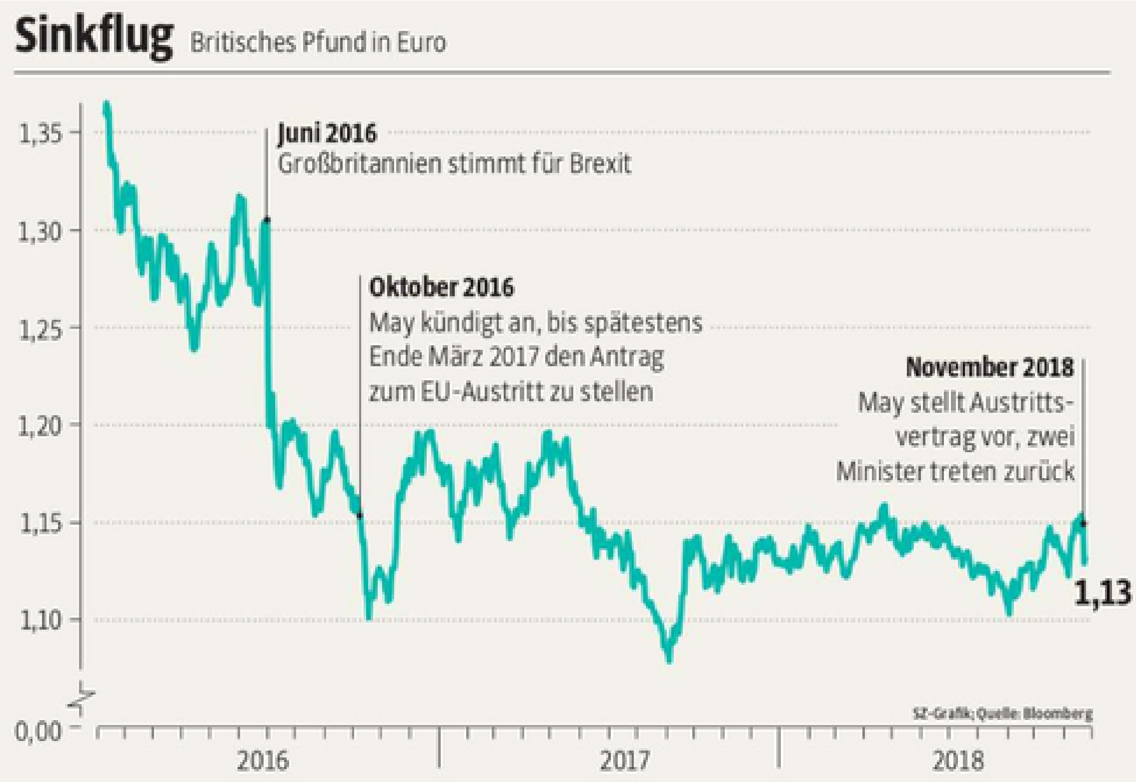
Solution

a) International arbitrage strategy
   - **Strategy**: Buy 50 units of good *08/15* in Germany for \$2 each with your \$100. Then, sell these units in Switzerland or the USA for \$6 each, making a total of \$300. This is a classic arbitrage strategy.
   - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
- **USD to EUR:** $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
- **EUR to USD:** $0.5\frac{EUR}{USD}$
- **USD to CHF:** $\frac{2}{3}\frac{USD}{CHF}$
- **CHF to USD:** $1.5\frac{CHF}{USD}$
- **CHF to EUR:** $\frac{3}{1}\frac{CHF}{USD}$
- **EUR to CHF:** $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 1.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 1.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

1.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

1.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 1.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

1.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

1.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{1.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

1.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I_{t-1}^{€} \cdot E_{t-1}^{\frac{₺}{€}} \cdot E_{t}^{\frac{€}{₺}} = I_{t}^{€} \tag{1.2}$$

1.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1 + \pi) \tag{1.3}$$

1.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{\text{€}} - I_{t-1}^{\text{€}}}{I_{t-1}^{\text{€}}} = \frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{\text{€}} = I_{t-1}^{\text{€}} \cdot (1 + i^*) \cdot E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}} \cdot (1 + \pi^*), \tag{1.4}$$

where $I_{t-1}^{\text{€}}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{\text{€}}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1 + i^*)$, inflation $(1 + \pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}})$:

$$\begin{aligned}
\underbrace{\frac{I_t^{\text{€}^*}}{I_{t-1}^{\text{€}}} - 1}_{r} &= (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}}}_{\alpha} - 1 \\
r^* &= (1 + i^*) \cdot (1 + \pi^*) \cdot \alpha - 1
\end{aligned} \tag{1.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned}
r^* &= (1 + i^*) \cdot \alpha - 1 \\
\Leftrightarrow r^* &= \alpha + \alpha i^* - 1.
\end{aligned} \tag{1.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned}
\Leftrightarrow r^* &= \alpha + \alpha i^* - 1 + i^* - i^* \\
\Leftrightarrow r^* &= \alpha - 1 + i^* + \alpha i^* - i^* \\
\Leftrightarrow r^* &= \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\
\Leftrightarrow r^* &= w + i^* + i^* w
\end{aligned} \tag{1.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 1.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:

- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?

Solution

Exchange rates and where to invest (Exercise 10.8)

a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

Thus, it is better to invest in Europe.

b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 1.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.

a) Where should you invest, given the following informations:
   - The interest rate in Germany is 1%.
   - The interest rate in Turkey is 10%.
   - 1€ can be converted to 7 ₺ this year in the FOREX
   - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
   - You expect no inflation in Germany and Turkey.
b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.

Solution

Turkey vs. Germany (Exercise 10.9)

a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:
b) **(Exact) calculation method in four steps:**
   1. `exchange € to ₺ in t-1:`

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

   2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

   3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$\begin{aligned} r_{GER} =& 0.01 \\ r_{TUR} =& \frac{108.4507 - 100}{100} = 0.084507 \end{aligned}$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$\begin{aligned} TUR \rightarrow I_t^{€} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507 \\ GER \rightarrow I_t^{€} =& 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01 \end{aligned}$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$

$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$\begin{aligned} r'_{GER} =& 0.01 \\ r'_{TUR} =& 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591 \end{aligned}$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$\begin{aligned} I_t^{€} =& I_{t-1}^{€} E_{t-1}^{₺/€} (1+i) E_t^{€/₺*} \\ \Leftrightarrow E_t^{€/₺*} =& \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€} (1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311 \end{aligned}$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$\begin{aligned} r_{GER} =& i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1 \\ \Leftrightarrow r_{GER} - i_{TUR} + 1 =& \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} \\ \Leftrightarrow E_t^{€/₺*'} =& (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺} \\ \Leftrightarrow E_t^{€/₺*'} =& (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13 \end{aligned}$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$
\begin{aligned}
r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01 \\
I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1 \\
\rightarrow r^*_{TUR} =& 0.01
\end{aligned}
$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 1.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider "1 EUR to cost 1 INR more" properly. This does not mean 1 INR is equal to 1 €!

1.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{1.8}$$
$$i = w + i^* \tag{1.9}$$
$$\tag{1.10}$$
$$\Leftrightarrow w = i - i^* \tag{1.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

1.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro ($E^{\frac{CHF}{€}}$), as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

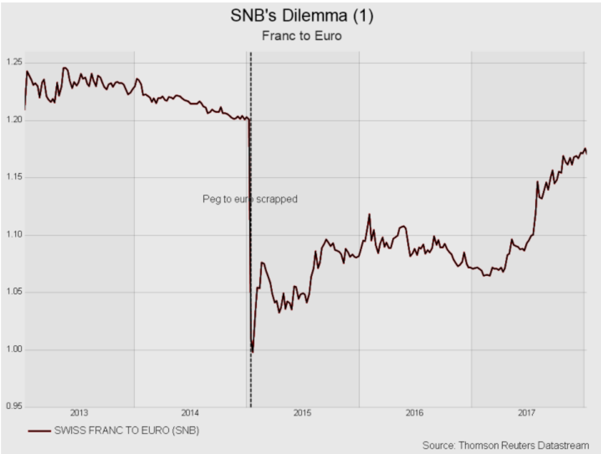
$$w = i - i^*$$

where

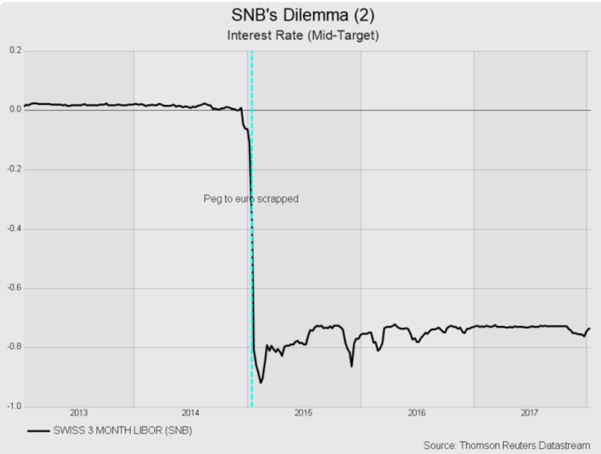
$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 1.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$



(b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

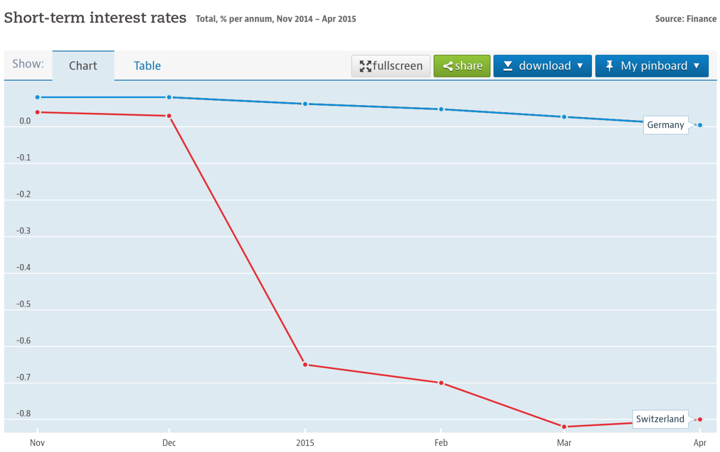
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 1.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

1.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{1.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{\text{€}}{\text{₺}}} = E_{t}^{\frac{\text{€}}{\text{₺}}} \Leftrightarrow \frac{E_{t-1}^{\frac{\text{€}}{\text{₺}}}}{E_{t}^{\frac{\text{€}}{\text{₺}}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$\begin{aligned} r^* &= (1+i^*)\cdot(1+\pi^*)\cdot \underbrace{\alpha}_{=1} - 1 && (1.13)\\ \Leftrightarrow r &= i + \pi + \pi i && (1.14) \end{aligned}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{1.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

> Recommended reading
>
> Wikipedia (2025): Wikipedia entry to the Fisher Effect.

1.3 Balance of payments

> Required reading
>
> Council of Economic Advisers (2004, ch. 14)

1.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

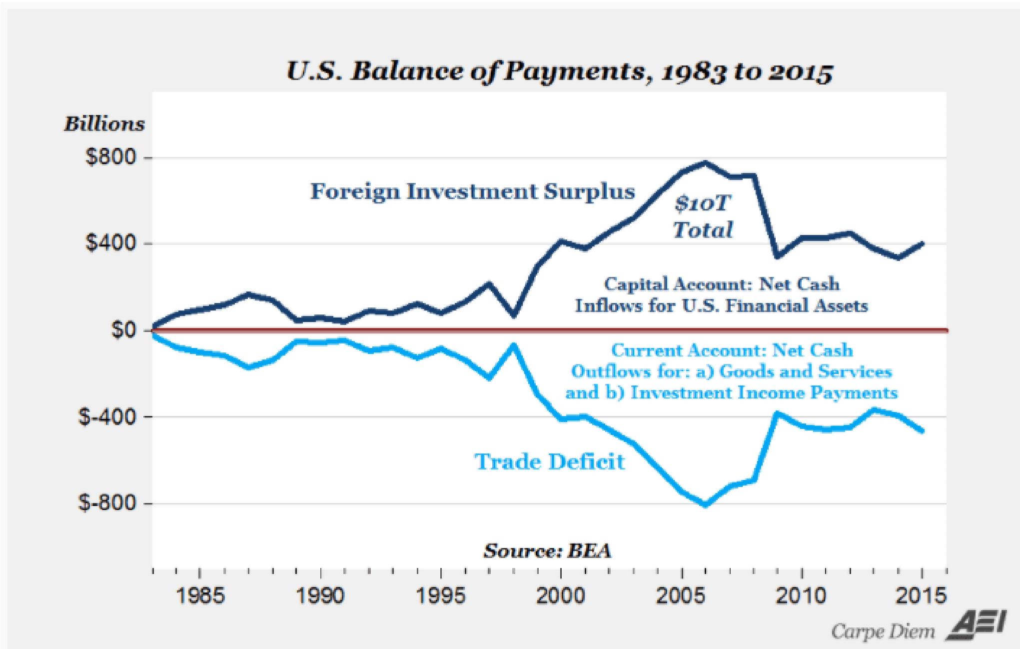
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 1.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 1.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 1.14: U.S. Balance of Payments



1.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

   1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 1.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

1.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

1.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

1.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

1.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

1.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$\begin{aligned} Y &= C + I + G \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\ \Leftrightarrow S &= I, \end{aligned}$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

1.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$\begin{aligned} Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\ \Leftrightarrow \underbrace{S - I}_{NCO} &= NEX \end{aligned}$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

1.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 1.15: Trump worries about the U.S. trade deficit

As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 1.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 1.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 1.16: The trade deficit of the United States over time

Chapter 2

International trade

Learning objectives

- Understand the basic concepts underpinning international trade, including the principle of mutual benefits.
- Evaluate reasons for trade, including technology differences, resource endowments, and government policies.
- Explain the difference of absolute comparative advantage and their role in driving trade patterns.
- Understand how differences in labor and capital endowments influence trade patterns.
- Discuss the impact of international trade on factor prices.

Recommended reading: Suranovic (2012, Chapters 2, 3, 5)

Trade is usually a voluntary decision by buyers and sellers, which means that transactions would not take place if one party were to lose from the exchange. While this reasoning is persuasive, it alone does not fully justify unrestricted international trade. In the following chapters, we will look at the concept that trade should be mutually beneficial to the parties directly involved. We will also discuss the ways in which trade can be beneficial to all parties, even though it is not necessarily beneficial to all. The remainder is structured as follows:

- Section 2.1 explains Mankiw's principle that trade can make everyone better off.
- Section 2.2 paraphrases the sources of international trade.
- Section 2.3 provides a theoretical framework of trade and shows that under certain circumstances international trade can yield a miserable growth path for a country.
- Section 2.4 explains that more trade does not have to be good for a country's wealth.
- Section 2.5 introduces the concept of comparative advantage. It claims that trade is due to autarky price differences that stem from country-specific differences such as technology, factor endowments, or taste.
- Section 2.6 shows that opening up to free trade generates winners and losers and that countries' endowments with labor and capital determine patterns of trade.

2.1 Trade can make everyone better off

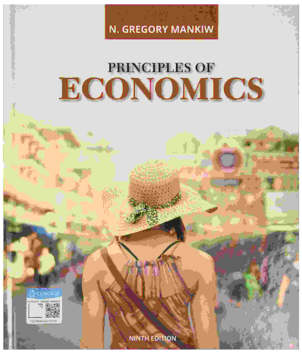
N. Gregory Mankiw (*1958) is one of the most influential economists. In his best-selling textbook *Principles of Economics* (Mankiw, 2024, pp. 8–9) he claims ten principles of economics of which one is entitled *Trade can make everyone better off* which he explains as follows:

> You have probably heard on the news that the Japanese are our competitors in the world economy. In some ways, this is true, for American and Japanese firms do produce many of the same goods. Ford and Toyota compete for the same customers in the market for automobiles. Compaq and Toshiba compete for the same customers in the market for personal computers.

Figure 2.1: Mankiw and his textbook

(a) N. Gregory Mankiw

(b) Mankiw's textbook



Source: Harvard.edu and Mankiw (2024).

> Yet it is easy to be misled when thinking about competition among countries. Trade between the United States and Japan is not like a sports contest, where one side wins and the other side loses. In fact, the opposite is true: Trade between two countries can make each country better off.
>
> To see why, consider how trade affects your family. When a member of your family looks for a job, he or she competes against members of other families who are looking for jobs. Families also compete against one another when they go shopping, because each family wants to buy the best goods at the lowest prices. So, in a sense, each family in the economy is competing with all other families.
>
> Despite this competition, your family would not be better off isolating itself from all other families. If it did, your family would need to grow its own food, make its own clothes, and build its own home. Clearly, your family gains much from its ability to trade with others. Trade allows each person to specialize in the activities he or she does best, whether it is farming, sewing, or home building. By trading with others, people can buy a greater variety of goods and services at lower cost.
>
> Countries as well as families benefit from the ability to trade with one another. Trade allows countries to specialize in what they do best and to enjoy a greater variety of goods and services. The Japanese, as well as the French and the Egyptians and the Brazilians, are as much our partners in the world economy as they are our competitors.

2.2 Reasons for Trade

Trade involves willingly giving up something to receive something else in return, which should benefit both parties involved, although not necessarily everyone affected by the trade. We will discuss the negative effects of international trade on bystanders later. In this section, we briefly outline basic reasons for individuals and hence countries to engage in trade. Of course, the list is incomplete.

Differences in Technology: Advantageous trade can occur between countries if they have different technological abilities to produce goods and services. Technology refers to the techniques used to convert resources (labor, capital, land) into outputs. Differences in technology form the basis for trade in the Ricardian Model of comparative advantage. We will revisit this in more detail in Section 2.5.

Differences in Endowments: Trade also occurs because countries differ in their resource endowments, which include the skills and abilities of the workforce, available natural resources, and the sophistication of capital stock such as machinery, infrastructure, and communication systems. Differences in resource endowments are the basis for trade in the pure exchange models (see Section 2.3) and the Heckscher-Ohlin Model (see Section 2.6).

Differences in Demand: Trade between countries occurs because demands or preferences differ. Individuals in different countries may prefer different products even if prices are the same. For example, Asian populations might demand more rice, Czech and German people more beer, the Dutch more wooden shoes, and the Japanese more fish compared to Americans.

Economies of Scale in Production: Economies of scale, where production costs fall as production volume increases, can make trade between two countries advantageous. This concept, known as *increasing returns to scale*, plays a significant role in Paul Krugman's *New Trade Theory*, which we will discuss later.

Existence of Government Policies: Government tax and subsidy programs can create production advantages for certain products, leading to advantageous trade arising solely from differences in government policies across countries. We will explore the impact of tariffs and regulations in Chapter 3.

2.3 Exchange economy

Recommended reading

Suranovic (2012, Chapter 3)

2.3.1 A simple barter model

The simplest example to show that trade can be beneficial to people is the barter model. In trade, barter is a system of exchange in which participants in a transaction directly exchange goods or services for other goods or services without using a medium of exchange, such as money.

Figure 2.2: Stylized example of weißwürst and pretzels

Source: *Wikipedia*

Suppose there are two people, Anton (A) and Barbara (B). Anton has 10 Weißwürste (white sausages) and Barbara has 10 pretzels. Together, they are isolated from the rest of the world for a few days due to a natural disaster. Fortunately, they both have additional access to an endless supply of sweet mustard and beer and they now wonder how to share pretzels and sausages the upcoming days. Let's assume that both of them accept only a white sausage eaten together with a pretzel. That is, eating two pretzels with a sausage is no better than eating a pretzel and a sausage. After some discussion, Barbara gives 5 pretzels and Anton gives Barbara 5 sausages in return. They strongly believe that there is no better way to share food.

This example shows that trade can be beneficial for two individuals. Here we basically assume two things. Firstly, two individuals can trade and secondly, they are endowed with different goods.

Exercise 2.1. How Barbara and Anton trade (Solution 2.1)

a) Visualize the starting point of Anton and Barbara as described above in a two-way plot where the Anton's initial endowment with sausages is drawn on the y-axis and Barbara's endowment with pretzels is drawn on the x-axis.

b) Given their preferences, mark the consumption point after goods were traded. Also, draw in the plot how much Anton and Barbara exports and imports, respectively.
c) Sketch the indifference curve of both individuals in the consumption point after trade has happened.
d) Draw a new two-way plot and assume that Barbara now gives away 2 pretzels in order to receive one sausage. Mark the resulting consumption points of Anton and Barbara. Given their unchanged preference for having one sausage with one slice of bread at best, visualize with the help of sketched indifference curves that both individuals are worse off as compared to consuming 5 units of pretzels and sausages each.

Solution 2.1. How Barbara and Anton trade (Exercise 2.1)
In Figure 2.3 you find a sketch of a solution to tasks a. to c. Figure 2.4 provides a solution to task d.

Figure 2.3: The deal of Anton and Barbara

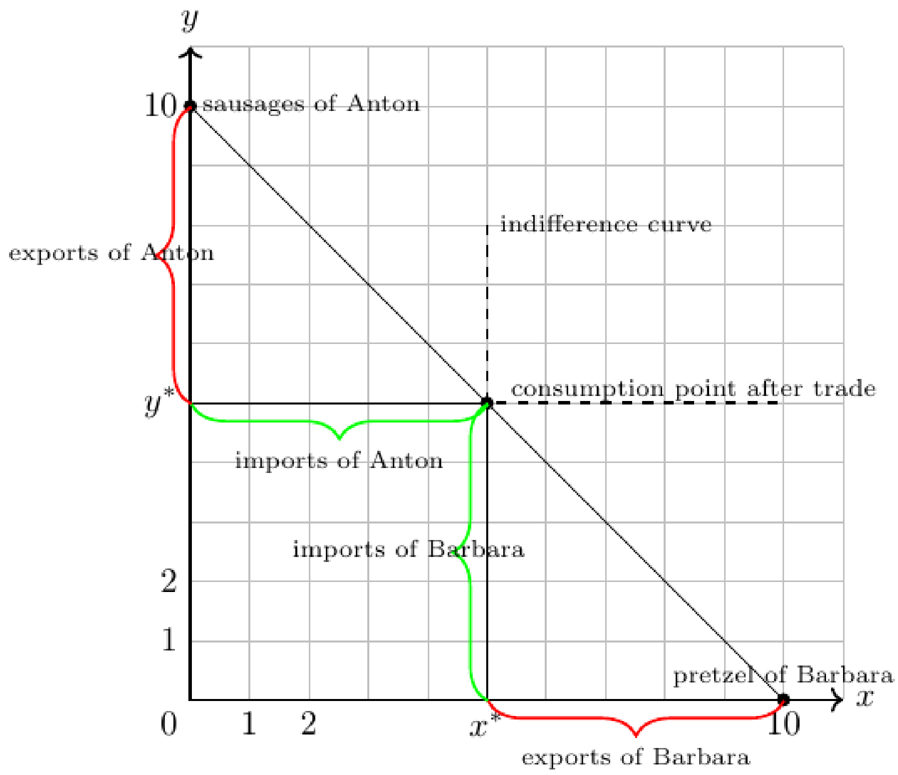
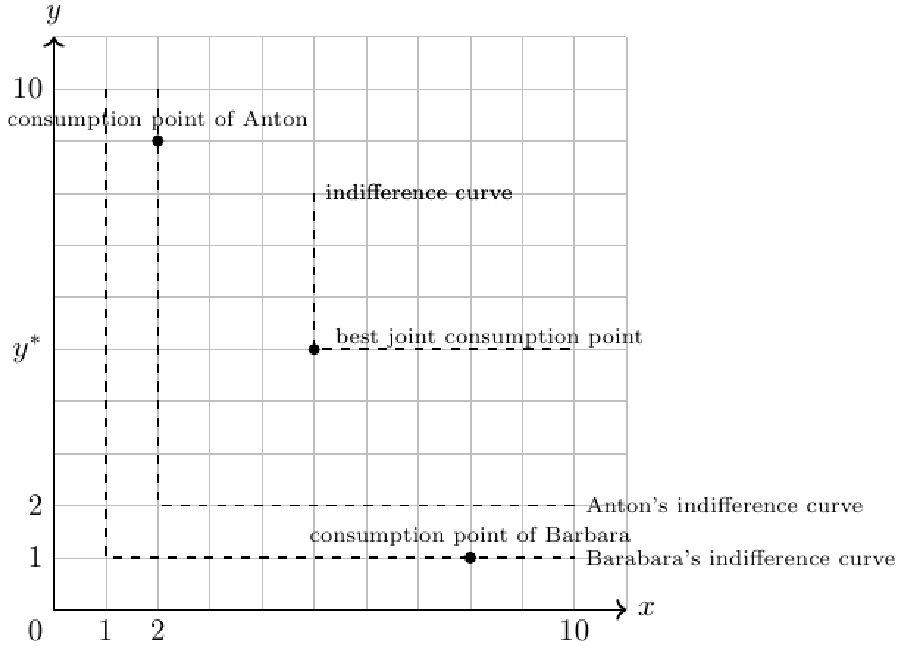


Figure 2.4: Indifference curves of Anton and Barbara



2.3.2 Terms of trade

Definition

The terms of trade is defined as the quantity of one good that exchanges for a quantity of another. It is typical to express the terms of trade as a ratio.

In the example of Barbara and Anton, the exchange of goods occurs at a 1:1 ratio. In economics, this is referred to as the terms of trade being 1. The terms of trade are defined as the relative price of exports in relation to imports, or in other words, how much of one good can be exchanged for another. For instance, determining how many sausages can be exchanged for how many pretzels. The terms of trade, determined by the two trading partners, depend on a variety of distinct factors, including:

Preferences: For trade to occur, each trader must desire something the other has and be willing to give up something of their own to obtain it. Formally, the expected utility of consuming some of Anton's bread must exceed the disutility of foregoing a few of his sausages, and vice versa for Barbara. Typically, the goods are substitutable rather than perfectly complementary, as is assumed in our specific example.

Uncertainty: Both individuals have clear preferences. If Barbara has never tried Anton's sausages, and Anton typically prefers bread over pretzels, offering free samples before an exchange could reduce uncertainty. Without a sample, their trade would be based on expectations about the taste of the other's product.

Scarcity: The availability of the two goods influences the terms of trade. If, for instance, Barbara has 1000 pretzels, the terms of trade with the sausages would likely change.

Size: The physical size of the goods can impact the terms of trade.

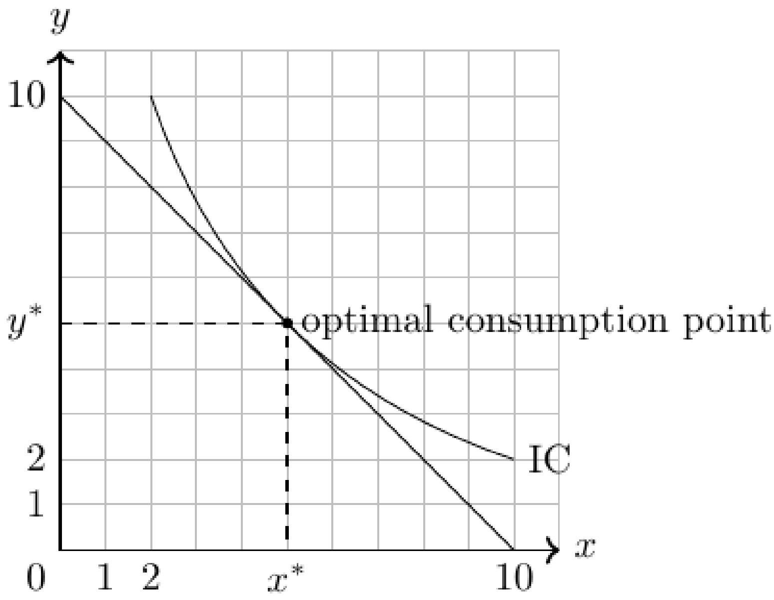
Quality: The quality of goods affects the terms of trade. If the pretzels are stale and hard, both might prefer fewer pretzels per sausage.

Persuasion: If Barbara is a more persuasive salesperson than Anton, she might be able to negotiate more favorable terms of trade.

Government Policy: Taxes imposed by an official based on the traded quantities could affect the terms of trade. Additionally, if laws prevent Barbara and Anton from meeting, no trade would occur.

Exercise 2.2. Terms of trade (**?@sol-Termsoftrade**)

Figure 2.5: Optimal consumption point



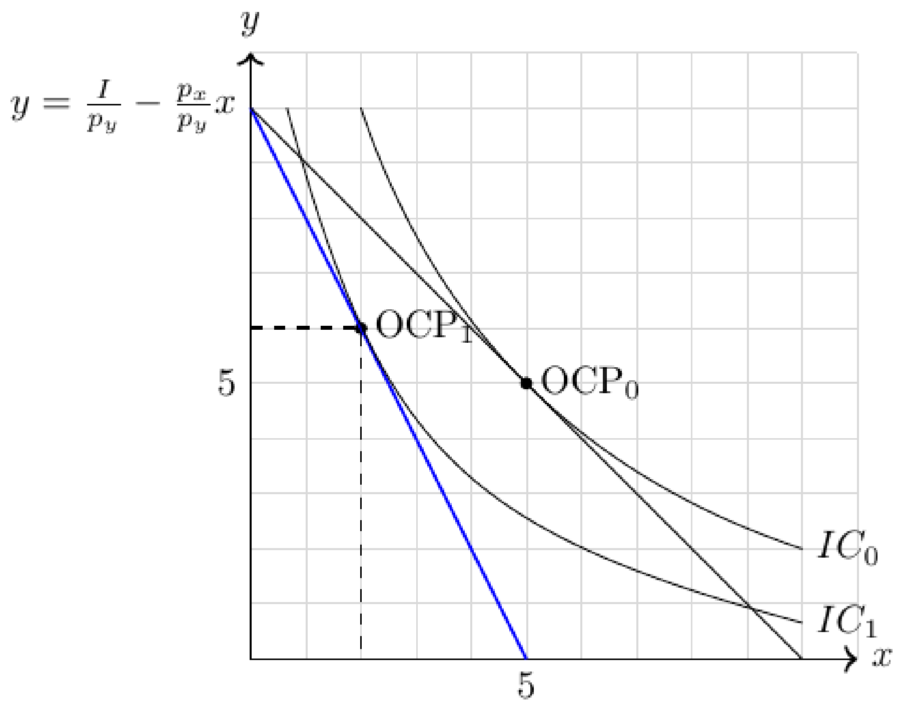
Suppose you have a fixed income $I = 10$ that you can spend on consuming two substitutable goods x, y at certain prices $p_x = 1, p_y = 1$. The current consumption decission is sketched in the figure above. Suppose the price of good x increases, that is, $p_x = 2$. Draw the new budget line. How will consumption change? What are the new terms of trade?

Solution

The new point of optimal consumption OCP_1 at $(x = 2, y = 6)$ illustrates that an increase in the price of good x leads consumers to substitute good x and consume more of good y but less of good x.

The terms of trade are now $\frac{p_x}{p_y} = 2$. That is, consumers are willing to give up 1 unit of good x to receive 2 units of good y. The budget line is drawn in blue.

Figure 2.6: Optimal consumption point after price increase



Note: The indifference curve IC_1 in the graph is just a guess of mine because we don't have preferences in form of a utility function given. For example, you can also draw an indifference curve that gives you the optimal consumption point at $(x = 1; y = 8)$ or $(x = 4; y = 2)$.

2.3.3 Endowments in an Exchange Economy

In this section, we examine a basic scenario where productive units within an economy are unable to adjust their output to recent changes in world market prices, which stem from global demand and supply fluctuations. Economists refer to the resulting availability of goods as endowments. Essentially, a country is endowed with a certain quantity of goods and seeks to trade these goods on global markets to maximize its welfare. In Section 2.6 we will assume that countries are endowed with a certain amount of factors of production that they can use to produce various goods.

2.3.3.1 Fixed production

Imagine that country H produces $\bar{x}_1^H$ units of good 1 and $\bar{x}_2^H$ units of good 2. In autarky (a state of where there is no trade), it consumes all the goods it produces. This scenario is shown in Figure 2.7, where point A represents the optimal welfare outcome with utility W_A^H for country H in autarky.

Now, let's assume country H can trade with the rest of the world at global market prices, where the price ratio of good 1 to good 2 in the world market, $(\frac{p_1}{p_2})_W$, is greater than in autarky, $(\frac{p_1}{p_2})_A$:

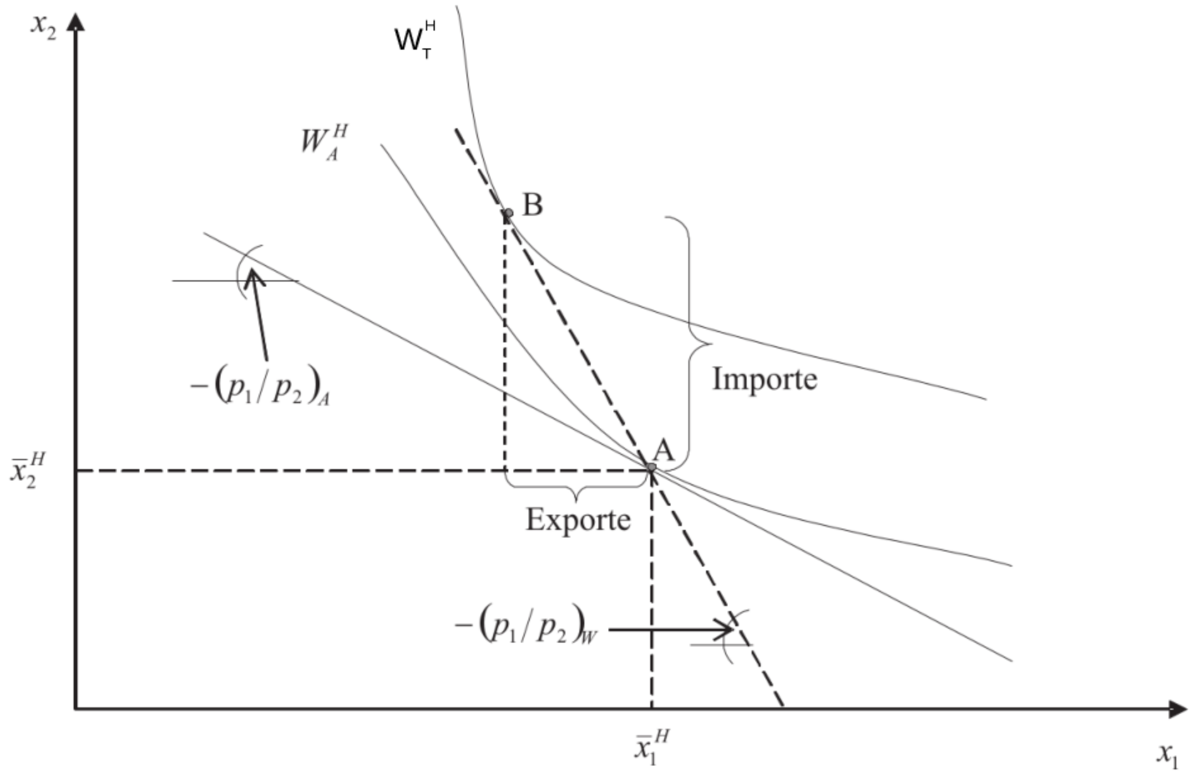
$$\left(\frac{p_1}{p_2}\right)_W > \left(\frac{p_1}{p_2}\right)_A, \tag{2.1}$$

With trade, country H can achieve a higher utility, $W_T^H > W_A^H$, by exporting good x_1 and importing good x_2, thus moving to a more advantageous consumption point.

2.3.3.2 Flexible production

- Trade is even more beneficial to a country if it can adjust its production to export more goods that are relatively high priced in the world market. This statement is shown in Figure 2.8.

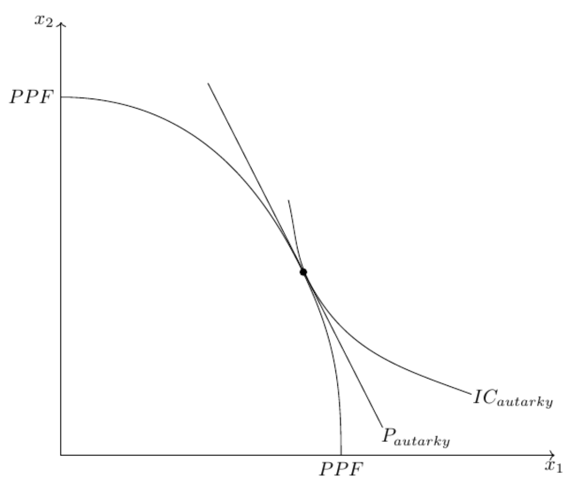
Figure 2.7: Optimizing consumption through trade



- In autarky, optimal consumption would be at point A and optimal consumption would be at point C under free trade. Now suppose that producers in country H know that they can sell their goods at price p_1^W and p_2^W before deciding what to produce. Then they would choose production point B on the production frontier curve to export good x_1 and import good x_2 at price $(\frac{p_1}{p_2})_A$ to be consumed at point D. Welfare at point D is higher than at point C or A because we end up at the highest indifference curve.

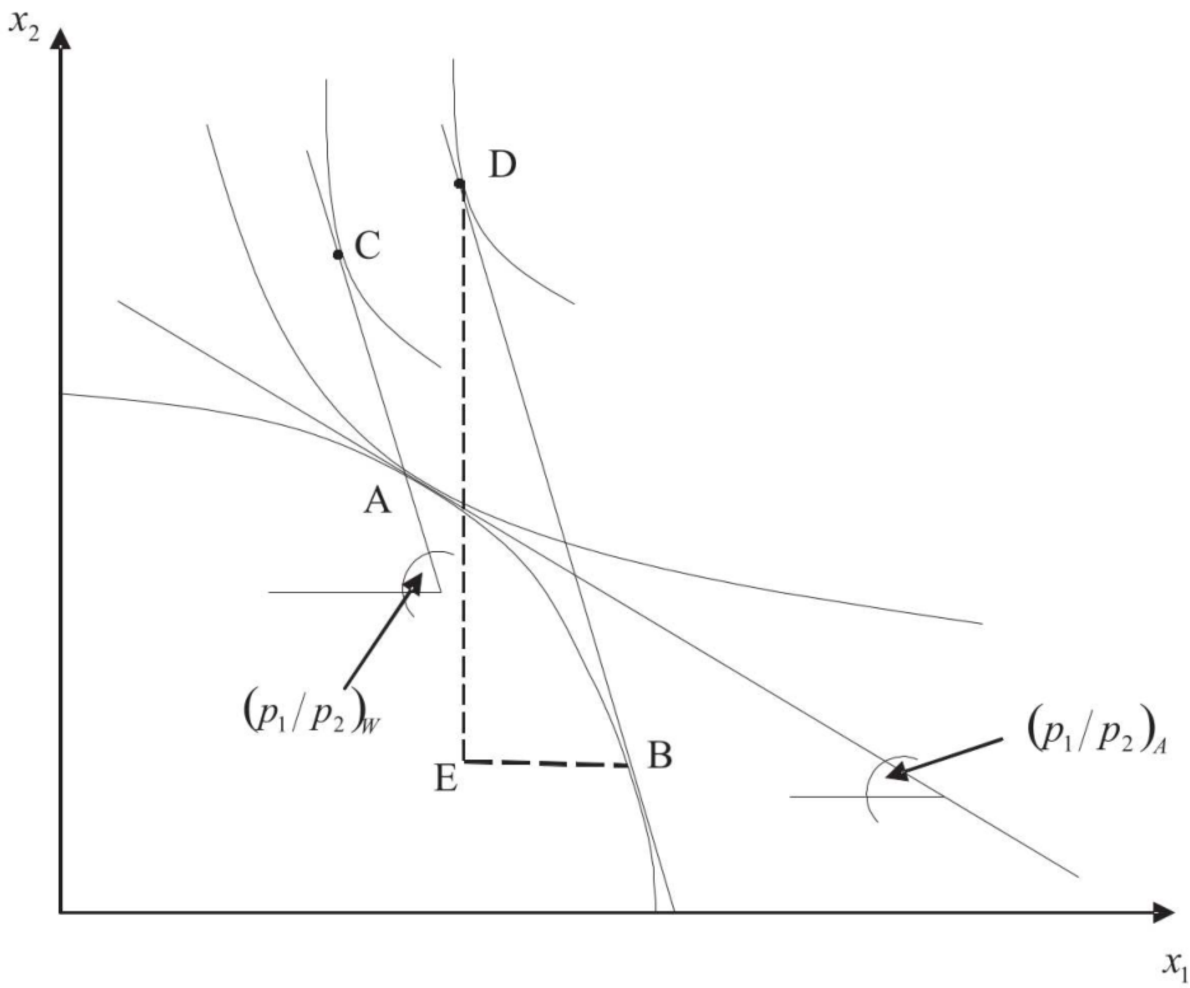
Exercise 2.3. Production and consumption

Figure 2.9: Optimizing consumption by adjusting production and trade



In Figure 2.9 the production possibility frontier curve, PPF, of a country, H, in autarky in which only two products, x_1 and x_2, can be produced and consumed, respectively.

Figure 2.8: Optimizing consumption by adjusting production and trade



a) Given the country is in autarky (that is, no trade), the price relation of both goods within the country is represented by the line denoted with $P_{autarky}$. The indifference curve that represents the utility maximizing level of utility is denoted with $IC_{autarky}$. Mark in the figure how much of both goods are produced and consumed, respectively.

b) Suppose country H opens up to trade with foreign countries. Further assume that the country can trade with other countries at fixed world market prices

$$\left(\frac{p_1}{p_2}\right)_W > \left(\frac{p_1}{p_2}\right)_A, \tag{2.2}$$

where $(\frac{p_1}{p_2})_A$ denotes the price relation of country H in autarky, $P_{autarky}$. Sketch the world market price relation in the figure and mark the new production point on the production possibility frontier curve. Moreover, mark below those statements that are **true**:

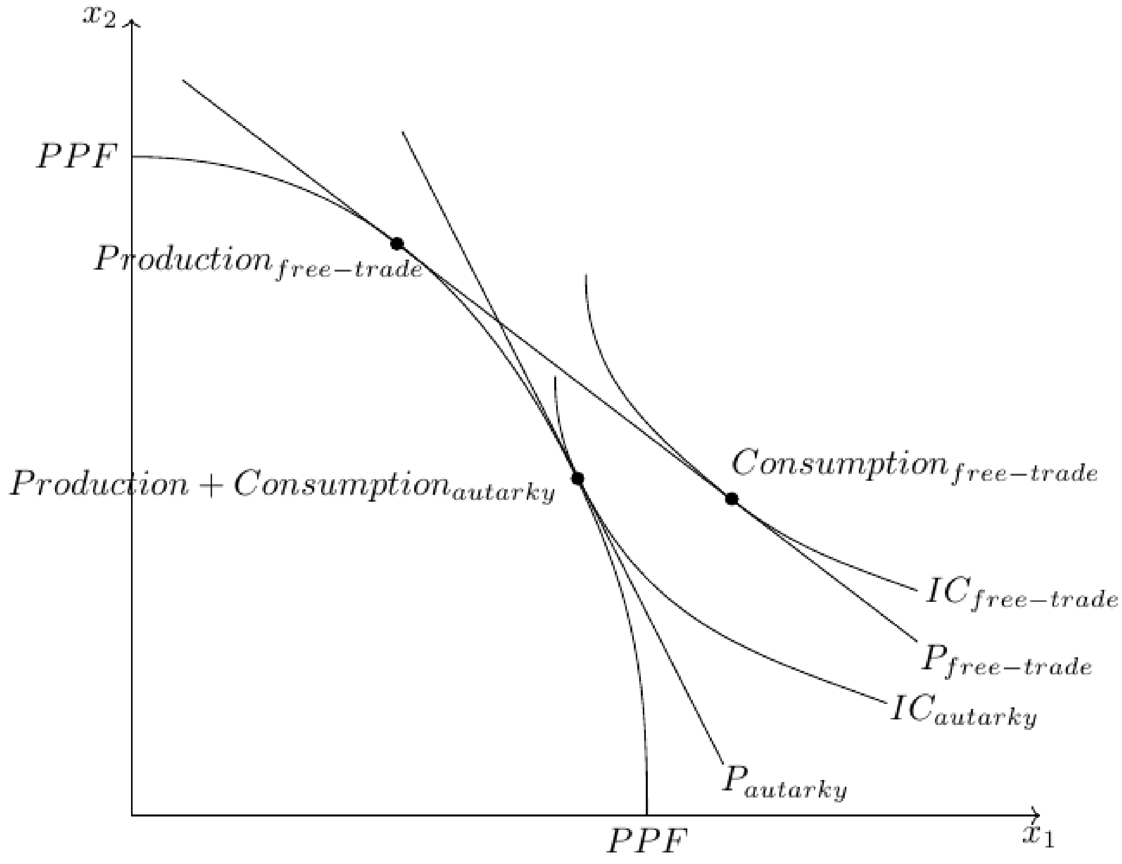
c) Country H will produce more of good x_1 than in autarky
d) Country H will produce more of good x_2 than in autarky
e) Country H will consume more of good x_1 than in autarky
f) Country H will export good x_1 and import good x_2.
g) Country H will export good x_2 and import good x_1.
h) Country H will suffer a loss of welfare due to opening up to trade.

Exercise 2.4. Production and consumption (**?@sol-gains**)
Show that opening markets to foreign trade can be beneficial for a small economy where only two goods can be produced and consumed. Use a two-way diagram to do this. In particular, show the consumption and production point of the economy in autarky with the corresponding price relation. Then assume that the economy opens up to the foreign market, allowing it to buy goods at world prices that are different from prices in autarky. Show the consumption and production point of the autarkic economy with the corresponding price relation under free trade. Can you outline the higher level of welfare in free trade?

Solution

As visualized in Figure 2.10, the indifference curve under free trade lies above the IC under autarky. This reflects the higher utility level under free trade.

Figure 2.10: Gains from trade



2.4 More trade is not necessarily good (immiserizing growth)

So far, I have implicitly assumed that the world market price is fixed and not changed by the entry of country H into the free trade market. When the latter is the case, economists speak of a small open economy (SOE). In general, a SOE is an economy that is so small that its policies do not change world prices.

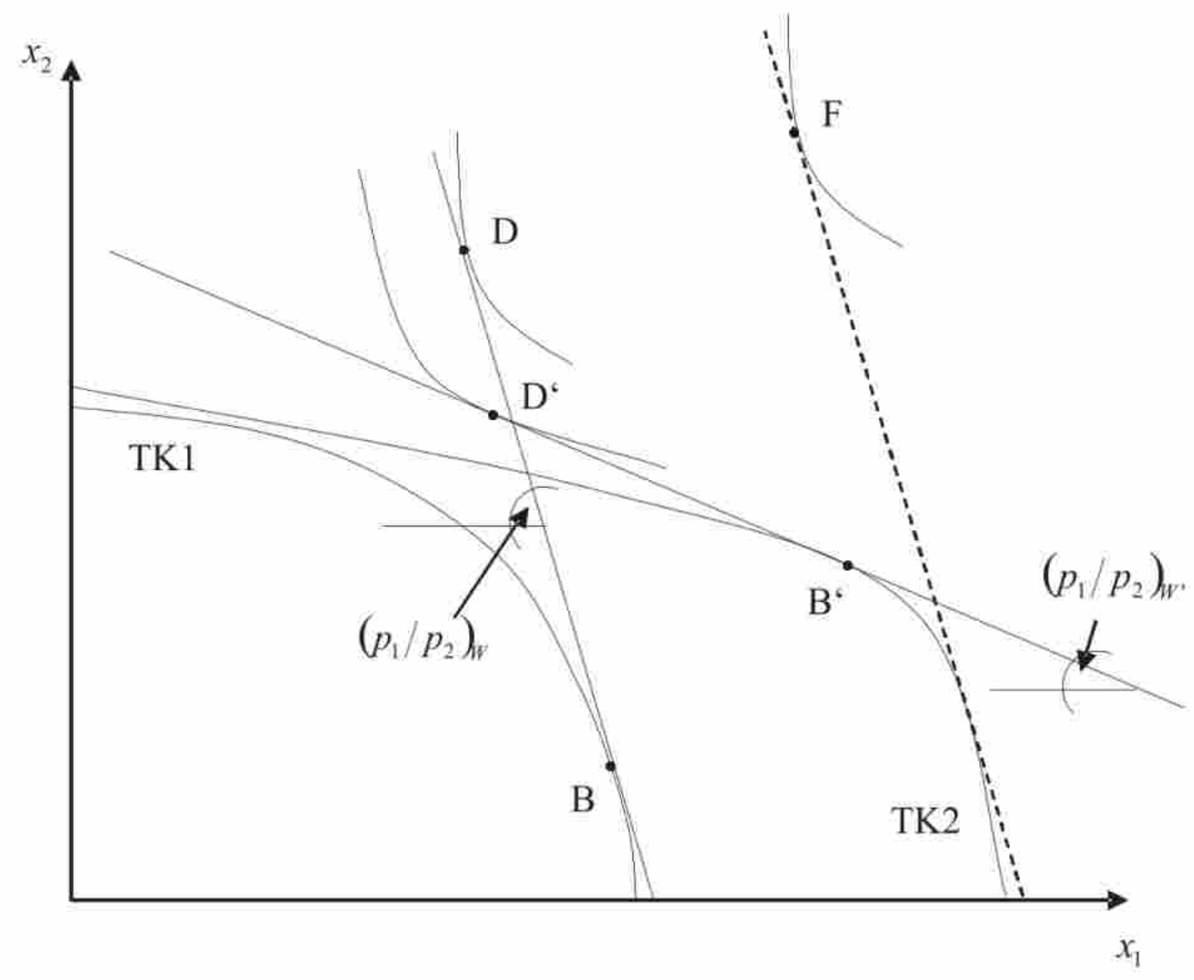
Suppose that country H is not an SOE. What would happen to world prices if country H offered a lot of good x_1 to receive good x_2? Obviously, $(\frac{p_1}{p_2})_W$ would fall. In the worst case, country H is so large that

$$\left(\frac{p_1}{p_2}\right)_W = \left(\frac{p_1}{p_2}\right)_A .$$

This means that country H has no benefits from free trade.

Assuming that a (large) country cannot opt out from free trade and that the exporting sector grows, there is a theoretical scenario called *immiserizing growth* that shows that free trade countries are worse off in the long run. This scenario is illustrated in Figure 2.11. The figure summarizes two periods. In the first period, country H produces at point B and consumes at point D, trading goods at world prices $(\frac{p_1}{p_2})_W$. Then country H grows in sector 1. This is shown in the new production possibility curve TK2. If country H were able to trade at the old world price, it would be able to consume at point F. Unfortunately, country H is not a SOE, and therefore world prices (from country H's perspective) deteriorate to $(\frac{p_1}{p_2})'_W$. This has bad implications for country H, since its optimal consumption is now at point D', which has lower welfare relative to point D. However, this is not an argument against trade, since the welfare at point D' is still above the production possibility curve in autarky, TK1.

Figure 2.11: Immiserizing growth



2.5 The theory of comparative advantage (Ricardian Model)

Learning objectives

- Less-developed countries can compete in international markets even if they are less productive in producing everything. In other words, opening to trade is beneficial for countries that have an absolute disadvantage in the production of all goods.
- Both, developed and less-developed countries can gain from international trade.
- Specialization in production increases the price of exported goods for that country. As a result, prices converge.
- A discussion of national competitiveness is not useful through the lens of the Ricardo theorem.

Recommended reading: Suranovic (2012, Chapter 2)

Figure 2.12: This painting shows Ricardo, aged 49 in 1821.

Source: National Portrait Gallery

David Ricardo (1772-1823), one of the most influential economists of his time, had a simple idea that had a major impact on how we think about trade. In Ricardo (1817), he argued that bilateral trade can be a positive-sum game for both countries, even if one country is less productive in all sectors, if each country specializes in what it can produce relatively best.

He introduced the theory of comparative advantage that is still an important corner stone of the modern theory of international trade[1] It refers to the ability of one party (an individual, a firm, or a country) to produce a particular good or service at a lower opportunity cost than another party. In other words, it is the ability to produce a product with the highest relative efficiency, given all other products that could be produced. In contrast, an absolute advantage is defined as the ability of one party to produce a particular good at a lower absolute cost than another party.

Figure 2.13: Comparative advantage: Specialize and exchange

As shown in Figure 2.13, the concept of comparative advantage is quite simple. Two parties can increase their overall productivity by sharing the workload based on their respective comparative advantages. Once they have achieved this increase in productivity, they must agree on how to divide the resulting output. Of course, both parties must benefit compared to a scenario in which they work independently.

[1]Actually, strictly speaking, this is not correct, since the original description of the idea can already be found in Torrens (1815). However, David Ricardo formalized the idea in his 1817 book using a convincing and simple numerical example. For more information on this, as well as a great introduction to the Ricardian model and more, I recommend Suranovic (2012).

2.5.1 Defining absolute and comparative advantages

A subject (country, household, individual, company) has an **absolute advantage** in the production of a good relative to another subject if it can produce the good at lower total costs or with higher productivity. Thus, absolute advantage compares productivity across subjects but within an item.

A subject has a **comparative advantage** in the production of a good relative to another subject if it can produce that good at a lower opportunity cost relative to another subject.

Let me explain the idea of the concept of comparative advantage with some examples:

Old and young

Two women live alone on a deserted island. In order to survive, they have to do some basic activities like fetching water, fishing and cooking. The first woman is young, strong and educated. The second is older, less agile and rather uneducated. Thus, the first woman is faster, better and more productive in all productive activities. So she has an absolute advantage in all areas. The second woman, in turn, has an absolute disadvantage in all areas. In some activities, the difference between the two is large; in others, it is small. The law of comparative advantage states that it is not in the interest of either of them to work in isolation: They can both benefit from specialization and exchange. If the two women divide the work, the younger woman should specialize in tasks where she is most productive (for example, fishing), while the older woman should focus on tasks where her productivity is only slightly lower (for example, cooking). Such an arrangement will increase overall production and benefit both.

The lawyer's typist

The famous economist and Nobel laureate Paul Samuelson (1915-2009) provided another example in his well-received textbook of economics, as follows: Suppose that in a given city the best lawyer also happens to be the best secretary. However, if the lawyer focuses on the task of being a lawyer, and instead of practicing both professions at the same time, hires a secretary, both the lawyer's and the secretary's performance would increase because it is more difficult to be a lawyer than a secretary.[2]

2.5.2 Autarky: An example of two different persons

Assume that A and B want to produce and consume y and x respectively. Because of the complementarity of the two goods, each must be consumed in combination with the other. The utility function of both persons is $U_{\{A;B\}} = min(x, y)$. Both persons work for 4 time units, that is, their units of labor are $L_A = L_B = 4$. A needs 1 units of labor to produce one unit of good y and 2 units of labor to produce one unit of good x. B needs $\frac{4}{10} = 0.4$ units of labor to produce one unit of good y or good x. Thus, their **labor input coefficients**, which measure the units of labor required by a subject to produce one unit of good, are $a_y^A = 1, a_x^A = 2, a_y^B = 0.4, a_x^B = 0.4$:

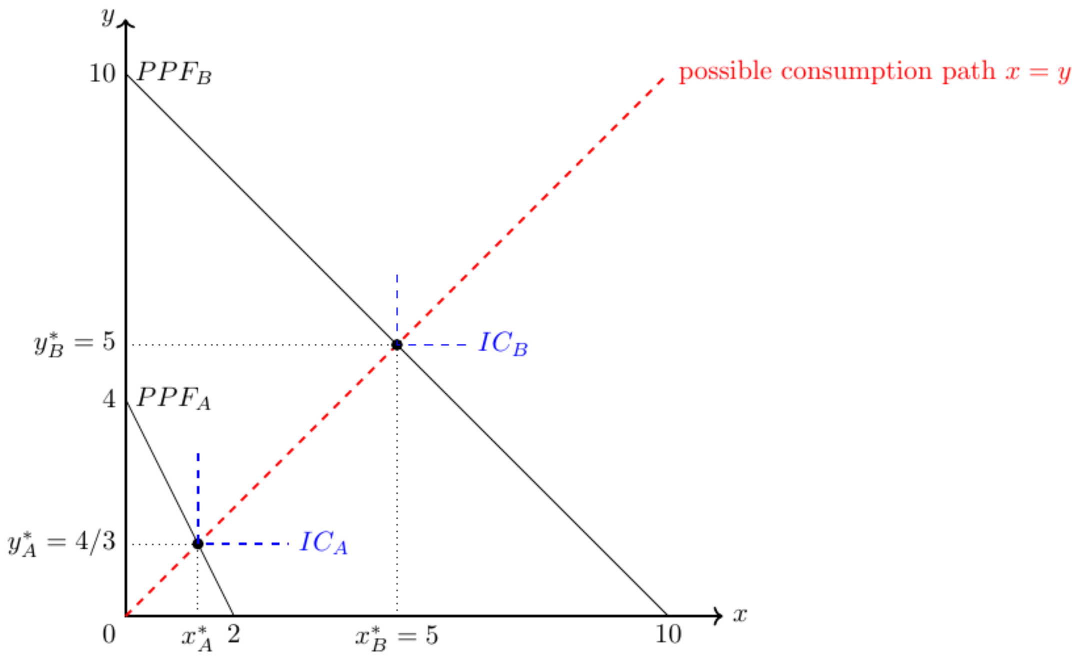
input coefficient (a)	A	B
Good y	1	0.4
Good x	2	0.4

Spending all her time in the production of y, A can produce $\frac{L_A}{a_y^A} = \frac{4}{1} = 4$ units of y and B can produce $\frac{L_B}{a_y^B} = \frac{4}{0.4} = 10$ units of y. Spending all her time in the production of y, A can produce $\frac{L_A}{a_x^A} = \frac{4}{2} = 2$ units of $x$and B can produce $\frac{L_B}{a_x^B} = \frac{4}{0.4} = 10$ units of x. Knowing this, we can easily draw the production possibility frontier curves (PPF) of person A and B as shown in Figure 2.14.

In autarky, both person maximize their utility: Individual A can consume $\frac{4}{3}$ units of each good and individual B can consume 5 units of each good. The respective indifference curves are drawn in dashed blue lines in Figure 2.14.

[2] In the first eight editions the example comprised a male lawyer who was better at typing than his female secretary, but who had a comparative advantage in practising law. In the ninth edition published 1973, both lawyer and secretary were assumed to be female (see Backhouse & Cherrier, 2019). Unfortunately, women are still discriminated against in introductory economics textbooks (see Stevenson & Zlotnik, 2018).

Figure 2.14: The production possibility frontier in autarky



Exercise 2.5. Indifference curves for perfect complementary goods

a) Name some real world examples of goods that are perfectly complementary.

b) The blue dashed lines in Figure 2.14 represent the indifference curves of individual A and B. The upward sloping dashed black line is denoted with "possible consumption path''. Explain, why is it not correct–in strict sense–to name it like that?

2.5.2.1 Can person A and B improve their maximum consumption with cooperation?

Let us assume the two persons come together and try to understand how they can improve by jointly deciding which goods they should produce. If we assume that both persons redistribute their joint production so that both have an incentive to share and trade, we can concentrate on the total production output. Their joint PPF curve can then be drawn in two ways:

1. Person A specializes in good x, then the joint production possibilities are presented in Figure 2.15.

If A produces only good x, as shown in Figure 2.15, we see that A and B can consume a total of 6 units of goods x and y. This is less in total than in autarky, where A can consume $\frac{4}{3}$ units of each good and person B can consume 5 units of each good, giving a combined consumption of $\frac{19}{3} = 6,\bar{6}$.

2. Person A specializes in good y, then the joint production possibilities are presented in Figure 2.16.

If A produces only good y, as shown in Figure 2.16, we see that A and B can consume a total of 7 units of goods x and y. Thus, both can be better off compared to autarky, since the total quantity distributed is larger. Thus, we have an **Pareto improvement** here because at least one person can be better off compared to autarky.

In Figure 2.17, the three possible consumption scenarios are marked with a dot and the PPFs of person A specializing in the production of good x ($PPF_{A\to x}$) or good y ($PPF_{A\to y}$) are also drawn. The scenario with person A specializing in the production of good y is the output maximizing solution.[3]

2.5.2.2 Optimal production in cooperation

In order to produce the most bundles of both goods, the optimal cooperative production is

[3]Note that this is also true for any other utility function, since $PPF_{A\to y}$ is always above $PPF_{A\to x}$.

Figure 2.15: World PFF, A specializes in x

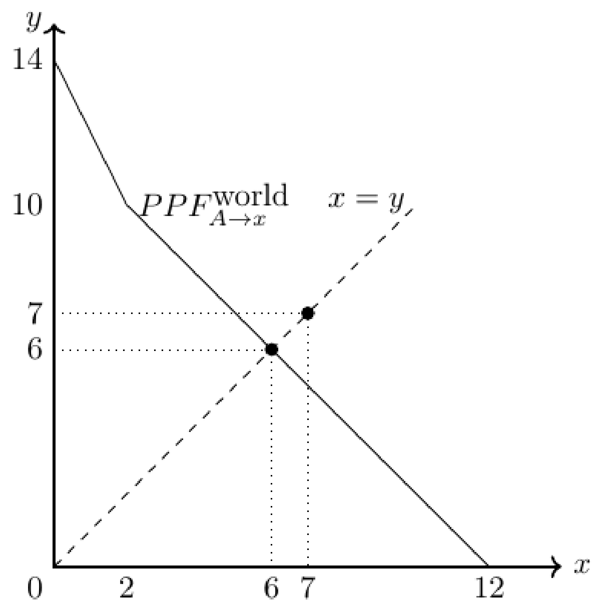


Figure 2.16: World PFF, A specializes y

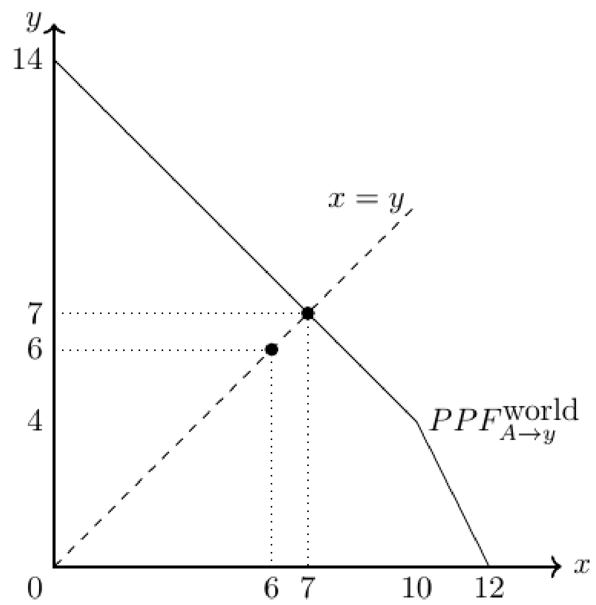
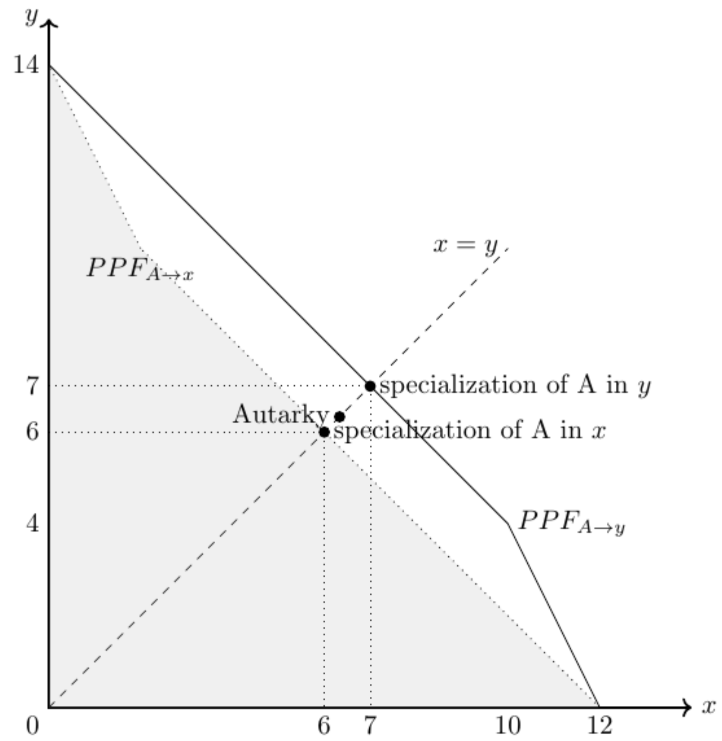


Figure 2.17: World PFF in autarky when A specialize in producing good y



production in cooperation	A	B
Good y	4	3
Good x	0	7

2.5.2.3 Check for absolute advantage

Employing 10 units of labor B can produce more of both goods and hence has an absolute advantage in producing x and y. Formally, we can proof this by comparing the input coefficients of both countries in each good:

absolute advantage	A		B	
Good y	$a_y^A = 1$	$>$	$0.4 = a_y^B$	$\Rightarrow$ B has an absolute advantage in good y
Good x	$a_x^A = 2$	$>$	$0.4 = a_x^B$	$\Rightarrow$ B has an absolute advantage in good x

2.5.2.4 Check for comparative advantage

The slope of the PPFs represent the *marginal rate of transformation*, the terms of trade in autarky and the opportunity costs of a country. The opportunity costs are defined by how much of a good x (or y) a person (or country) has to give up to get one more of good y (or x). For example, A must give up $\frac{a_x^A}{a_y^A} = \frac{1}{2} = 0.5$ of good x to produce one more of good y. Thus, A's opportunity costs of producing one unit of y is the production foregone, that is, a half good x. All opportunity costs of our example are:

opportunity costs of producing ...	A	B
... 1 unit of good y:	$\frac{a_y^A}{a_x^A} = \frac{1}{2} = 0.5$ (good x)	$\frac{a_y^B}{a_x^B} = \frac{0.4}{0.4} = 1$ (good x)

Table 2.5: : Consumption and trade when all gains from cooperation goes to A

(a) Consumption

	A	B
Good y	2	5
Good x	2	5

(b) Exports and imports of goods

	A	B
Good y	-2	2
Good x	2	-2

opportunity costs of producing …	A	B
…1 unit of good x:	$\frac{a_x^A}{a_y^A} = \frac{2}{1} = 2$ (good y)	$\frac{a_x^B}{a_y^B} = \frac{0.4}{0.4} = 1$ (good y)

Person A has a comparative advantage in producing good y since A must give up less of good x to produce one unit more of good y than person B must. In turn, Person B has a comparative advantage in producing good x since B must give up less of good y to produce one unit more of good x than person B must give up of good y to produce one unit more of good x. Thus, every person has a comparative advantage and if both would specialize in producing the good in which they have a comparative advantage and share their output they can improve their overall output as was shown in Figure 2.17.

An alternative and more direct way to see the comparative advantages of A and B, respectively, is by comparing the two input coefficients of A with the two input coefficients of B:

$$\frac{a_y^A}{a_x^A} \lesseqqgtr \frac{a_y^B}{a_x^B} \quad \Rightarrow \quad \frac{1}{2} < \frac{0.4}{0.4}.$$

Thus, A has a comparative advantage in y and B in x.

Comparative advantage: Definition
Economic subjects (e.g., individuals, households, firms, countries) should specialize in the production of that good in which they have a comparative advantage, that is, the ability of an economic subject to carry out a particular economic activity (e.g., producing goods) at a lower opportunity cost than a trade partner.

- $\frac{a_y^A}{a_x^A} > \frac{a_y^B}{a_x^B} \Rightarrow$ country A (B) has a comparative advantage in good x (y)
- $\frac{a_y^A}{a_x^A} < \frac{a_y^B}{a_x^B} \Rightarrow$ country A (B) has a comparative advantage in good y (x)
- $\frac{a_y^A}{a_x^A} = \frac{a_y^B}{a_x^B} \Rightarrow$ no country has a comparative advantage

2.5.2.5 Trade structure and consumption in cooperation

If A specializes in the production of y, she must import some of good y, otherwise she cannot consume a bundle of both goods as desired. In turn, B wants to import some of the good y. B will not accept to consume less than 5 bundles of y and x as this was his autarky consumption. Thus, B wants a minimum of 2 units of good y from A. A will not accept to give more than $4 - \frac{4}{3} = 2\frac{2}{3}$ items of good y away and he wants at least $\frac{4}{3}$ items of good x. Overall, we can define three trade scenarios:

1. All gains from cooperation goes to A (see Figure 2.18 and Table 2.5);
2. All gains from cooperation goes to B (see Table 2.6); or
3. The gains from specialization and trade are shared by A and B with a trade structure between the two extreme scenarios.

Each of the three cases yield a *Pareto-improvement*, that is, none gets worst but at least one gets better by mutually decide on production and redistribute the joint output. In the real world, however, it is often difficult for countries to cooperate and decide mutually on production and consumption. In particular, it is practically difficult to enforce redistribution of the joint outcome so that everyone is better off. So let's examine whether there is a mechanism that yields trade gains for both trading partners.

Table 2.6: : Consumption and trade when all gains from cooperation goes to B

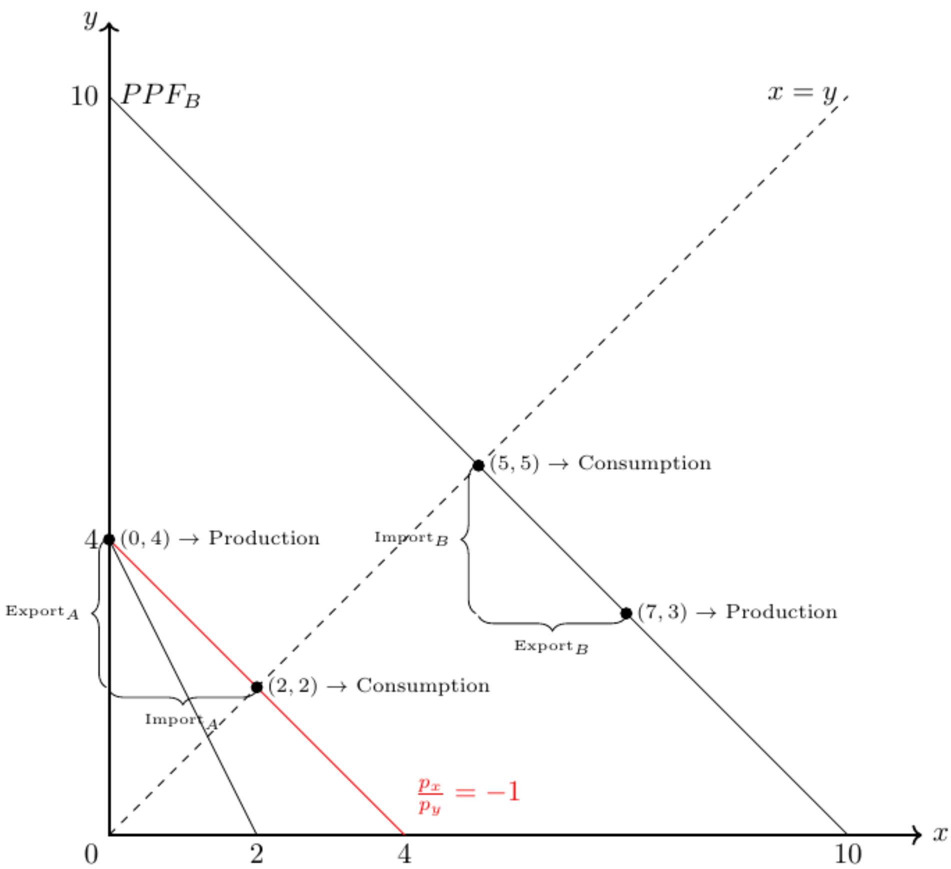
(a) Consumption

	A	B
Good y	$\frac{4}{3}$	$5\frac{2}{3}$
Good x	$\frac{4}{3}$	$5\frac{2}{3}$

(b) Exports and imports of goods

Trade	A	B
Good y	$-\frac{2}{3}$	$\frac{2}{3}$
Good x	$\frac{4}{3}$	$-\frac{4}{3}$

Figure 2.18: Bilateral trade with one winner



2.5.3 The Ricardian model

To understand the underlying logic of the argument, let us formalize and generalize the situation of two subjects and their choices for production and consumption.

In particular, the Ricardian Model build on the following assumptions:

- 2 subjects (A,B) can produce 2 goods (x,y) with
- technologies with constant returns to scale. Moreover,
- production limits are defined by $y^i Q^i_y + a^i_x Q^i_x = L^i$\$, where a^i_j denotes the unit of labor requirement for person $i \in \{A, B\}$ in the production of good $j \in \{x, y\}$ and Q^i_j denotes the quantity of good j produced by person i, and Q^i_j the quantity of good j produced by person i and Q^i_j the quantity of good j produced by person i. (Imagine they both work 4 hours).
- Let a^i_j denote the so-called labor input coefficients, that is, the units of labor required by a person $i \in \{A, B\}$ to produce one unit of good $j \in \{x, y\}$.
- Suppose further that person B requires fewer units of labor to produce both goods, that is, $a^A_y > a^B_y$ and $a^A_x > a^B_x$, and that
- a comparative advantage exists, that is, $\frac{a^B_y}{a^B_x} \neq \frac{a^A_y}{a^A_x}$.

Ricardian theorem
If each country specialize in the production in the good for which it has a comparative advantage and exports this good, both countries gain from trade when the new world market price relation, $\frac{p^*_y}{p^*_x}$, lies between the price relations of both countries[4]

$$\frac{a^B_y}{a^B_x} = \frac{p^B_y}{p^B_x} > \frac{a^*_y}{a^*_x} = \frac{p^*_y}{p^*_x} > \frac{p^A_y}{p^A_x} = \frac{a^A_y}{a^A_x}$$

because the consumption possibilities enlarge for both countries compared to a situation with no trade.

2.5.4 Distribution of welfare gains

The Ricardo theorem tells us nothing about the precise distribution of welfare gains. In this section, I will show that the distribution of welfare gains is the result of relative supply and demand in the world.

To illustrate this, consider Ricardo's famous example[5] of two countries (England and Portugal) that can produce cloth T and wine W with different input requirements, namely:

$$\frac{p^P_W}{p^P_T} = \frac{a^P_W}{a^P_T} = \frac{8}{9} < \frac{12}{10} = \frac{a^E_W}{a^E_T} = \frac{p^E_W}{p^E_T}$$

Thus, England has an absolute disadvantage in the production of both goods, but England has a *comparative advantage in the production of cloth* and Portugal has a *comparative advantage in the production of wine*. Let us further assume that both countries are similarly endowed with labor, $\bar{L}$. Then we can calculate the world supply of cloth and wine given relative world prices, $\frac{p_T}{p_W}$. Since we know that Portugal will only produce wine if the price of wine relative to cloth is above $\frac{p_W}{p_T} = \frac{8}{9}$ and England will only produce wine if the price of wine relative to cloth is above $\frac{p_W}{p_T} = \frac{12}{10}$, we can draw the relative world supply of goods as

[4] In order to see that the relative prices within a country equals the relative productivity parameters, consider that nominal income of labor in producing good $j \in \{x, y\}$, $w_j L^i_j$, must equal the production value, that is, $p^i_j x^i_j$:

$$w_j L^i_j = p^i_j x^i_j.$$

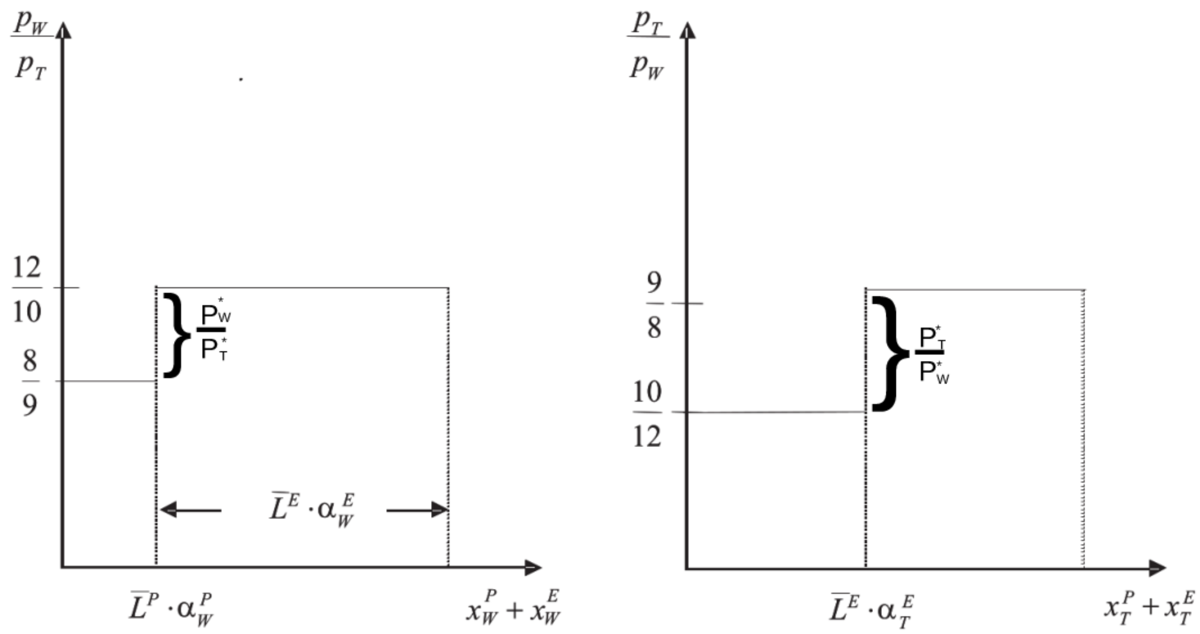
Setting $w_j = 1$ as the numeraire and re-arranging the equation, we get

$$p^i_j = \frac{L^i_j}{x^i_j} = a^i_j.$$

[5] The example is explained by Suranovic (2012) in greater detail.

shown in the left panel of Figure 2.19. Note that α in the figure means $\frac{1}{a}$. Similarly, we can draw in the world supply of clothes, shown in the left panel of Figure 2.19.

Figure 2.19: World's relative supply



Whether both countries specialize totally in the production of one good, or only one country does so depends on world demand for both goods at relative prices. Since we know from the Ricardo Theorem that the world market price relation, $\frac{p_T^*}{p_W^*}$, must be between the two autarky price relations:

$$\frac{p_T^P}{p_W^P} > \frac{p_T^*}{p_W^*} > \frac{p_T^E}{p_W^E}. \tag{2.3}$$

If world demand for cloth would be sufficiently high to have a world price of

$$\frac{p_T^P}{p_W^P} = \frac{9}{8}$$

Portugal would not gain from trade. On the contrary, if world demand for wine would be sufficiently high to have a world price of

$$\frac{p_T^P}{p_W^P} = \frac{10}{12}$$

England would not gain from trade. Thus, the price span between $\frac{10}{12}$ and $\frac{9}{8}$ says us which country gains from trade. For example, at a world price of

$$\frac{p_T^*}{p_W^*} = 1$$

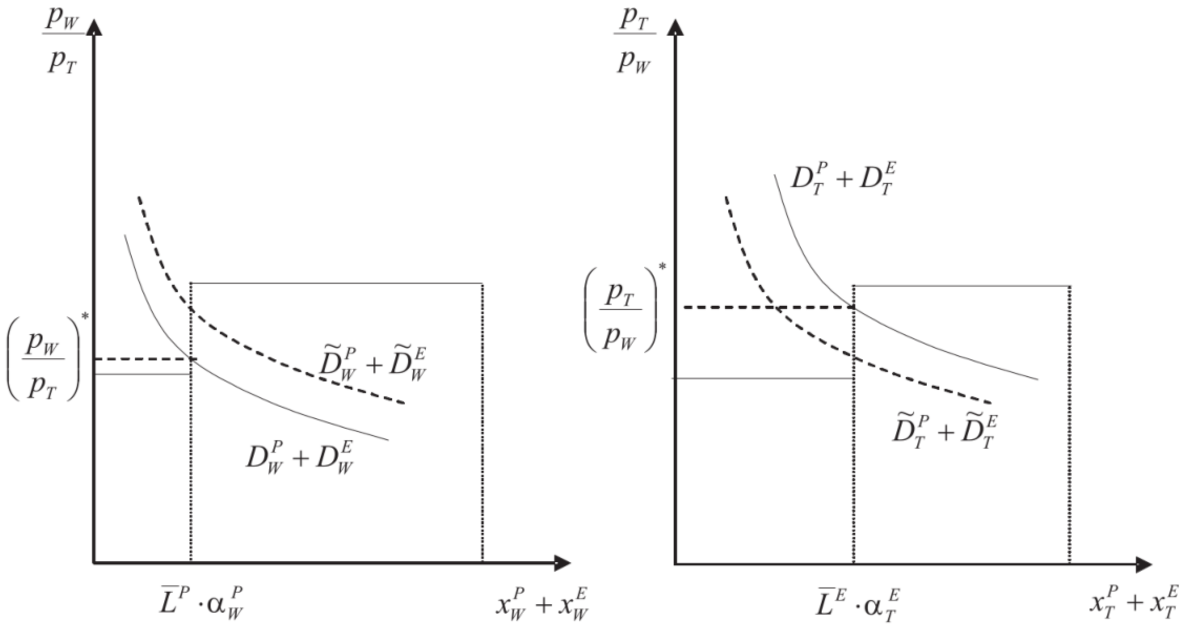
about 57%

$$\left[\frac{\left(1 - \frac{10}{12}\right)}{\left(\frac{9}{8} - \frac{10}{12}\right)} \approx 0.57\right] \tag{2.4}$$

of the gains through trade will be distributed to Portugal and about 43% will be distributed to England.

In Figure 2.20, I show two demand curves of the World. The dashed demand curve represents a world with a relative strong preference on wine and the other demand curve represents a relative strong demand for cloth. Since Portugal has a comparative advantage in producing wine, they would happy to live in a world where demand for wine is relatively high, whereas the opposite holds true for England.

Figure 2.20: World's relative supply and demand



Exercise 2.6. Comparative advantage and opportunity costs
Assume that only two countries, A and B, exist. Both countries are equally endowed with labor which is the only production factor. Both countries can produce either good y or good x. The table below gives the input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively. Assume that both countries have 12 units of labor available.

	Country A	Country B
Good y	1	3
Good x	2	4

a) Name the country with an absolute advantage.
b) Draw the production possibility curves in a y-x-diagramm.
c) What are *opportunity costs*?
d) Calculate how many goods of x country A has to give up to produce one unit more of good y.
e) Calculate how many goods of y country A has to give up to produce one unit more of good x.
f) Calculate how many goods of x country B has to give up to produce one unit more of good y.
g) Calculate how many goods of y country B has to give up to produce one unit more of good x.
h) Name the country with a comparative advantage in good y.
i) Name the country with a comparative advantage in good x.

Solution

a) Country A has an absolute advantage in producing both goods as

$$a_y^A = 1 < 3 = a_y^B$$

and

$$a_x^A = 2 < 4 = a_x^B$$

b) Solution is shown in the lecture.
c) Opportunity cost is the value of what you lose when choosing between two or more options. Alternative definition: Opportunity cost is the loss you take to make a gain, or the loss of one gain for another gain.
d) If A wants to produce one unit more of good y it has to give up $\frac{1}{2}$ units of good x.
e) If A wants to produce one unit more of good x it has to give up 2 units of good y.
f) If B wants to produce one unit more of good y it has to give up $\frac{3}{4}$ units of good x.
g) If A wants to produce one unit more of good x it has to give up $\frac{4}{3}$ units of good y.

opportunity costs of producing ...	A	B
... 1 unit of good y	$\frac{a_y^A}{a_x^A} = \frac{1}{2} = 0.5$ (good x)	$\frac{a_y^B}{a_x^B} = \frac{3}{4}$ (good x)
... 1 unit of good x	$\frac{a_x^A}{a_y^A} = \frac{2}{1} = 2$ (good y)	$\frac{a_x^B}{a_y^B} = \frac{4}{3} =$ (good y)

h) Country A has a comparative advantage in producing good y.
i) Country B has a comparative advantage in producing good x.

Exercise 2.7. The best industry is not competitive
Assume that only two countries, A and B, exist. Both countries are equally endowed with labor which is the only production factor. Both countries can produce either good y or good x. The table below gives the input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively.

Good	Country A	Country B
Good y	10	9
Good x	12	10

Discuss absolute and comparative advantages. How much faster does B needs to in producing good y to become an exporter of that good?

Solution

The logic of opportunity cost is straightforward. You must compare the opportunity costs across countries: If country A wants to produce one more unit of good y, it requires 10 units of labor. With these 10 units, it could produce 10/12 = 0.83 units of good x because it requires 12 units of labor to produce 1 unit of good x. If country B wants to produce one more unit of good y, it requires 9 units of labor. With these 9 units, it could produce 9/10 = 0.9 units of good x because it requires 10 units of labor to produce 1 unit of good x. Thus, the opportunity costs of country A are smaller compared to country B in producing good y. This is because country A has to give up less production of good x in order to produce 1 more unit of good y.

opportunity costs of producing...	Person A	Person B
...1 unit of good y:	$\frac{a_y^A}{a_x^A} = \frac{10}{12} \approx 0.83$ (good x)	$\frac{a_y^B}{a_x^B} = \frac{9}{10} = 0.9$ (good x)
...1 unit of good x:	$\frac{a_x^A}{a_y^A} = \frac{12}{10} = 1.2$ (good y)	$\frac{a_x^B}{a_y^B} = \frac{10}{9} \approx 1.11$ (good y)

Thus, A has a comparative advantage in producing good y and B has a comparative advantage in producing good x. This seems to be counterintuitive as B can produce faster anything and everybody else.
When looking on input coefficients, we get

$$\frac{a_y^A}{a_x^A} = \frac{10}{12} < \frac{9}{10} = \frac{a_y^B}{a_x^B}$$

which gives us the same comparative advantages as described above.
To become an exporter of y, B needs to have lower opportunity costs in the production of y than A. This can happen by becoming more productive in producing y **and/or** by becoming 'slower' in producing good x so that $\frac{a_y^B}{a_x^B} < \frac{10}{12}$

Exercise 2.8. Comparative advantage and input coefficients
Assume that only two countries, A and B, exist. Both countries are equally endowed with labor which is the only production factor. Both countries can produce either good y or good x. The table below gives the input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively.

	Country A	Country B
Good y	400	2
Good x	300	1

a) Name the country with an absolute advantage.
b) Name the country with a comparative advantage in good y.
c) Name the country with a comparative advantage in good x.

Solution

a) Country B has an absolute advantage in producing both goods.
b) Country A has a comparative advantage in producing good y.
c) Country B has a comparative advantage in producing good x.

Exercise 2.9. Comparative advantage: Germany and Bangladesh
The table below gives the unit of labor needed to produce one machine, one ship, and one cloth in Germany and Bangladesh.

	Machine	Ship	Cloth
Bangladesh	100	10000	50
Germany	5	50	3

a) Which country has an absolute advantage in the production of machines, ships, and clothes?
b) What is Germany's and Bangladesh's comparative advantage if we look only at machines and ships?
c) What is Germany's and Bangladesh's comparative advantage if we look only at machines and clothes?
d) What is Germany's and Bangladesh's comparative advantage if we look only at ships and clothes?
e) Can you infer from the previous calculations which good Germany will export for sure and which good it will surely not export?

Solution

a) Germany has an absolute advantage in the production of the three goods because it labor input coefficients are smaller in all three goods.
b) Since $p_B^{m/s} = \frac{100}{10000} < p_G^{m/s} = \frac{5}{50}$ Bangladesh has a comparative advantage in producing machines and Germany has a comparative advantage in producing ships.
c) Since $p_B^{m/c} = \frac{100}{50} > p_G^{m/c} = \frac{5}{3}$ Bangladesh has a comparative advantage in producing clothes and Germany has a comparative advantage in producing machines.
d) Since $p_B^{s/c} = \frac{10000}{50} > p_G^{s/c} = \frac{50}{3}$ Bangladesh has a comparative advantage in producing clothes and Germany has a comparative advantage in producing ships.
e) Germany has a clear comparative advantage in producing ships and hence will export ships. Moreover, Germany has a clear comparative disadvantage in producing cloth and will definitely import clothes.

Exercise 2.10. Multiple choice: Ricardian model
Assume that only two countries, A and B, exist. Both countries are equally endowed with labor which is the only production factor. Both countries can produce either good y or good x. The table below gives the input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively.

	Country A	Country B
Good y	40	20
Good x	30	10

Which of the following statements is/are true?
a) Country A has an absolute advantage in producing both goods.
b) Country B has an absolute advantage in producing both goods.
c) Country A has a comparative advantage in good y and a comparative disadvantage in good x.
d) Country B has a comparative advantage in good y and a comparative disadvantage in good x.
e) Trade will not occur between these two countries.

Solution

Choices b) and c) are correct.

Exercise 2.11. Ricardian Model again
Assume that only two countries, A and B, exist. Both countries are equally endowed with the only production factor labor which can be used to produce either good y or good x. The table below gives input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively.

	Country A	Country B
Good y	11	22
Good x	8	16

Which of the following statements is true?

a) Country A will export good y and import good x.
b) Country B will export good y and import good x.
c) Country B has an absolute disadvantage in producing both goods.
d) Trade will not occur between these two countries.

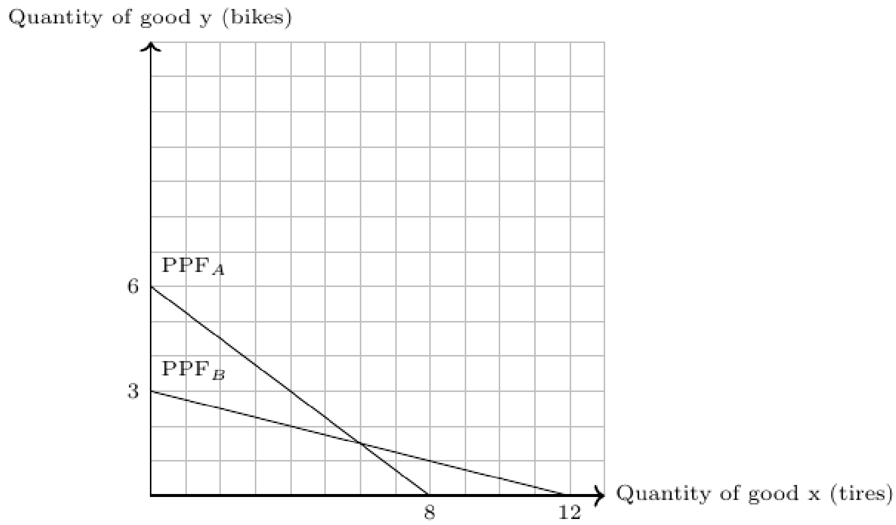
Solution

c) and d) are true.

Exercise 2.12. Bike and tires

Consider two countries, A and B. Both have a labor endowment of 24, $L^A = L^B = 24$. In both countries two goods can be produced: bikes, which are denoted by y, and bike tires, which are denoted by x. Assume that the two goods can only be consumed in bundles of one bike and two bike tires. The following graph illustrates the production possibility (PPF) curve of both countries in autarky, i.e, country A and B do not trade with each other.

Figure 2.21: Production possibilities of bike and tires in A and B



a) How many **complete bikes**, that is, one bike with two tires, can be consumed in autarky in country A and B, respectively. Draw the production points for country A and B into the figure. (A calculation is not necessary.)
b) Calculate —for both countries—the input coefficients, a, that is, the units of labor needed to produce one unit of good y and good x, respectively. Fill in the four input coefficients in the following table:

	Country A	Country B
Good y (bikes)	( )	( )
Good x (bike tires)	( )	( )

c) Fill in the ten gaps ( ) in the following text:
If we assume that both countries specialize completely in the production of the good at which they have a comparative advantage and trade is allowed and free of costs, then

- country A produces ( ) units of bikes and ( ) units of tires and
- country B produces ( ) units of bikes and ( ) units of tires.

Moreover, since both countries aim to consume complete bikes, that is, one bike with two tires,

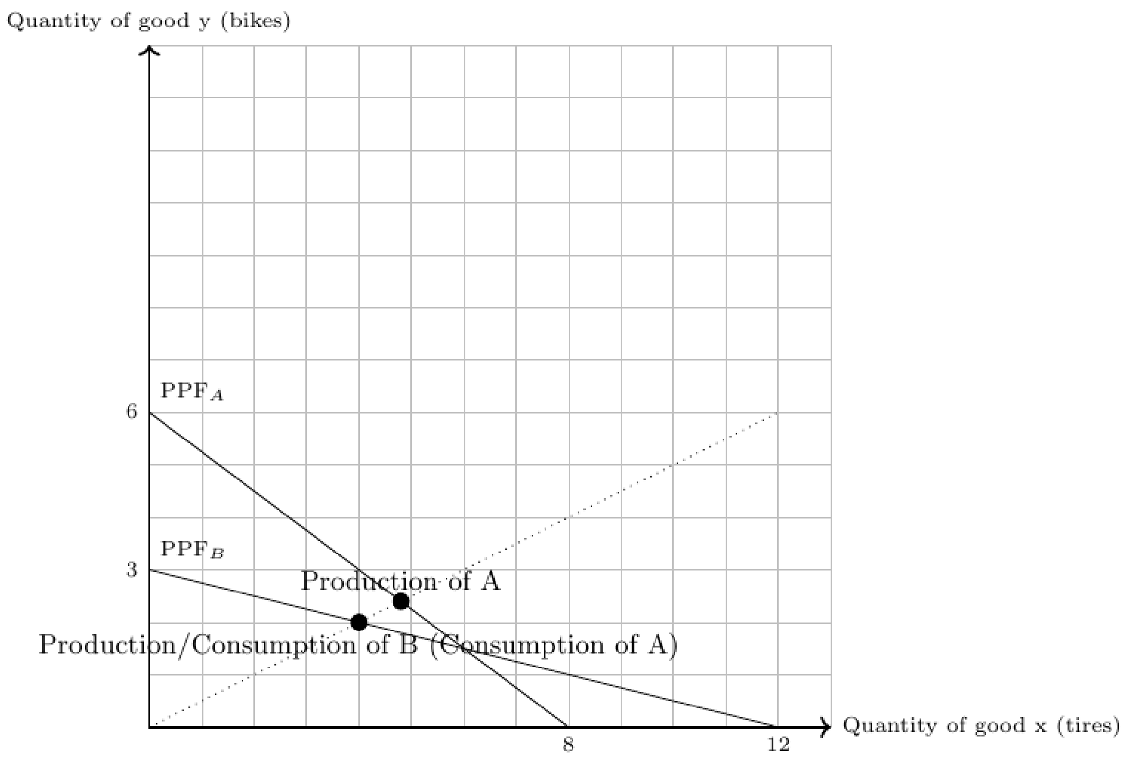
- country A exports ( ) units of ( ) and imports ( ) units of ( ) and
- country B exports ( ) units of ( ) and imports ( ) units of ( ).

Under free trade - country A can consume ( ) complete bikes and - country B can consume ( ) complete bikes.

Solution

a) Both countries can consume 2 complete bikes, see Figure 2.22.

Figure 2.22: Production and consumption in A and B



b)

	Country A	Country B
Good y (bikes)	24:6=4	24:3=8
Good x (bike tires)	24:8=3	24:12=2

c) If we assume that both countries specialize completely in the production of the good at which they have a comparative advantage and trade is allowed and free of costs, then
- country A produces 6 units of bikes and 0 units of tires and
- country B produces 0 units of bikes and 12 units of tires.

Moreover, since both countries aim to consume complete bikes, i.e., one bike with two tires,
- country A exports 3 units of bikes and imports 6 units of tires and
- country B exports 6 units of tires and imports 3 units of bikes.

Under free trade
- country A can consume 3 complete bikes and
- country B can consume 3 complete bikes.

Exercise 2.13. Ricardian model MC
Assume that only two countries, A and B, exist. Both countries are equally endowed with the only production factor labor which can be used to produce either good y or good x. The table below gives input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively.

	Country A	Country B
Good y	321	899
Good x	459	999

Which of the following statements is true?
a) Country A has an absolute advantage in both goods.
b) Country A has an absolute advantage in good y
c) Country A has a comparative advantage in both goods.
d) Country B has a comparative advantage in both goods.
e) Country A has a comparative advantage in good y.
f) Country B has a comparative advantage in good y.

Solution
a), b), and e) are correct statements.

2.6 Trade because of different endowments (Heckscher-Ohlin model)

Learning objectives

- Understand the expansion of the Ricardian trade model through the introduction of multiple production factors.
- Learn that differences in countries' factor endowments drive international trade patterns according to the Heckscher-Ohlin framework.
- Understand that a country's comparative abundance in a particular factor gives it a comparative advantage in goods that use that factor intensively.
- Understand the tendency of international trade to equalize factor prices across countries.
- Reflect on how trade can serve as a substitute for the physical mobility of production factors between countries.

Recommended reading: Suranovic (2012, Chapter 5)

2.6.1 Nobel prize winning theory

The Model which we discuss in this section is named after two Swedish economist, Eli Heckscher (1879-1952) and Bertil Ohlin (1899-1979). Bertil Ohlin received the Nobel Prize in 1977 (together with James

Meade). The HO-Model, as it is often abbreviated, was the main reason for the price. Here is an excerpt of the Award ceremony speech:

> *Your Majesties, Your Royal Highnesses, Ladies and Gentlemen,*
> *The question why individuals, firms and nations exchange goods and services with each other, and how these processes are influenced by government policies, may be regarded as the basic issue in the science of economics. In the case of exchange between countries, the dominating theory was for a long time – from the beginning of the 19th century – David Ricardo's theory of comparative advantage. Ricardo explained there the structure of foreign trade by differences in the production technology between nations. Over the years the theory was gradually improved upon in various ways, but a more basic overhaul did not take place until Bertil Ohlin in the early 1930's published his work Interregional and International Trade, which is now a classic, and James Meade in the 1950's came out with his important volumes on The Theory of International Economic Policy.*
> *Bertil Ohlin showed in this work, which to some extent was inspired by a remarkable article by Eli Heckscher, that foreign trade may arise even if the production technology were identical in different nations. It is enough that the supplies of the factors of production of various kinds – such as labor of different types, capital, and land – differ among nations. The starting point of Ohlin's theory is that a country tends to be an exporter of commodities that use relatively large amounts of the factors of production which are in ample supply as compared to domestic demand – in the hypothetical case without foreign trade. For instance, to take a simple example, if land is abundant in Australia while labor is relatively plentiful in England, we would expect Australia to be an exporter of commodities which for their production require much land, such as wool, while England would be an exporter of commodities the production of which requires relatively much labor, such as textiles.*
> *From this simple theoretical structure, the so-called Heckscher-Ohlin model, follow a number of interesting theorems. One of them, the factor price equalization theorem, tells us that foreign trade tends to equalize the prices of the factors of production in different countries. For instance, when Australia starts to export land-intensive goods, the demand for land goes up relative to labor, with a rise in land prices as a result, while the export of labor-intensive goods by England pulls up wages there relative to the price of land. Thus, trade in commodities tends to have the same effects on the prices of the factors of production as if the factors themselves could move freely between countries. In this sense, commodity trade is a substitute for international mobility of the factors of production. Another inference from Ohlin's theory is that a tariff on a labor-intensive good, such as textiles, affects the distribution of income in favor of labor in the importing country, while a tariff on a capital-intensive commodity, such as wool or steel, results in an income redistribution in favor of the owner of capital.*
> Source: www.nobelprize.org

The Ricardo model explains international trade as advantageous because of comparative advantages that are the result of technological differences. This means that comparative advantage in the Ricardian model is solely the result of **productivity differences**. The size of a country or the size of the countries' endowments does not matter for comparative advantage in the Ricardian model because there is only one factor of production in Ricardian models, namely labor. However, the assumption that there is only one factor of production is unrealistic, and we should ask what happens **if there is more than one factor of production but no productivity differences**? What happens if the two factors are available differently in different countries? What is the significance of endowment differences for international trade? And which owner of a factor of production will be a winner when a country opens up to world trade, and who will lose? The HO model can provide answers to these questions.

In Table 2.18, I show that countries do indeed differ substantially in their total factor productivity, capital stock, and labor endowments, which are likely correlated with total population.

Table 2.18: Endowment differences across countries in 2010

RegionCode	Capital stock at current PPPs (in mil. 2011USD)	Population (in millions)	Capital stock per capita
ITA	10421041	60	174885
ESP	7806612	47	167518
FRA	10405968	65	160395
GBR	9973122	63	159019
DEU	12687682	80	157738
USA	48876336	310	157729
AUS	3332890	22	150382
CAN	5065392	34	148431
JPN	17161376	127	134790
SAU	3716382	28	132300
KOR	6052155	49	123287
TWN	2835890	23	122549
ROU	1271652	20	62647
VEN	1765996	29	60905
BRA	9869311	199	49691
RUS	6746460	143	47126
POL	1769004	39	45859
THA	2977965	67	44652
IRN	3234132	74	43555
ARG	1773984	41	43034
MEX	5054693	119	42613
TUR	2938288	72	40634
UKR	1616826	46	35420
IDN	8146254	242	33716
COL	1446480	46	31501
CHN	42218080	1341	31483
PER	681036	29	23185
PHL	1560017	93	16767
IRQ	443733	31	14375
IND	15356803	1231	12475

Source: Penn World Tables 9.0

2.6.2 The Heckscher-Ohlin (factor proportions) model

Assumptions:

1. **Two countries**: Home country and foreign country. Variables referring to foreign countries are marked with an asterisk, $*$.

2. **Two goods**: x and y.

3. **Two factors of production**: K and L. This is new in relation to the Ricarkian model! Let's name the factors K and L, which stands for capital and labor.

4. **Goods differ in terms of their need for factors of production**:

$$\frac{K_y}{L_y} \neq \frac{K_x}{L_x}.$$

   This means that one good must be produced in a capital-intensive way and the other in a labor-intensive way. If we assume that good y is capital intensive and good x is labor intensive in production, we can write:

$$\frac{K_y}{L_y} > \frac{K_x}{L_x}.$$

In this inequality, the quantity of capital required to produce good y, K_y, is on the left-hand side relative to the quantity of labor required to produce good y, L_y, that is, the capital intensity of good y.The capital intensity of good x is on the right-hand side of the inequality. Rewriting this inequality, we can express it in terms of labor intensities: $\frac{L_y}{K_y} < \frac{L_x}{K_x}$. It should be clear that both inequalities say the same thing.

5. **No technology differences between countries**: Since we already know from Ricardian theory that productivity or technology differences are a source of international trade, we do not want to explain the same thing again with the HO model. So we assume that all input coefficients are the same in all countries.

6. **Different relative factor endowments**:

$$\frac{K}{L} \neq \frac{K^*}{L^*}.$$

Since countries are assumed to have different factor endowments, the model links a country's trade pattern to its endowment of factors of production. The capital-labor ratio in the home country, $\frac{K}{L}$, must differ from the ratio abroad. Suppose the home country is capital-rich and the foreign country is labor-rich. Then we have the following ratios between capital and labor in the two countries:

$$\frac{K}{L} > \frac{K^*}{L^*}.$$

This means that the capital-labor ratio (a country's capital intensity) is higher in the home country than abroad. In terms of the ratio between labor and capital, that is, the labor intensity of a country, this can be expressed as follows: $\frac{L}{K} < \frac{L^*}{K^*}$. It should be clear that both inequalities say the same thing.

7. **Free factor movement between sectors** Both factors can be used in the production of both goods. Note that cross-country movement of factors (migration, foreign direct investment) is not allowed.

8. **No trade costs** Final products can be traded without any costs.

9. **Equal tastes in countries and homothetic preferences** Consumers in both countries have the same utility function. Homothetic preferences simply mean that for given relative prices, income does not affect the ratio of consumption.

2.6.3 Heckscher-Ohlin theorem

- Consider that the home country has relatively more capital and the foreign country relatively more labor and that the good y is capital intensive in production whereas the good x is labor intensive.
- Then it is relatively cheap for the home country to produce the capital-intensive good because it is endowed with a lot of capital, while it is relatively costly to produce the good with which the country is hardly endowed.

- Thus, the home country has a comparative advantage in producing the capital-intensive good.
- The opposite is true for the foreign country.

Heckscher-Ohlin Theorem

The capital abundant country exports the capital-intensive good. The labor abundant country exports the labor-intensive good.
In other words:
A country export goods that are intensive in its relatively abundant factor and will import goods that are intensive in its relatively scarce factor.

2.6.4 Factor-price equalization theorem

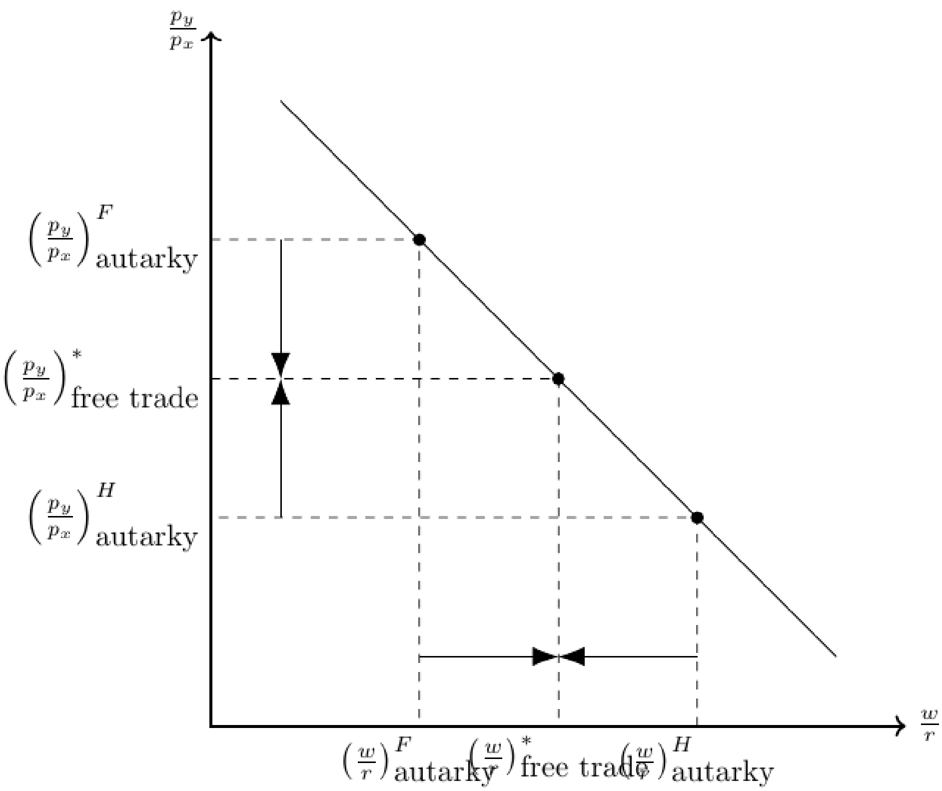
- As a result of the Heckscher-Ohlin theorem, output of the good in which the country has a comparative advantage would increase. The capital intensive country will produce more capital intensive goods and the labor intensive country will produce more labor intensive goods.

- As the production of the good that makes intensive use of the abundant resource increases, the demand for that resource will also increase. Demand for the scarce resource will also increase, but to a lesser extent.
- If production of the good that intensively uses the scarce resource decreases, both abundant and scarce resources will be released, but relatively more of the scarce resource than of the abundant resource.
- In autarky, the relatively scarce factor in the home country was labor and factor prices were as follows:
$$\frac{w}{r} > \frac{w^*}{r^*}$$
- After opening to trade, production shifts to the home country so that the wage falls ($w \downarrow$) and the rent rises ($r \uparrow$).
- After opening to trade, production shifts abroad so that the wage rises, $w^* \uparrow$, and the rent falls, $w^* \downarrow$.
- This reallocation process, and hence the change in factor prices, continues until factor prices are equal in all countries:
$$\frac{w}{r} = \frac{w^*}{r^*}$$
- Figure 2.23 visualizes the reasoning behind the factor-price equalization theorem.

Factor-price equalization theorem

The prices of the two factors of production (wage and rent) will be equalized across countries as a result of international trade in goods.

Figure 2.23: HO Model and factor prices



- I recommend a clip of Mike Moore explaining how trade based on factor endowments affects wages and returns to capital, see this video:

Why does the Factor-Price Equalization Theorem not (fully) hold?

In the real world, factor prices do not equalize due to frictions such as transportation costs, trade barriers, and the presence of goods that are rarely or never traded.

Trade as an alternative to factor movements:

The factor price equalization theorem contains an interesting insight: if a country allows free trade in its products, it will automatically export the abundant factor indirectly in the form of goods that intensively use the abundant factor.

Exercise 2.14. Ricardo and Heckscher-Ohlin

a) Discuss the main differences of the Ricardian Model and the Heckscher-Ohlin Model.
b) Assume that only two countries, A and B, exist. Both countries are equally endowed with the only production factor labor which can be used to produce either good y or good x. The table below gives input coefficients, a, for both countries, that is, the units of labor needed to produce one unit of good y and good x, respectively. Name the country with a comparative advantage in good y.

	Countries	
	A	B
Good y	10	11
Good x	1	2

Exercise 2.15. HO-Model in one figure

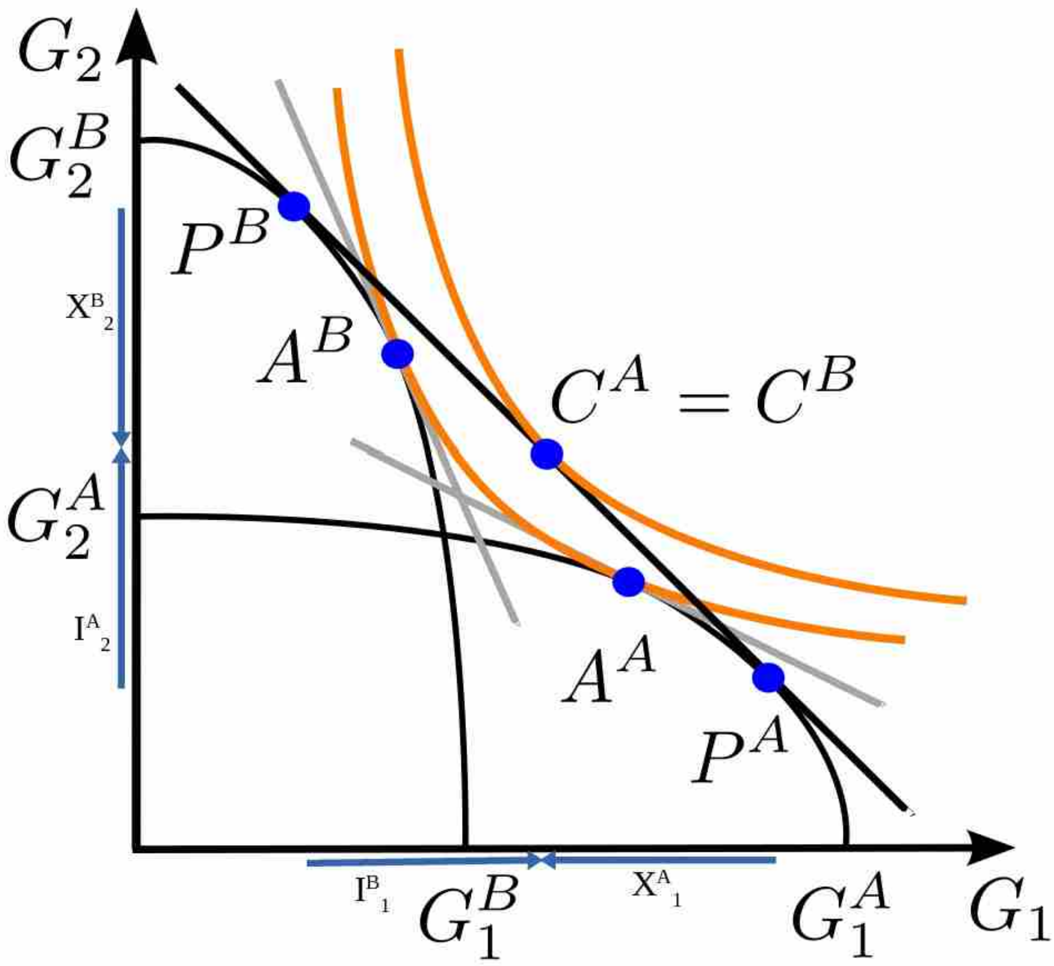
Suppose consumers from country A and the foreign country B like to consume two goods that are neither perfect substitutes nor perfect complements. Moreover, assume for simplicity that both countries have the same size but have different endowments, as stated in the assumptions above. Moreover, assume the factor intensity of production as stated in the assumptions above.

a) Sketch the production frontiers for both countries in autarky. Show graphically the relative price in autarky.
b) You will see that the relative prices of goods differ across countries:

$$\left(\frac{p_1}{p_2}\right) \neq \left(\frac{p_1}{p_2}\right)^*.$$

That means, the Home country A has a comparative advantage in producing good 1.
c) Now, sketch the world market price that will maximize the utility.
d) Where are the new production and consumption points of both countries?
e) Show in the graphic how much each country trades.
f) I recommend a clip of Mike Moore who also explains the HO-Model with production possibility curves, see this video.
Solution

Figure 2.24: HO-Model in one figure



Two identical countries (A and B) have different initial factor endowments. I assume that country A is abundantly endowed with the production factor that is intensively used in the production of good 1, the reverse holds for country B. Thus, the two solid black lines in Figure 2.24 represents the respective production possibility frontier curves. The orange lines represents the respective indifference curves. Autarky equilibria are marked with A^A and A^B, respectively. The production points in trade equilibrium are marked with P^A and P^B, the consumption point of both countries is in $C^A = C^B$. Thus, production and consumption points are divergent. The indifference curve under free trade is clearly above the other indifference curve in autarky. The solid black line that is tangient to the consumption point under free trade represents the utility maximizing world market price under free trade. The exports, X, and imports; I, are denotes correspondingly to the goods and country names.

Exercise 2.16. Multiple choice: HO-Model
Given are the assumptions of the Heckscher-Ohlin Model. In particular, assume that only two countries, A and B, and two goods, y and x, exist. Consider the following data:

	Countries	
	A	B
Factor Endowments		

Labor Force	20	30
Capital Stock	30	40

If good y is capital intensive in production and good x is labor intensive in production then, following the Heckscher-Ohlin Theorem, ...

a) ... country A will export good y.
b) ... country B will export good y.
c) ... both countries will export good y.
d) ... trade will not occur between these two countries.

Solution
Multiple choice: HO-Model (Exercise 2.16)
Answer a) is correct.

2.7 The specific factor model

Figure 2.25: Not everybody wins with free trade

Source: otherwords.org

From the Ricardian model, we know that trade is a positive-sum game. If free trade is beneficial to a country, as Ricardo predicts, why isn't everyone happy with free trade? In democratic societies, policymakers sometimes adopt protectionist trade policies because of pressure from interest groups and public demand. The discrepancy between the promises and potential benefits of trade on the one hand and the negative consequences of free trade for many groups on the other is illustrated in Figure 2.25. The models so far do not give us a way to see which groups actually suffer from free trade, and thus we have no clue why there are incentives for interest groups to oppose free trade. Are anti-free trade policy preferences the result of ignorance, general worldviews, political ideology, environmental attitudes, social trust, or other factors? Well, these things may play a role, but there are also economic factors, that is, the self-interest of individuals and groups within an economy, that can account for anti-free trade attitudes. In the following sections, we will discuss a theory that shows that while free trade benefits countries as a whole, not everyone within a country benefits equally. Some benefit more than others, and some are actually made worse off by free trade.

In the next two subsections, we derive some key hypotheses that free trade favors those people in a country who have abundant factors of production and disadvantages those who have scarce factors. Moreover, free trade favors investors and workers in export-oriented industries with comparative advantages.

2.7.0.1 Assumptions

The sector-specific model, also known as the Ricard-Viner model, can show that there are winners and losers in international trade. The model is based on the following assumptions:

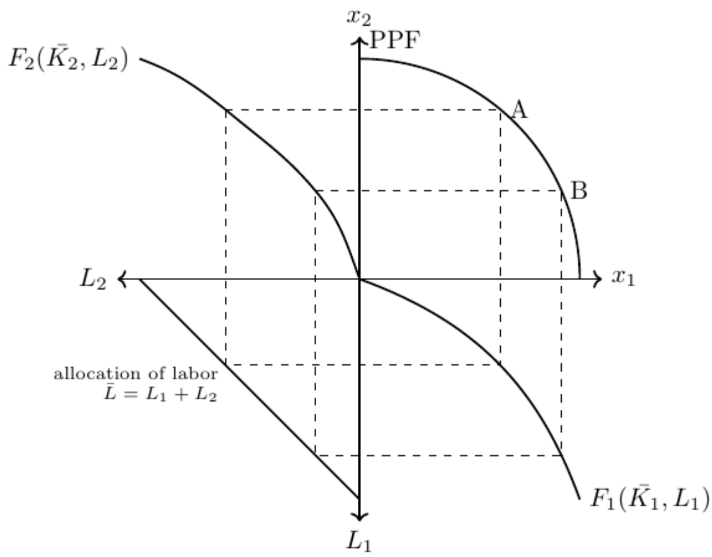
1. 2 countries $i \in \{A, B\}$

2. 2 goods (sectors) $g \in \{1, 2\}$
3. 3 factors of production: Labor L, capital specific to the production of good 1, K_1, and capital specific to the production of good 2, K_2[6]. The technologies for the production of both goods are now represented by two production functions $Q_1 = F_1(\bar{K}_1, L_1)$ and $Q_2 = F_2(\bar{K}_2, L_2)$, where both factors of production have positive but decreasing marginal products
4. The capital allocated to each sector is fixed for both countries: $K_1 = \bar{K}_1, K_2 = \bar{K}_2$
5. The labor assigned to each sector (L_1 and L_2) can change in response to external shocks: $\bar{L} = L_1 + L_2$
6. perfect competition
7. perfect market clearing (no unemployment)
8. country A is a small open economy (we consider only country A and therefore do not use a subscript for countries in the following)

2.7.0.2 The production possibility frontier with two factor inputs:

The two production functions, the fixed endowments and the distribution of labor determine the aggregate PPF. The PPF, which is the product of two production functions (F_1 and F_2), is shown in Figure 2.26. The figure shows, for both production points A and B, how the mobile factor of production, labor, must be reallocated from sector 2 to sector 1 in order to produce more of good 1 in production point B. The second and fourth quadrants show the respective production functions of sectors 1 and 2.

Figure 2.26: PPF with two factors and positive but declining marginal products



2.7.0.3 Equillibrium in autarky:

- Depending on a country's demand for good 1 and 2 a production point on the PPF is chosen at which it must hold that the slope of the PPF curve and the price relation (that is, relation of marginal product of labor in sector 1 and sector 2) must be equal:

$$\frac{p_1}{p_2} = \frac{\frac{\partial F_2}{\partial L_2}}{\frac{\partial F_1}{\partial L_1}}$$

- What can we say about the rents of the production factors?
- From the assumption of perfect competition it follows that firms do not make a positive profit in equilibrium, $\pi \stackrel{!}{=} 0$. Thus, the equilibrium wage for sectors $g \in \{1, 2\}$ are given by the profit

[6]You can think of capital specific to the production of manufacturing goods (good 1) and land specific to the production of food sector goods (good 2)

maximizing of firms

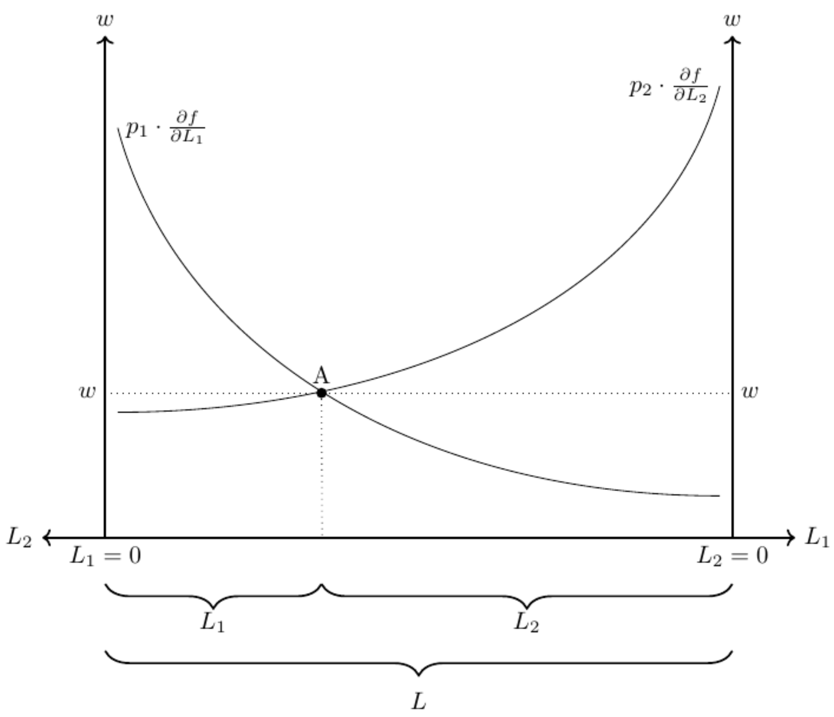
$$\pi_g = p_g \cdot F_g(\bar{K}_g, L_g) - w_g L_g - r_g K_g$$
$$\frac{\partial \pi_g}{\partial L_g} = p_g \cdot \frac{\partial F_g}{\partial L_g} - w_g \overset{!}{=} 0 \qquad \Leftrightarrow w_g = p_g \frac{\partial F_g}{\partial L_g}$$

- We know that labor can move freely between sectors and an equilibrium exists when there are no incentives to move any further. That is the case when wages in both sectors are equal, $w_1 = w_2$. Thus, we can express wages in terms of purchasing power in units of good 1 as follows:

$$w_1 = p_1 \frac{\partial F_1}{\partial L_1} \qquad \text{and} \qquad w_2 = p_2 \frac{\partial F_2}{\partial L_2}$$
$$\Rightarrow w = p_1 \frac{\partial F_1}{\partial L_1} = p_2 \frac{\partial F_2}{\partial L_2}$$
$$\Leftrightarrow \frac{w}{p_1} = \frac{\partial F_1}{\partial L_1}$$
$$\Leftrightarrow \frac{w}{p_2} = \frac{\partial F_2}{\partial L_2}$$

- Figure 2.27 presents the equilibrium wage and the optimal allocation of labor into sector 1 and 2.

Figure 2.27: Equilibrium with two sectors



2.7.0.4 Equilibrium under free trade:

Assume the price of good 1 and good 2 increase due to a trade opening in the same proportion. What happens with the real wage and the real incomes of capital-1 and capital-2 owners? The answer is: no real changes occur.

- The wage rate, w, rises in the same proportion as the prices, so the real wages are unaffected. In Figure 2.27 this can be shown by shifting both curves upward.
- The real incomes of capital owners also remain the same because there will be no reallocation of labor across sectors.

Now, assume only the price of good 1 rises for 10% while p_2 remains fixed, $\frac{p_1'}{p_2} > \frac{p_1}{p_2}$. What happens with the real wage and the real incomes of capital-1 and capital-2 owners? The answer is: some win, some lose, and some maybe win.

2.7.0.5 Wages:

- $p_1 \frac{\partial F_1}{\partial L_1}$ rises and hence labor reallocates from sector 2 to sector 1 ($L_1 \uparrow$ and $L_2 \downarrow$). This is shown in Figure 2.28.
- This reallocation of labor has some implications for the real wages measured in purchasing power of good 1 and 2, respectively:
- The price of good 1 has increased by 10%, the wage has however increased by less than 10% (compare the length of BC and BD in the figure), whereas the price for food stays constant.
- Thus, the purchasing power in buying good 2 increased, whereas the purchasing power in buying good 1 decreased. Hence, workers gain when buying good 2 but lose when buying good 1
- Overall, the welfare effect from real wages is unclear and depends on preferences.

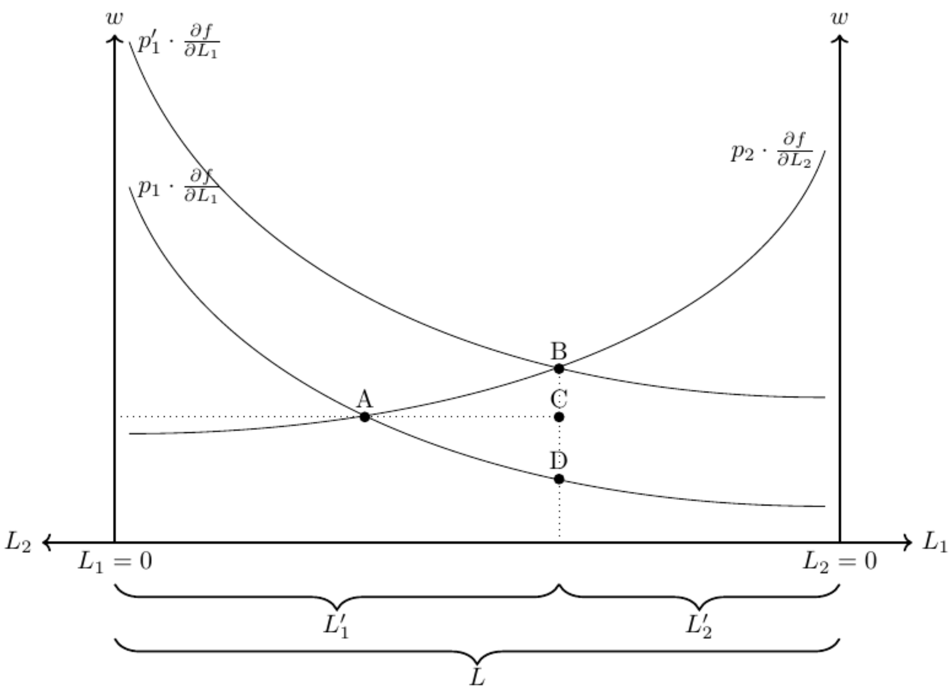
2.7.0.6 Owner of capital-1:

- Owners of capital-1 receive a 10% higher price on their products but have to pay a less than 10% higher wage.
- Overall, capital-1 owners gain from free trade because they can employ more workers (at a higher price) now.

2.7.0.7 Owner of capital-2:

- Owner of capital-2 receive the same price on their products but have to pay a higher wage.
- Overall, capital-2 owners lose from free trade because they can employ less workers at a higher price now.

Figure 2.28: Equilibrium when one price changes



Chapter 3

Trade policy

In this chapter, we discuss countries' incentives and opportunities to influence trade flows and the welfare implications of trade policy. In particular, we provide information on how the World Trade Organization organizes the world trading system.

3.1 Globalization

The term "globalization" is often used in different contexts and is usually implicitly associated with diverse and sometimes contradictory ideas about how the world works. There is no clear and generally accepted definition of the term. The use of the term carries a high risk of being misunderstood, as the conversation partner may have a different understanding of the term.

Nevertheless, it is important to understand the various meanings of the term to be able to understand the arguments that involve the term. Additionally, it allows you to phrase your own argument more precisely.

So, how can we get known to the various meanings of the term globalization. One way is to ask ChatGPT. Below you find my take on asking OpenAI (2024).

> Discuss: What do people mean when they use the term "globalization"? NextGeneration:AI
>
> Globalization is a multifaceted concept that refers to the increasing interconnectedness and interdependence of countries and cultures around the world. When people use the term "globalization," they often mean several interrelated processes:
>
> Economic Globalization: This aspect emphasizes the integration of national economies through trade, investment, and capital flows. It involves the reduction of trade barriers, the rise of multinational corporations, and the spread of global supply chains. Economic globalization has led to increased access to goods, services, and jobs across borders.
>
> Cultural Globalization: This involves the sharing and blending of cultural elements such as language, traditions, music, and values. Through media, travel, and technology, cultural practices and ideas can spread more freely, leading to both cultural exchange and homogenization. It raises discussions around the preservation of local cultures versus the influence of dominant global cultures.
>
> Political Globalization: This refers to the increasing influence of international institutions and agreements, such as the United Nations, the World Bank, and trade treaties. It encompasses the idea of global governance and the shared responsibility of nations to address global challenges like climate change, human rights, and security.
>
> Technological Globalization: This highlights the role of technology in fostering globalization. Advances in communication, transportation, and information technology have made it easier for people and businesses to connect globally. The internet, for example, enables instantaneous communication and the transfer of information across borders.

Social Globalization: This aspect focuses on the movements of people around the world, including migration, tourism, and the exchange of ideas and social practices. It emphasizes how global interactions affect societal structures and relationships.

Environmental Globalization: This addresses the global nature of environmental issues, such as climate change and biodiversity loss, which require international collaboration and efforts to manage resources sustainably.

Critically, globalization is also a subject of debate and contention. Advocates argue that it can lead to economic growth, cultural exchange, and improved living standards. Critics, however, point to issues such as economic inequality, cultural erosion, and exploitation as consequences of globalization. Additionally, events like the COVID-19 pandemic have sparked discussions about the vulnerabilities and risks associated with a highly interconnected world.

Overall, globalization encompasses a broad range of interactions and dependencies that shape contemporary society, economy, and culture on a global scale.

3.2 Political arguments for trade restrictions

Like most things in real life, trade is never all good or all evil. There are arguments in favor of opening up foreign markets and promoting international cooperation, but there are also plausible arguments that justify restricting international trade. Very often it is an empirical question as to which line of argumentation dominates.

When politicians and interest groups debate the pros and cons of trade, we must be aware of the unfortunate circumstance that not everything that is plausible is logically correct or empirically dominant. Below I will discuss some plausible arguments in favor of trade restrictions. The list is incomplete. Each argument is a topic in itself, and it needs to be further investigated whether these arguments are really valid arguments in favor of trade restrictions.

3.2.1 The desire to reduce domestic unemployment

As we learned in the previous sections, the domestic production is the result of the world market price in the long-run. However, in the short run this means that production factors need to reallocate from one sector to the other. So far, we assumed that this reallocation happens without any frictions. Thus, we just moved along the PPF curve. In reality the transformation process is costly because the people loose their jobs without finding a job in another sector instantaneously without any costs. In reality a transformation process comes along with costs such as social costs and search and matching costs. Thus, it can be a rational strategy to decrease the reallocation/transformation pressure in order to organize the reallocation of productions factors properly holding the external negative effects of transformation low. Nevertheless, we should not forget that (in the long run) reallocation of production factors and the adaption of new technologies is basically one of the most important sources of welfare growth, if not the only source.

3.2.2 The key enabling technology argument

If domestic industries are fostered, there might be technological spillovers to other industries in the country. As the government internalizes these spillovers, they have an incentive to protect and support these key to growth industries and technologies, respectively.

3.2.3 The need to counteract dumping in international trade

Selling goods in a foreign market below the price charged domestically can be called dumping. This sort of price competition is harmful when foreign producers hamper competition and discourage innovation and upgrading. For example, predatory dumping can give arguments for anti-dumping policy interventions. Predatory dumping is a type of anti-competitive behavior in which a foreign company prices its products below market value in an attempt to drive out domestic competition. This may lead to conditions where the company has a monopoly in a certain product or industry in the targeted market with bad implications for social welfare.

3.2.4 The government revenue argument

Government can finance their budget by raising tariffs.

3.2.5 The national defense argument

National defense is an obviously legitimate goal for any sovereign government and hence, domestic industries that supply goods and services that are important for a potential military emergency should have a special protection.

3.2.6 The wish to decrease the national balance of payments deficit

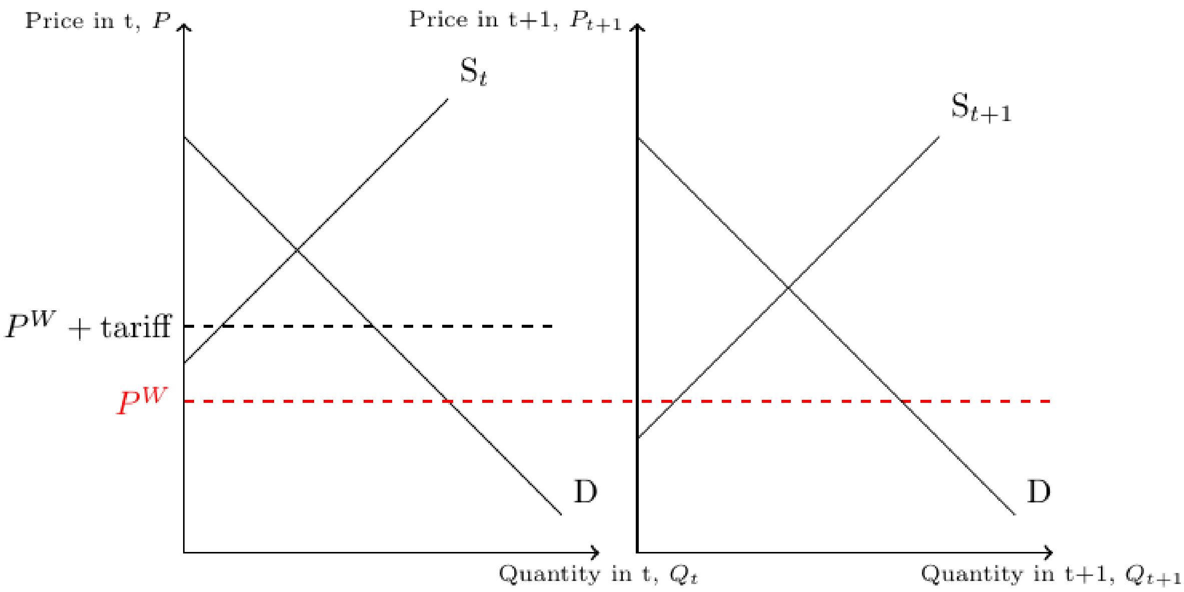
Countries that have a large trade deficit wish – for whatever reason (see Section 10.3}) – to increase import restrictions in order to decrease the export deficit.

3.2.7 The income redistribution argument

As we have learned, trade generates winners and losers and hence is a source for the distribution of wealth. Government can use this knowledge to redistribute income or decrease income inequality. However, it is almost certain that this politic is not the most efficient and best way to achieve the said goals because we have also learned that trade is beneficial for a country as a whole.

3.2.8 The infant industry argument

Figure 3.1: The infant industry argument



The basic idea is that no economic activities will happen in industries in which there are no possibilities to make positive profits because competition from abroad is currently to strong. A finite protection from international competition can make firms to grow and become more productive so that they can face foreign competition after the protection is abolished. The core of the argument is that infant industries do not have economies of scale like competitors from abroad and, hence, need to be protected until they can attain similar economies of scale.

Figure 3.1 provides a visualization that may help to understand the infant industry argument. In the left panel you see that the domestic supply curve lies above the world market price, P^W. Thus, the domestic industry is not competitive enough to produce at costs lower than the world market price. A tariff in time t would protect the domestic market so that some firms start to produce and sell their goods at home. The hope of the government now is that the firms become more productive over time and in turn their supply curve shifts downwards. The downward shifted supply curve in time $t+1$ is shown in the right panel. Here, the government can remove the tariff without crowding out the domestic production.

Exercise 3.1. Arguments for trade restrictions (Solution 3.1)
Explain briefly (2-3 sentences) the infant industry argument.

Solution 3.1. Arguments for trade restrictions (Exercise 3.1)
A finite protection from international competition can make firms to grow and become more productive so that they can face foreign competition after the protection is abolished. The core of the argument is that infant industries do not have economies of scale like competitors from abroad and, hence, need to be protected until they can attain similar economies of scale.

Exercise 3.2. Buy local be happy?

Figure 3.2: Biden and "BUY AMERICAN"

In many countries, including the U.S. (see Figure 3.2), people tend to believe that it is better to buy at home than abroad. A Statement of The White House on July 28, 2021 says:

> "The President believes that when we spend American taxpayers' dollars, it should support American workers and businesses. In his first week in office, President Biden signed Executive Order 14005, Ensuring the Future is Made in All of America by All of America's Workers, launching a whole-of-government initiative to strengthen the use of federal procurement to support American manufacturing.''

There are intuitive reasons to think that way. However, there are also some logical and persuasive arguments that confront that point of view. Please read the following quotes and discuss whether or not buying locally can be a welfare-enhancing strategy.
The first excerpt is entitled with *15 Reasons to Buy American Made Products* and stems from www.buydirectusa.com:

> Next time you are in a store or shopping online look for the Made in USA label. The job you save by doing so could one day be your own!
>
> 1. When you buy American products you support American workers. Existing jobs are saved and more employment opportunities are created.
> 2. When you buy American Made products you support companies that are doing business in America.
> 3. Hundreds of major American corporations are continuing to ship thousands of jobs overseas. Displacing the American worker.
> 4. Since 2000. the United States has lost an incredible 32% of its manufacturing jobs.
> 5. To prevent more of our manufacturing cities all over America from being transformed from thriving communities into crime infested hellholes. What happened to Flint, MI and Camden, NJ can happen in any American city when corporations decide to move production overseas.
> 6. China is now the number one supplier of components that are critical to the operation of US defense systems. Does this bother anyone else?

7. According to the Economic Policy Institute The economy has been unable to create jobs due to America's massive trade deficit.
8. U.S. trade policies encourage businesses to relocate production of goods to other nations without penalizing them for selling those goods back to the United States. This has resulted in millions of lost jobs for the American people.
9. Since 1975, the US has imported more goods than it has exported. In 2010, the US had a deficit of $478 billion in global trade.
10. Over 30 years of trade policies such as NAFTA and CAFTA have taken jobs from the American people.
11. For every $1 billion in goods imported, the economy loses 9,000 jobs.
12. No regulation or safety standards in products made overseas. Chinese-made drywall used in US homes is creating health and safety hazards.
13. Moral implications of the exploitation of foreign workers and violations of child labor laws overseas.
14. Environmental standards are minimal or non existent in how products are made overseas. This has an impact on everyone on the planet.
15. Chinese imports accounted for more than 60% of the recalls announced by the Consumer Product Safety Commission in 2007

UPDATE

16. COVID – Where did that get released from?
17. When you buy products from the CCP, you are helping to fund their military which are a growing threat around the globe.
18. You don't have to swim to get the products you need.

The second quote stems from Federal Reserve Bank of Dallas (2002, p. 16) who try to de-mystify the intuition of the buy local propagandists using a lot of data and some logical arguments of which you can read one here:

> "A common myth is that it's better for Americans to spend their money at home than abroad. The best way to expose the fallacy in this argument is to take it to its logical extreme. If it's better for me to spend my money here than abroad, then it's even better to buy in Texas than in New York, better yet to buy in Dallas than in Houston... in my own neighborhood... within my own family... to consume only what I can produce. Alone and poor."

3.3 Stylized facts on trade openness

While often mentioned in the academic literature and heavily discussed in politics, the term *trade openness* lacks an accepted definition. Mostly it refers to the outward or inward orientation of a given country's economy and touches many things including some measureable indicators such as

- **Volume of trade:** the sum of exports and/or imports (see Figure 3.3)
- **Trade openness:** trade to GDP ratio (see Figure 3.4, and Figure 3.5)
- **Trade policy regime:** tariff profile, border efficiency, ...
- **Openness to FDI:** FDI inflow to GDP, ease of doing business
- **Infrastructure:** logistics performance, communications infrastructure, telephone lines, Internet
- **Political regime:** stability, democratic, open minded, reliable, ...

Figure 3.3: Global sum of exports

Figure 3.4: Export plus imports as a share of GDP

Figure 3.5: Globalization is not a new phenomenon

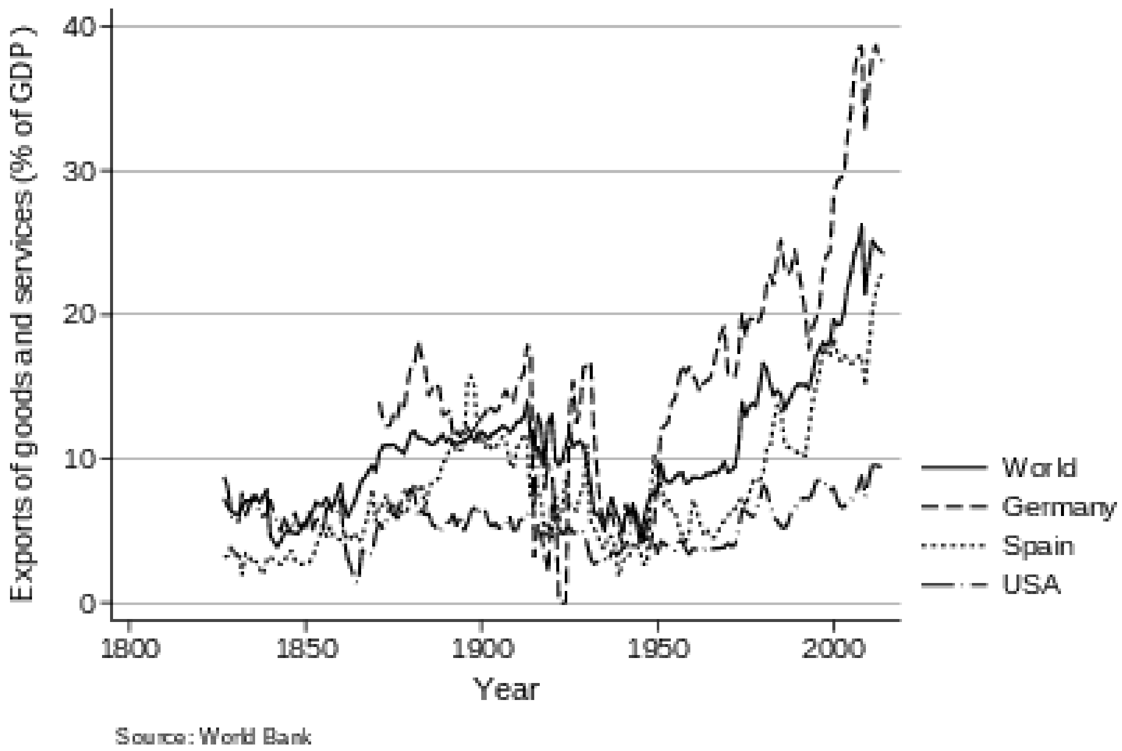


Figure 3.6: Transportation and communication costs

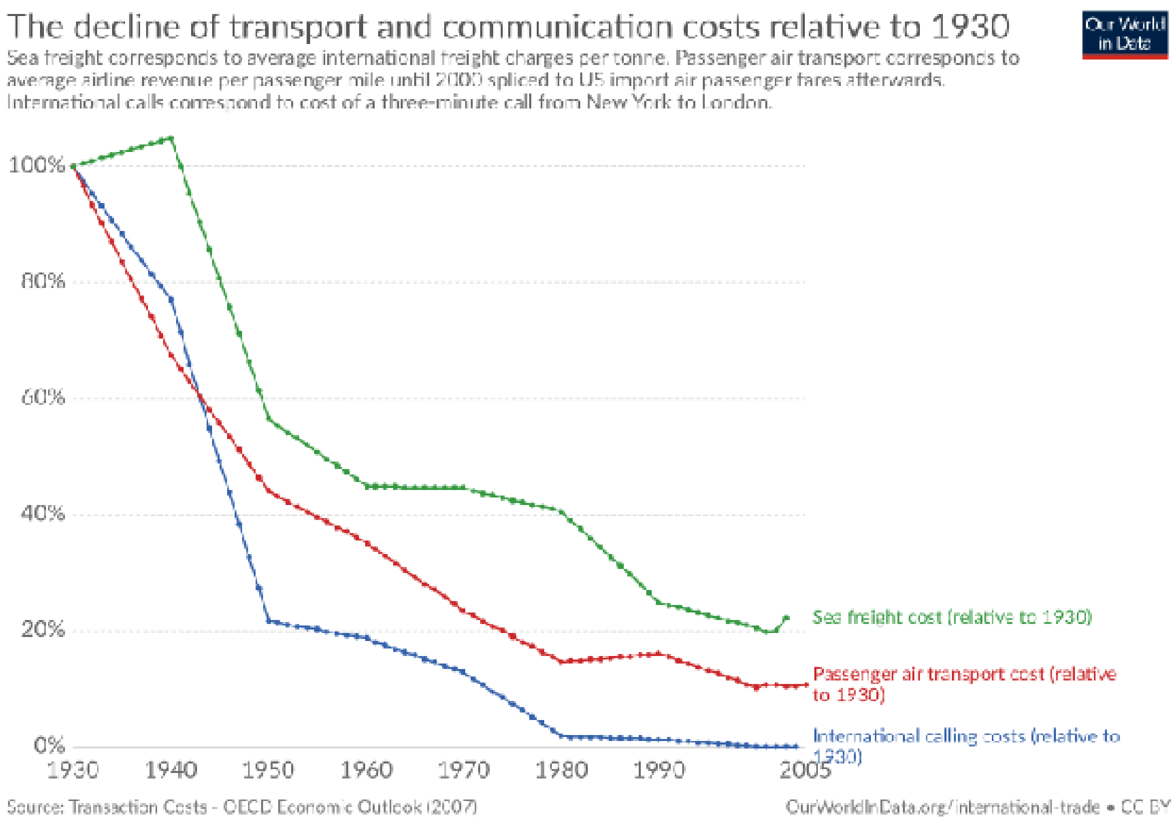
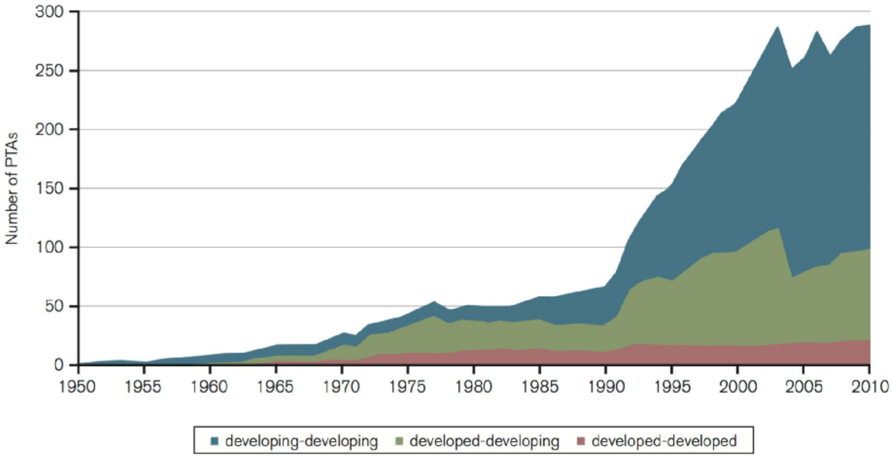
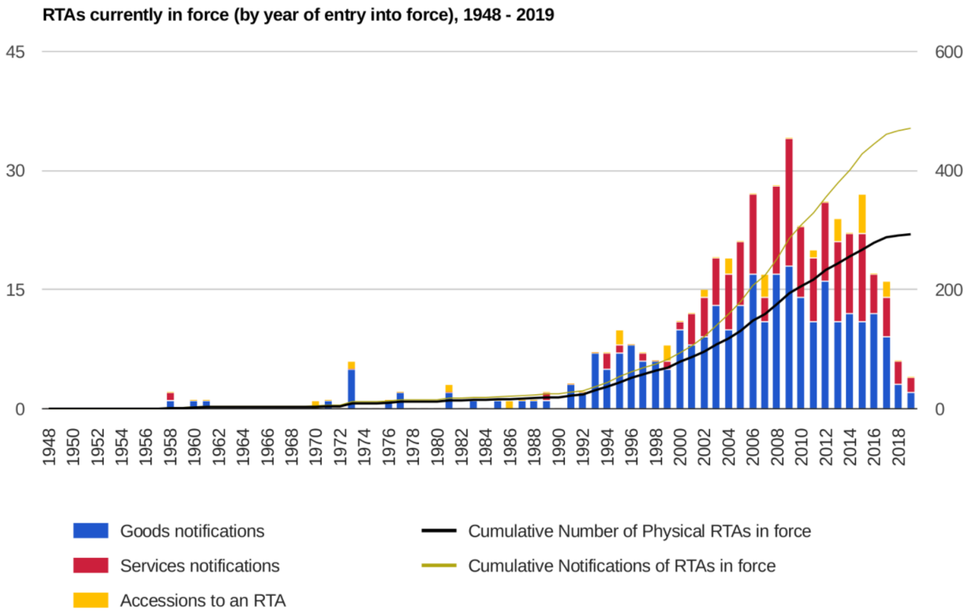


Figure 3.7: Number of Preferential Trade Agreements



Source: WTO Secretariat.

Figure 3.8: Number of Regional Trade Agreements



Source: WTO

Figure 3.9: The Regional Comprehensive Economic Partnership (RCEP)

Leaders and trade ministers of 15 Regional Comprehensive Economic Partnership (RCEP) countries pose for a virtual group photo in Hanoi, Vietnam on Sunday, Nov. 15, 2020.

3.4 Trade anecdotes

3.4.1 The Regional Comprehensive Economic Partnership (RCEP)

The leaders of China and another 14 countries in the Asia-Pacific region (see Figure 3.9) have signed one of the biggest free trade deals in history, covering 2.2 billion people and 30% of the world's economic output. The deal will cover nearly 28% of global trade.

The Regional Comprehensive Economic Partnership (RCEP) was signed over a video link on November 15th after eight years of negotiations.

The deal sets the terms of trade in goods and services, cross-border investment and new rules for increasingly important areas such as electronic commerce and intellectual property. The effect on the trade of finished goods between Asian nations will be particularly marked, analysts have said.

Trade and investment flows within Asia have vastly expanded over the past decade, a trend that has accelerated amid feuding between the US and China, in which the two superpowers have imposed billions of dollars' worth of punitive tariffs on each other's exports.

Unlike the CPTPP – the Comprehensive and Progressive Agreement for Trans-Pacific Partnership – and the EU, it does not establish unified standards on labor and the environment or commit countries to open services and other vulnerable areas of their economies.

Donald Trump in 2017 pulled out of the Trans-Pacific Partnership, a deal previously envisaged as a way of curbing China's influence.

3.4.2 Trade dispute between the USA and the European Union

ℹ Watch: Trade wars: How they work and who they impact

In June 2018, the U.S. government imposed tariffs on € 6.4 billion worth of European steel and aluminum exports, followed by additional tariffs in January 2020 affecting approximately € 40 million worth of EU exports of certain steel and aluminum derivatives. The EU imposed countervailing measures on € 2.8 billion worth of U.S. exports to the EU in June 2018 (a similar EU response followed the second set of U.S. tariffs in 2020). The remaining countervailing measures, affecting up to € 3.6 billion worth of exports, were scheduled to take effect on June 1, 2021. The EU suspended these measures until December 1, 2021, to allow the parties to work together on a longer-term solution. Following today's announcement by the U.S., these measures will not be imposed. (see European Commission, 2021)

Figure 3.10: Biden and von der Leyen on G20 leaders' summit in Rome, October 31

Source: REUTERS/Kevin Lamarque

In November 2021, President Biden has signed a deal to end tariffs on steel imports from the EU, which were imposed by his predecessor Donald Trump. But the agreement does not cover exports from the UK, putting British steelmakers at a disadvantage as is discussed in an article of the BBC, see *UK steel makers 'left behind' as US ends trade war*.

3.4.3 Boeing vs. Airbus

Boeing has continually protested over launch aid in the form of credits to Airbus, while Airbus has argued that Boeing receives illegal subsidies through military and research contracts and tax breaks. All that yielded litigation at the WTO and a series of decisions that allowed (trade) penalties of both sides.

For example, on 2 October 2019, the WTO approved US tariffs on $7.5 billion worth of European goods, and officially authorized them on 14 October, despite the European Union urging for a negotiated settlement. On 30 September 2020, however, the WTO approved the European Union's retaliatory tariffs on $4.1 billion worth of US goods, this is in addition to the previous unimplemented sanction allowing the EU the right to impose tariffs of up to $8.2 billion on US goods and services

This is a trade war where nobody will probably be better of in the end. For more details on this dispute, I recommend reading the Wikipedia entry.

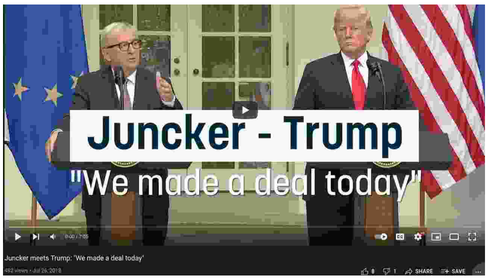
On June 15, 2021, the U.S. and the EU achieved a major breakthrough in the trade dispute between Boeing and Airbus, agreeing to end the 17-year dispute. All tariffs were suspended for five years.

3.4.4 Trump vs. the European Union (a.k.a. Jean-Claude Juncker)

Under president Trump, United States imposed tariffs on goods such as cars, olives, single malt whiskey, pecorino cheese, and wine. The EU, in turn, has raised tariffs on goods such as orange juice, bourbon, peanut butter, power boats, and Harley-Davidson motorcycles. This escalation was brought to a halt on July 25, 2020, Jean-Claude Junker and Donald J. Trump met at the White House to discuss the ongoing trade dispute, see Figure 3.11. They announced that the United States and the European Union would work to reduce tensions created by Trump's confrontational trade policies in the past. Before that meeting they made their standpoints clear as paraphrased below.

> Donald J. Trump wrote via Twitter on March 3, 2018:
>
> > "The United States has an $800 Billion Dollar Yearly Trade Deficit because of our very stupid trade deals and policies. Our jobs and wealth are being given to other countries that have taken advantage of us for years. They laugh at what fools our leaders have been. No more!"

Figure 3.11: Juncker and Trump made a deal



Jean-Claude Juncker said on March 2 (see euronews.com):

> "So now we will also impose import tariffs. This is basically a stupid process, the fact that we have to do this. But we have to do it. We will now impose tariffs on motorcycles, Harley Davidson, on blue jeans, Levis, on Bourbon. We can also do stupid. We also have to be this stupid."

Donald J. Trump wrote via Twitter on March 3, 2018:

> "If the E.U. wants to further increase their already massive tariffs and barriers on U.S. companies doing business there, we will simply apply a Tax on their Cars which freely pour into the U.S. They make it impossible for our cars (and more) to sell there. Big trade imbalance!"

3.4.5 Trump and his trade war with China

Donald J. Trump said in his 2016 presidential campaign, see time.com:

> *"We allowed foreign countries to subsidize their goods, devalue their currencies, violate their agreements and cheat in every way imaginable, and our politicians did nothing about it. Trillions of our dollars and millions of our jobs flowed overseas as a result. I have visited cities and towns across this country where one-third or even half of manufacturing jobs have been wiped out in the last 20 years. Today, we import nearly $800 billion more in goods than we export. We can't continue to do that. This is not some natural disaster, it's a political and politician-made disaster. Very simple. And it can be corrected and we can correct it fast when we have people with the right thinking. Right up here. [. . .] To understand why trade reform creates jobs, and it creates a lot of them, we need to understand how all nations grow and prosper. Massive trade deficits subtract directly from our gross domestic product. From 1947 to 2001, a span of over five decades, our inflation-adjusted Gross Domestic Product grew at a rate of 3.5 percent. However, since 2002, the year after we fully opened our markets to Chinese imports, the GDP growth rate has been cut in half. [. . .] A Trump administration will change our failed trade policies, and I mean quickly."*

I don't want to go into details about the trade disputes of China and USA. A concise and continually revised overview is offered by Wikipedia.

The following charts show the trade surplus/deficit (exports minus imports) for the USA, China, Russia, and Germany. The data were downloaded on 15th of June 2022 from tradingeconomics.com.

Figure 3.12 indicates that Trump was not successful in reducing the trade deficit. Overall, it seems to be the case that trade wars are not that easy to win as he claimed. It is rather difficult to impact the trade deficit within some years. Moreover, it is almost impossible to create more jobs that are lost and boost the economy with starting trade disputes.

For those who are interested: Here is a well researched article about that topic by Ryan Hass and Abraham Denmark, entitled *More pain than gain: How the US-China trade war hurt America*.

Exercise 3.3. Balance of payments across countries
Figure 3.13 shows the balance of trade over time for China, Russia, and Germany. Discuss the impact of COVID-19 on the balance of payments over time across the three countries.

Figure 3.12: Balance of trade of the U.S. over time

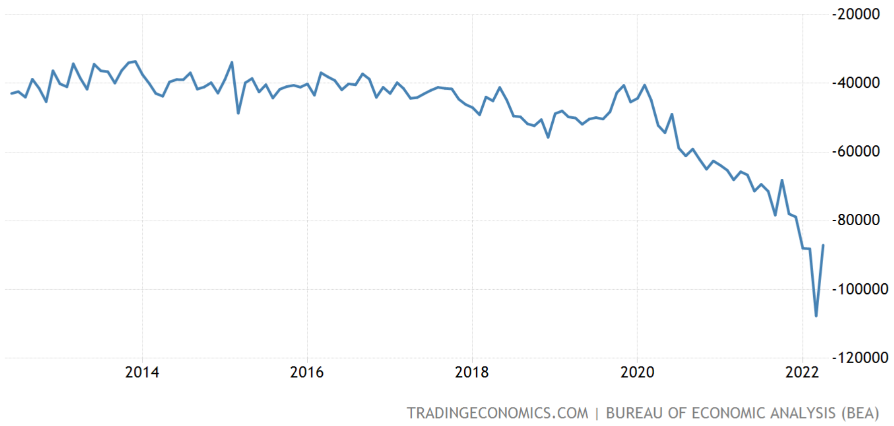
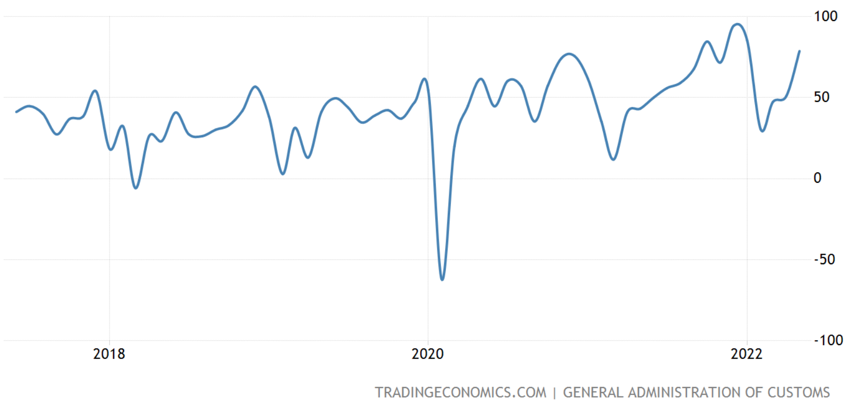
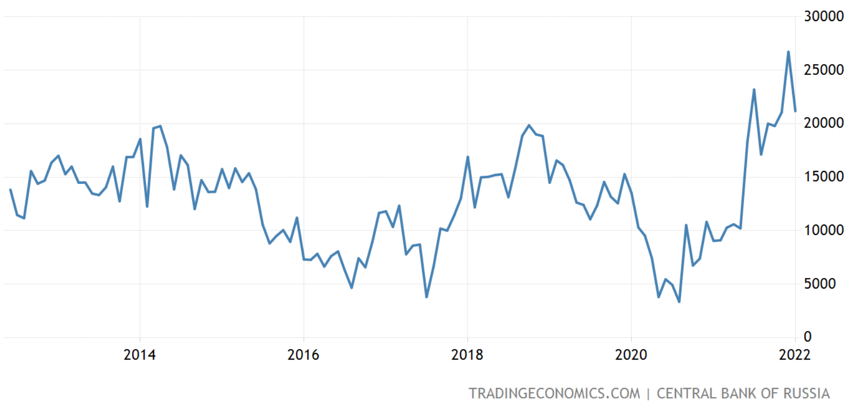


Figure 3.13: Balance of trade of China, Russia, and Germany over time

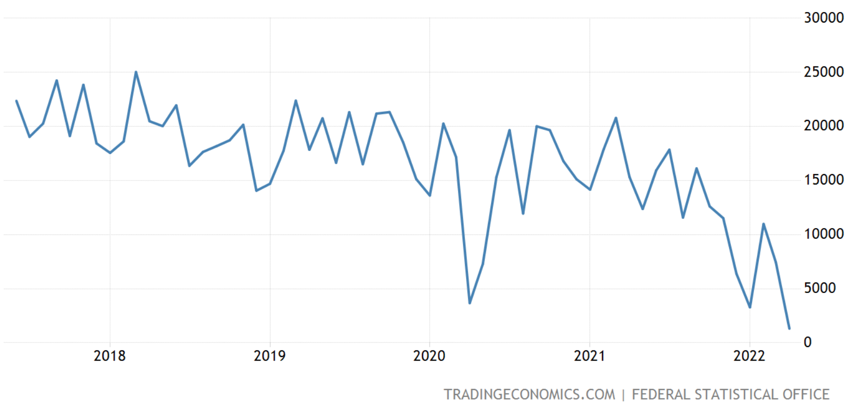
(a) China: Balance of trade



(b) Russia: Balance of trade



(c) Germany: Balance of trade



Exercise 3.4. Trump complains about the WTO

a) In an bloomberg interview Donald Trump said:

"I called NAFTA the second-worst trade deal ever made. I would say the WTO was the single worst trade deal ever made.
And if they don't shape up, I would withdraw from the WTO. We rarely won a lawsuit except for the last year. You know, in the last year, we're starting to win a lot. You know why? Because they know if we don't, I'm out of there. I'll take them out."

Discuss the legal constitution of the WTO and whether Donald Trump is right when he claims that other countries treat the United States unfair. Thereto, I recommend the article Why Trump's wrong about WTO treating US unfairly from Kucik (2018).

b) WTO members are not permitted to increase import tariffs without justification. An exception to this rule, however, is given when the *national security* of a nation is at risk. On this basis (which has been challenged within the WTO by several nations, including Canada), U.S. President Trump has issued executive orders imposing import tariffs on steel and aluminum imports for a set of different countries. Discuss whether this behavior can be considered as fair.

Solution

a) Trump's claims are difficult to assess because it is unclear what he means by fairness or how to define fairness in trade relations in general.
When referencing WTO rules, U.S. policy is far from a model of fairness to others, as too many countries have sued the U.S. for its discriminatory policies. Although he is wrong in his claim that the U.S. has "rarely won a lawsuit, with the exception of last year" (the U.S. win rate is similar to the average win rate), the U.S. is the country that has sued other members more often than any other country.

b) Imposing and increasing tariffs based on the exception rule could irreparably damage the WTO's authority to adjudicate trade disputes. This is because U.S. trade representatives contend that the WTO does not have the authority to mediate national security issues and should simply issue a ruling that the matter is not within the WTO's jurisdiction. This argument puts a gun to the WTO's head. If the WTO's Dispute Settlement Body follows this line of reasoning, any country could easily impose tariffs in the future, citing *national security*, without the WTO being able to judge whether or not the issue is truly one of national security. This reminds (me) of the Mexican standoff, that is, a confrontation between three or more parties in which there is no strategy that allows one party to win.

Exercise 3.5. Please read the following article "What's behind Trump's trade war?" by Derviş & Conroy (2018) and reflect on the arguments presented by the two authors. Do you comprehend their points in light of everything you've learned in the course so far? If anything is unclear, please specify what you find confusing.

What's behind Trump's trade war?

Derviş & Conroy (2018):

"*Donald Trump's justifications for his aggressive trade policy – that it will reduce the US current-account deficit and save vulnerable American industries – do not withstand scrutiny. At the heart of Trump's trade war is an impulse to free American power from the supposed shackles of multilateralism.*
WAHINGTON, DC – Since World War II's end, trade has grown 50 percent faster than global GDP, owing largely to successive rounds of liberalization under the auspices of the World Trade Organization (previously the General Agreement on Tariffs and Trade, or GATT). But now, U.S. President Donald Trump's latest dose of import tariffs could push the world into a full-blown trade war, undoing much of that progress.
Proponents of free trade have always celebrated the growth of international commerce because they regard it as a sign that countries are capitalizing on their comparative advantages through specialization, which implies increased efficiency overall. By contrast,

critics of free trade worry that it might lock poor countries into producing goods that offer little room for productivity growth, and point out that even if there are aggregate gains from globalization, there are also clear losers.

In fact, few would disagree that a static comparative advantage theory is a poor guide for development policy. A more dynamic framework is needed to determine whether trade also brings knowledge and learning to new markets. If it does, then it can be an engine of future economic growth and social progress.

Overall, there is overwhelming evidence that trade has indeed enriched developing countries where supportive policies have been in place. Over time, developing countries have learned to complement trade policies with higher investment in infrastructure and education. But with the world trading system now under assault by the United States, the question for developing countries is how to respond.

To justify his tariffs, Trump points to America's bilateral (or multilateral) trade deficits with its trading partners. But while tariffs can change the composition of trade flows, they will have little bearing on the current-account balance, which is determined by national savings and investment. If savings fall short of investment—as they do in the U.S.—the current account will necessarily be in deficit.

To be sure, tariffs can have an incidental effect on the current-account balance. As a tax on domestic consumers and a subsidy for certain domestic producers, tariffs reduce consumers' disposable income and augment capital income. To the extent that more capital income is saved relative to labor income, tariffs will increase the economy's overall savings rate. Nevertheless, this effect on the savings-investment balance is both weak and indirect.

At the micro level, Trump might argue that tariffs are necessary to protect particular sectors. But many of the goods imported into the U.S. actually contain intermediate inputs that were originally produced domestically (this is even more the case for China). So, to determine whether tariffs are actually protecting the value added-wages and profits in a particular U.S. sector, one must also account for the U.S. value added within imports that are now facing levies. Assuming that Trump's advisers have explained these complications to him, one wonders what his real rationale is.

While Trump's desire to prop up politically important industries and reduce the U.S. current-account deficit has certainly played a role in his trade policy, it is clear that his main target is the WTO and the multilateralism that it represents. Trump seems to think that multilateralism dilutes American power, given that the U.S. can always use its economic and geopolitical clout to win a bilateral dispute. What he doesn't realize is that even the world's most powerful country still needs impartial global rules and disinterested institutions to oversee them.

Over the past 70-odd years, the GATT/WTO system has developed into a multilateral arrangement whereby the same rules apply to all countries alike. That is not to say that bigger and richer countries lack advantages over smaller and poorer countries. Countries like the U.S. can allocate more staff and specialists to support their own producers in complicated trade negotiations, while also pursuing parallel (back-channel) diplomacy. Legally, however, the WTO is a grouping of equals. The "most favored nation" provision means that an advantage extended to one country's producers must be extended to all.

Perhaps most important, the WTO has a dispute-settlement mechanism (DSM) that provides for the timely resolution of disagreements between member states. Though the U.S. has won most of the cases that it has brought before the WTO's arbitration panel, it has also lost some. With the ability to hand down binding judgments, the DSM is a unique feature of the WTO system. No other multilateral body has such a mechanism.

There are many ways that the multilateral system could be improved, of course. The WTO, the World Bank, and the International Monetary Fund should be devising new approaches to address the growing influence of Big Tech; and competition policy needs to be brought into the twenty-first century. It might also be appropriate for the WTO to adopt a form of weighted voting, similar to the procedure used by the IMF and World Bank.

As for the criticism that globalization produces both winners and losers, this is not an argument against trade; it is an argument for policies to compensate those who have been left behind. On that basis, those who have rightly criticized the WTO in the past should join forces with its supporters. Both sides have an interest in defending this key institution of

> *global governance from the xenophobic unilateralism embodied by Trump's policies."*

3.5 Gains from trade

Figure 3.14 and Figure 3.15 contain domestic supply and demand curves. In autarky with no possibilities to trade, supply and demand must meet. Under free trade and a given world market price, P^W, countries can trade with each other. This has implications for the producer surplus (yellow area) and the consumer surplus (blue area), as shown in the figures. The area of the triangles a and b as denoted in Figure 3.15 represents the welfare gain from free trade that can be achieved given the world market price, P^W.

Figure 3.14: Two countries in autarky

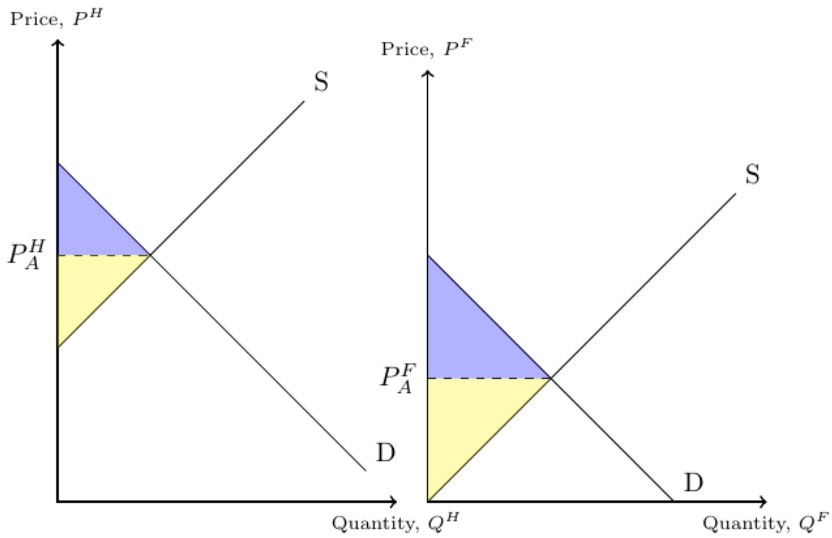
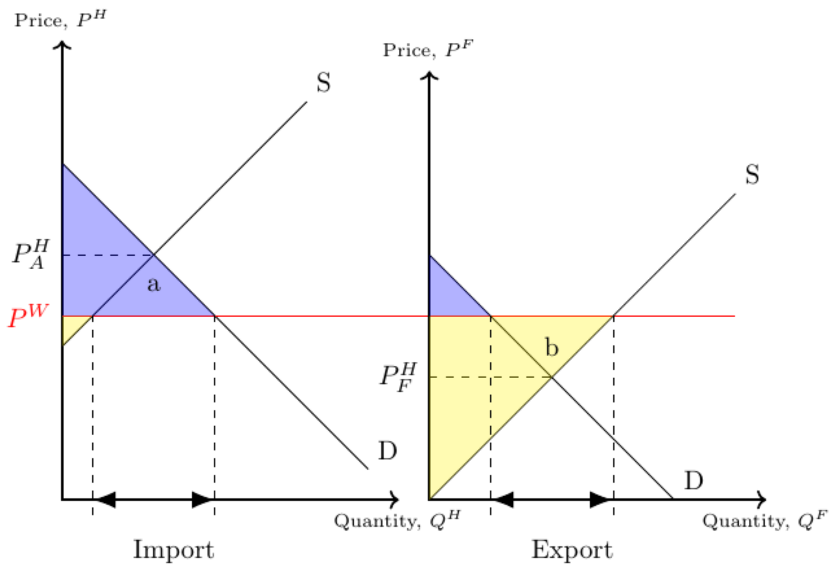


Figure 3.15: Two countries that trade with each other

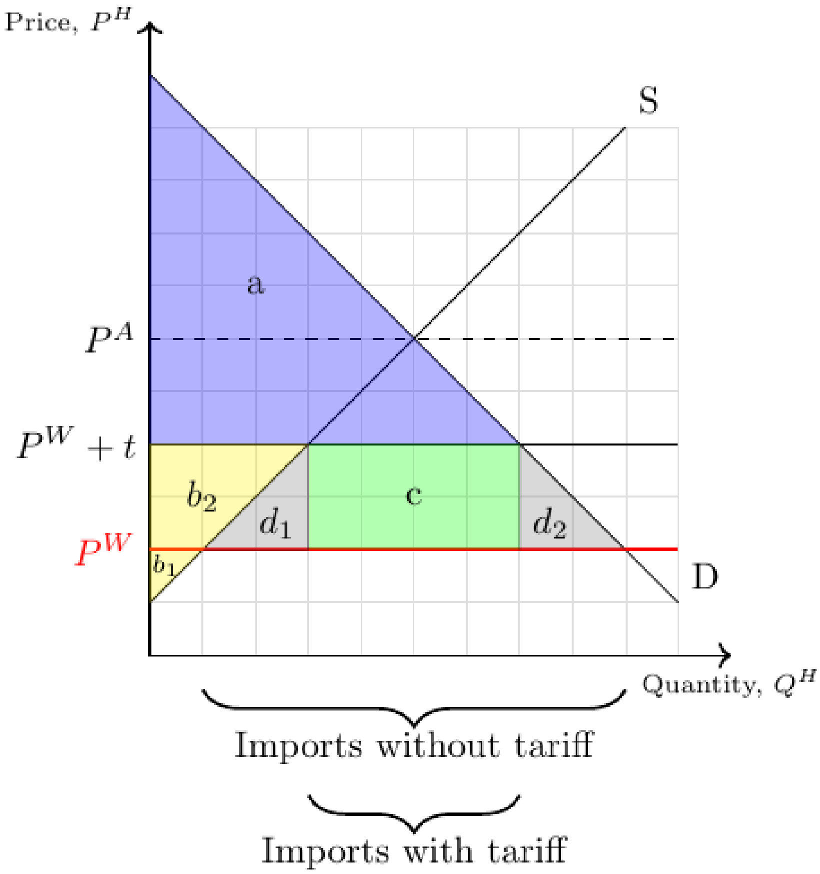


3.6 Tariffs in small open economies

Figure 3.16 can teach us a lot about the impact of a tariff t on trade and welfare. A tariff raises the domestic price of imported goods. If we assume that the imposition or change of a country's tariff has no effect on the world price, we consider what is called a small open economy, which is so small that the country's consumption and production decisions do not affect the world price. In other words, the country takes the world price for granted because its import demand does not change the world price.

In autarky, the economy represented in Figure 3.16 would consume 5 units at price P^A. Under free trade without tariffs, the country imports 8 units and consumes 9 units at the price of P^W. The consumer surplus corresponds to areas $a + b_2 + d_1 + c + d_2$ and the producer surplus corresponds to area b_1. After the introduction of tariff t, the consumer surplus is equal to area a and the producer surplus is equal to area $b_1 + b_2$. Thus, consumer surplus has decreased while producer surplus has increased. The area c is equal to the government's revenue. It represents the portion of the consumer welfare loss that is transferred to the government. Overall, welfare has decreased. The welfare loss is equal to the areas of the two triangles d_1 and d_2. These triangles represent what is called the *deadweight loss* due to the tariff. Specifically, triangle d_1 represents the reduction in imports that is replaced by domestic production, and triangle d_2 represents the loss in consumption due to a reduction in imports and a reduction in domestic consumption.

Figure 3.16: Tariff in a small open economy



The implications of a tariff in a small economy

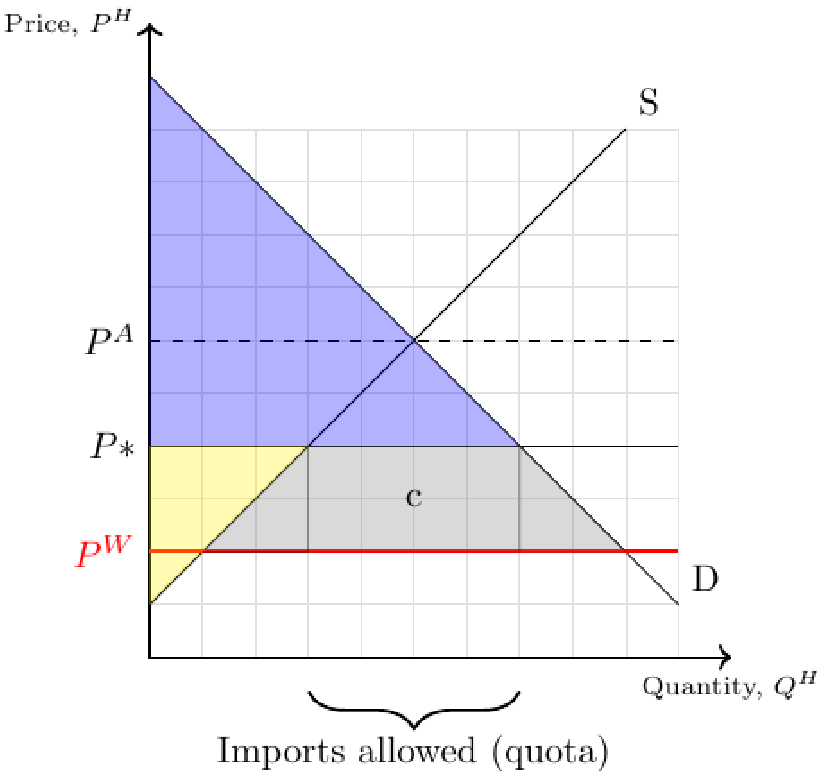
While a tariff protects domestic producers and increases their surplus, it reduces the surplus of consumers and leads to a deadweight loss of revenue. Overall, a tariff leads to a reduction in a country's welfare.

3.7 Quotas in small open economies

A trade restriction that sets a physical limit on the quantity of a good to be imported is called an import quota. It gives government officials more power and control than a tariff because they can strictly limit the quantity of goods traded and have the administrative authority to grant (or sell) import licenses to certain foreign exporters.

Figure 3.17 shows the impact of an import quota that allows an import quantity of 4 units. In this scenario, 7 units are consumed, four of which are imported. The price at which all seven units are consumed is $P*$. This is somewhat surprising because the world price P^W is less than P^*. The reason is that all firms that are allowed to sell their products do so at the highest possible price, that is, P^*. As above, the blue area is the consumer surplus and the yellow area is the producer surplus. The gray area is the loss in value due to the import rate. The rectangle c is only part of this loss, since we assume that the government does not sell the licenses to the best bidding exporting firm

Figure 3.17: Tariff in a small open economy



3.8 Tariffs in large open economies

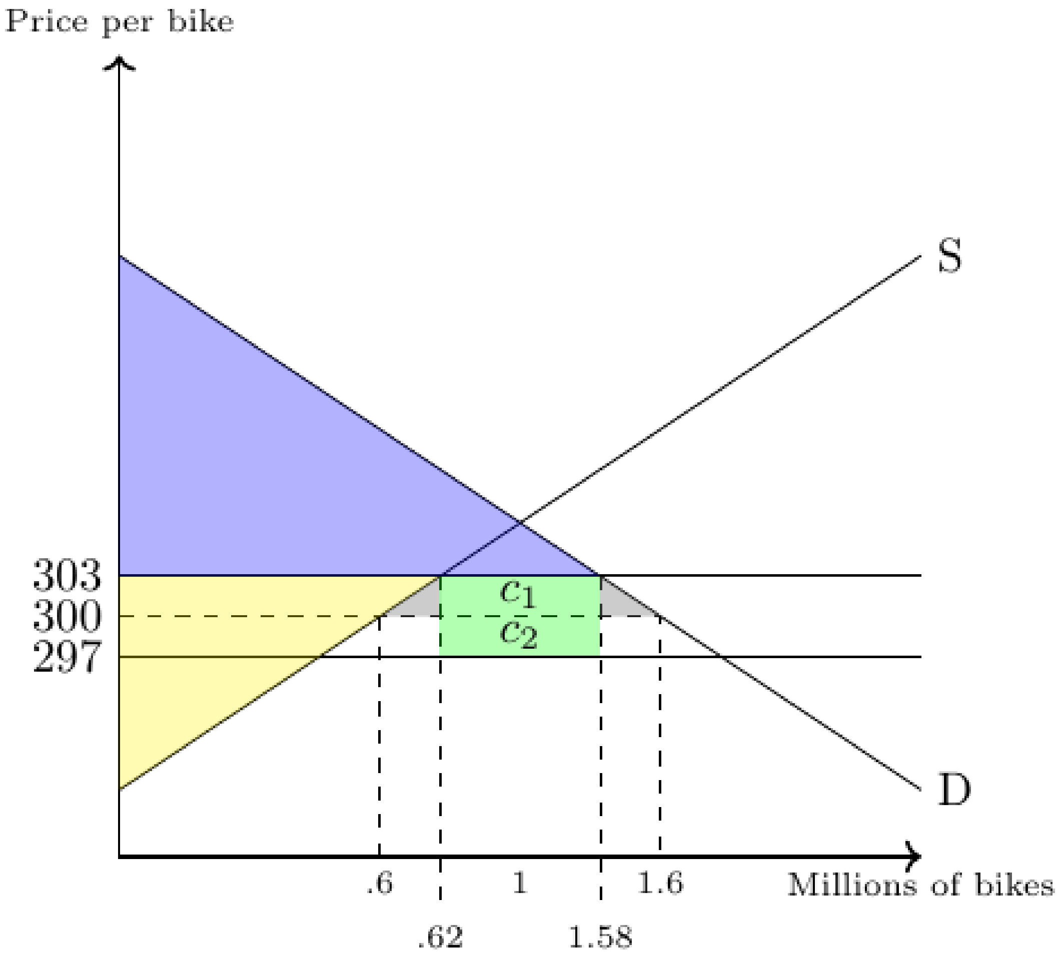
So far, we have assumed that the country of interest is small and takes the world market price as given. However, large countries' demand for imported goods can have an impact on world prices. If this is the case, we can show that a tariff can actually improve a country's welfare. Figure 3.18 illustrates the effects of a tariff on welfare, prices, and trade. In particular, we show the impact of a small tariff of 6 euros per bicycle.

Under free trade, the market for bicycle imports is cleared at a price of €300 and the country imports one million bicycles.

Now, if a tariff of 6€ per bicycle is imposed, the tariff drives a wedge between the price foreign exporters receive and the price domestic buyers of imports pay. That is, it becomes more expensive for domestic buyers to purchase imported bicycles. This, in turn, leads to an immediate drop in domestic demand for bicycles and pushes the world market price for bicycles to €297 Given the new world market price for bicycles, the domestic price for imported bicycles is €303 (297+6).

The consumer surplus is now represented by the blue area and the producer surplus by the yellow area. The green area represents the tariff revenue collected by the government. The two gray triangles, in turn, show the tariff-related deadweight losses. Compared to the free trade scenario, the country gains

Figure 3.18: The effect of a tariff in a large country



rectangle c_2. If the revenue in this area is greater than the deadweight loss, the country has improved its overall welfare by imposing a tariff.

Let us calculate whether this is the case here:

- Area c_2:
$$(1.58 \text{ million bikes} - 0.62 \text{ million bikes}) \cdot (€300 - €297) = €2.88 \text{ million}$$
- Deadweight loss:
$$\underbrace{\frac{(0.62 \text{ mio b.} - 0.6 \text{ mio b.}) \cdot (€303 - €300)}{2}}_{\text{left triangle}} + \tag{3.1}$$
$$\underbrace{\frac{(1.6 \text{ mio b.} - 1.58 \text{ mio b.}) \cdot (€303 - €300)}{2}}_{\text{right triangle}} \tag{3.2}$$
$$= €0.06 \text{ million} \tag{3.3}$$
- Indeed, the net gain is €2.82 million. Thus, a small tariff can increase the welfare of a country.

3.9 Other nontariff trade barriers

In addition to tariffs, there are a variety of other trade barriers. These so-called non-tariff barriers (NTBs) include quotas, export subsidies, domestic production subsidies, government buy-at-home policies, and product standards. Here is a more complete list:

- Import quotas
- Voluntary export restraints
- Antidumping laws
- Exchange-rate controls
- Countervailing duties
- Government subsidies
- Licensing, labeling and packaging restrictions
- Quality controls and technical standards
- Domestic-content laws
- Political rhetoric
- Embargoes and sanctions
- Most/least-favored nation status

For example, **product standards** are much more important than you might think. For example, no car from the United States can be sold in the European Union without modifications because our safety standards are different. Another example is the CE marking (see below). Harmonization of product standards is usually an important issue in trade agreements.

CE Marking

Figure 3.19: The CE marking

The CE marking shown in Figure 3.19 is one example for a non tariff trade barrier. It is not an abbreviation for *China Export*, as many believe. While CE is sometimes indicated as an abbreviation of *Conformite Europeenne* (French for *European Conformity*), it is not defined as such in the relevant legislation. The mark indicates that the product may be sold freely in any part of the European

Economic Area, irrespective of its country of origin. The CE marking is a declaration by the manufacturer (not by some authority!) that the product complies with EU standards for health, safety and environmental protection for products sold within the European Economic Area (EEA). Thus, it is not a quality indicator or a certification mark and may also be found on products sold outside the EEA. You may also know the _FCC Declaration of Conformity} which is used for selling certain electronic devices in the United States.

Exercise 3.6. Tariff (Solution 3.2)
Referring to Figure 3.20, the government of a large country needs your help to decide whether the introduction of a tariff of $100 per metric ton of on steel is a good idea, or not. At the current world market price of $p^W = 600$\$, the country imports 14 millions metric tons of steel. The government expects that a tariff of $100 per ton of steel would decrease the world market price of steel for $1.

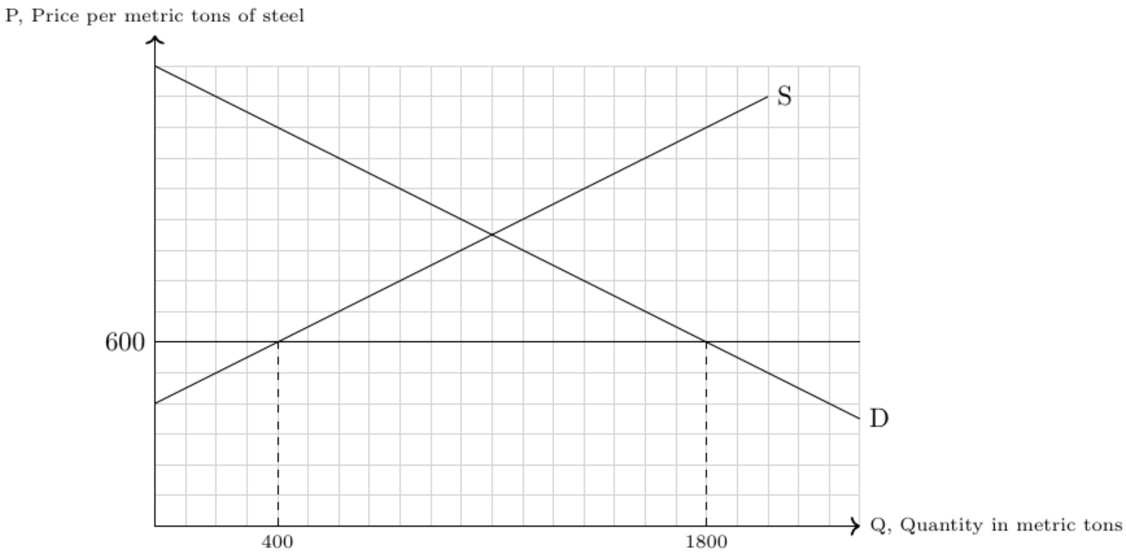
a) Calculate how much the overall welfare gain (or loss) of the country would be in case the government decides to introduce a tariff of $ 100 per ton of steel. Assume thereby that the supply curve is given by
$$P^s = 400 + \frac{1}{2}Q^s$$
and the demand curve is given by
$$P^d = 1500 - \frac{1}{2}Q^d.$$
These curves are also shown in the figure below.

b) What would be the tariff so high that it makes an import of steel prohibitively expensive.

c) What would be the world market price so low that it makes any domestic production unprofitable.

d) What would be the world market price so high that the country exports steel.

Figure 3.20: Exercise: Tariff



Solution 3.2. Tariff (Exercise 3.6)

a) By analogy with Figure 3.18, here we should compare the two gray triangles with area c_2.

The price per metric ton of steel from foreign suppliers will be $699 because government will charge $100 on each ton of steel which is now worth $599 on world markets. As $699 is still below the autarky price of $950, domestic suppliers will set prices to be equal to $699. Thus,

$$\begin{aligned}699 &= 400 + \frac{1}{2}Q^s \Leftrightarrow Q^s = 598\\ 699 &= 1500 - \frac{1}{2}Q^d \Leftrightarrow Q^d = 1602\\ 1602 - 598 &= 1004\end{aligned}$$

That means, at a price of $699 domestic supply is 598 and domestic demand is 1602 tons of steel. 1004 tons will be imported.
To calculate the *welfare loss* (the two triangles), we can calculate the left triangle only and double it (please note that this is only possible if both triangles really have the same size which is only the case if both supply and demand curves have the same slope in absolute terms!):

$$\begin{aligned}&\overbrace{\left(\underbrace{(598-400)}_{\text{loss in quantity}} \cdot \underbrace{\frac{1}{2}}_{\text{to get the triangle}} \cdot \underbrace{(699-600)}_{\text{increase in price}}\right)}^{\text{left triangle}} \cdot \overbrace{2}^{\text{right triangle is of same size}}\\ &= 9801 \cdot 2\\ &= 19602\end{aligned}$$

The welfare gain (the new square that is due to the change in world market price, a.k.a. c_2) is

$$1004\text{tons} \cdot 1 \left[\frac{\$}{\text{tons}}\right] = 1004\$.$$

Thus, overall welfare gain is

$$1004 - 19602 = -18598.$$

That means, the welfare loss exceeds the welfare gain by $ 18598.
b)

$$\begin{aligned}400 + \frac{1}{2}Q &= 1500 - \frac{1}{2}Q\\ \Leftrightarrow Q &= 1100\\ P^s &= 400 + \frac{1}{2} \cdot 1100\\ P^s &= 950\end{aligned}$$

At a price above $950, no steel would be imported. Thus, a tariff must be so high that the price of foreign steel within the country exceeds $950, that is, $P^W + t > 950$. Assuming that the world market price would have a lower bound of $599, that is, any tariff above $100 would not decrease the world market price any further, a tariff of $351 (950-599=351) would make imported steel prohibitively expensive.

c) Below a price of $400 any domestic production would be unprofitable because the supply curve tells us that no domestic producer would be able to supply anything at and below the price of $400. To proof that just set $Q^s = 0$ in the function of the supply curve and you get $P^s = 400$.

d) At a world market price above $950, it would be profitable to export steel because domestic supply exceeds domestic demand and the world market price is higher than the production costs.

Part II

INTERNATIONAL TRADE

Chapter 4

Monetary international economics

Students learn to...

- ...interpret exchange rates and relate their changes to the relative prices of countries' goods.
- ...predict the impact of exchange rate changes on business decisions and national economies.
- ...understand the linkage between interest rates and inflation in open economies.
- ...explain the interest rate parity condition and the purchasing power parity assumption.
- ...interpret and evaluate the balances of trade and

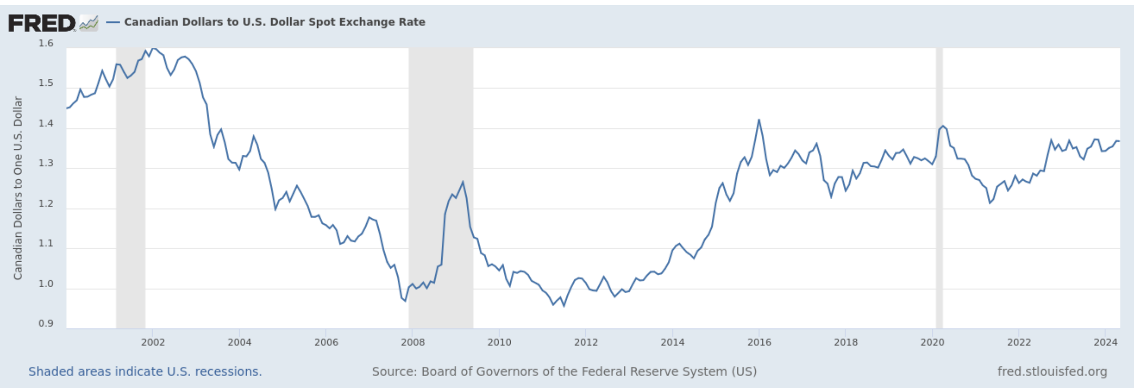
4.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 4.1. Exchange rates over time

Figure 4.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
   a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\ \text{USD} \cdot 1.6 \frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} \approx 2318.84\ \text{USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.
   i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.
   ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\ \text{USD} \cdot 1.38 \frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\ \text{CAD}.$$

Finally, you convert the CAD back to USD
   i) at the rate 1.38 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} = 1020\ \text{USD}.$$

   ii) at the rate 1.42 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.42} \frac{\text{USD}}{\text{CAD}} \approx 991.27\ \text{USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 4.2. Our relations are not good

Figure 4.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a "strong" Turkish Lira and a "weak" Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump's decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

4.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn't a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of "it depends" arguments because it is challenging to make convincing cases based on intricate relationships.

[1] The total value added of a country in a given period

[2] The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency

[3] The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.
- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

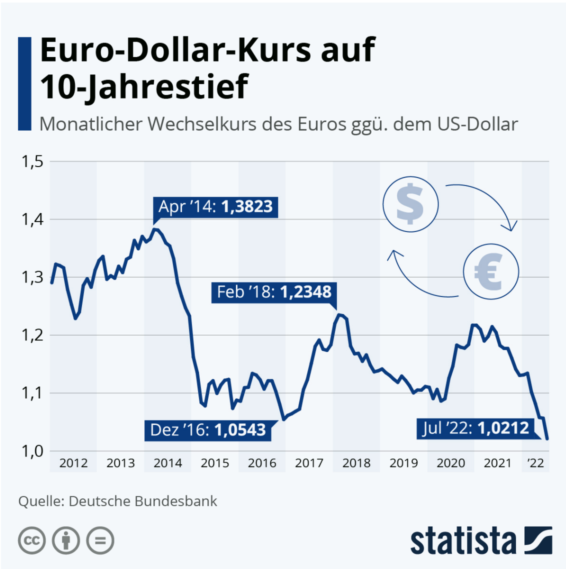
Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

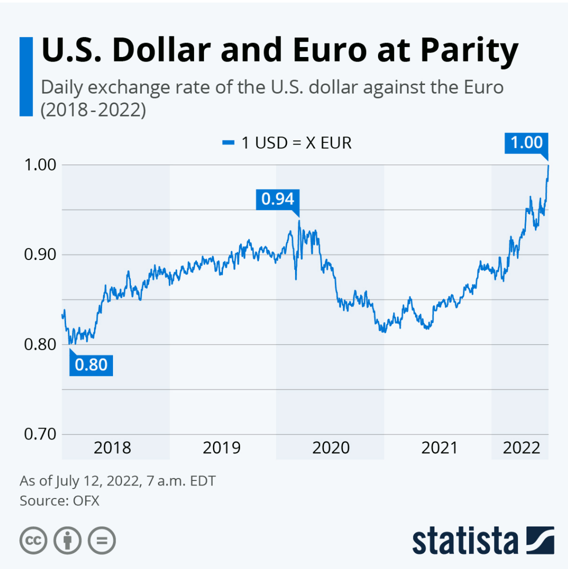
Exercise 4.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 4.3: Euro to Dollar

(a)



(b)



(c)

(d)

Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)
$$E^{€}_{\$} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 4.4. Exchange currencies
Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.
b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.
c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?
d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:
$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:
$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:
$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:
$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

4.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **Relative prices**
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{₺}{€}} = E^{\frac{€}{₺}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 4.4: One wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 1\frac{₺}{€} = 1₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1₺ \cdot 1\frac{\text{wine}}{₺} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{₺}} = 0.5$ and $E^{\frac{₺}{€}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 4.5: Two wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 2\frac{₺}{€} = 2₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2₺ \cdot 1\frac{\text{wine}}{₺} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **Exchange rates and relative prices**
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

4.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

4.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 4.6: *Who wins in the end?*

Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers.*"

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

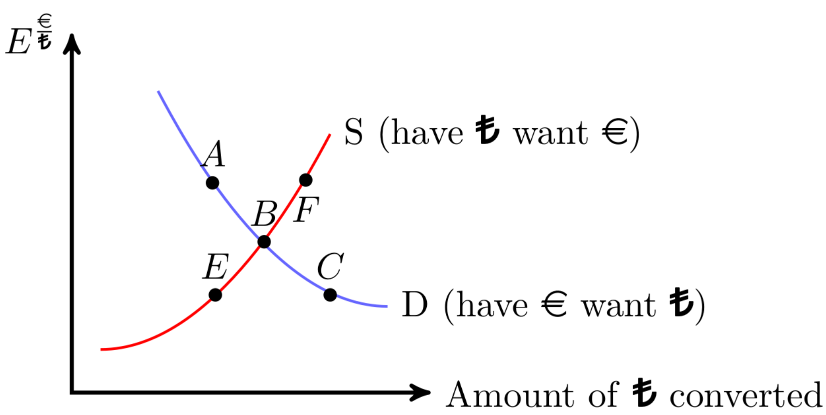
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

4.1.5 The FOREX

4.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 4.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{€}{₺}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{€}{₺}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{€}{₺}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{€}{₺}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 4.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

4.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 4.8: Players on the foreign exchange market

4.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

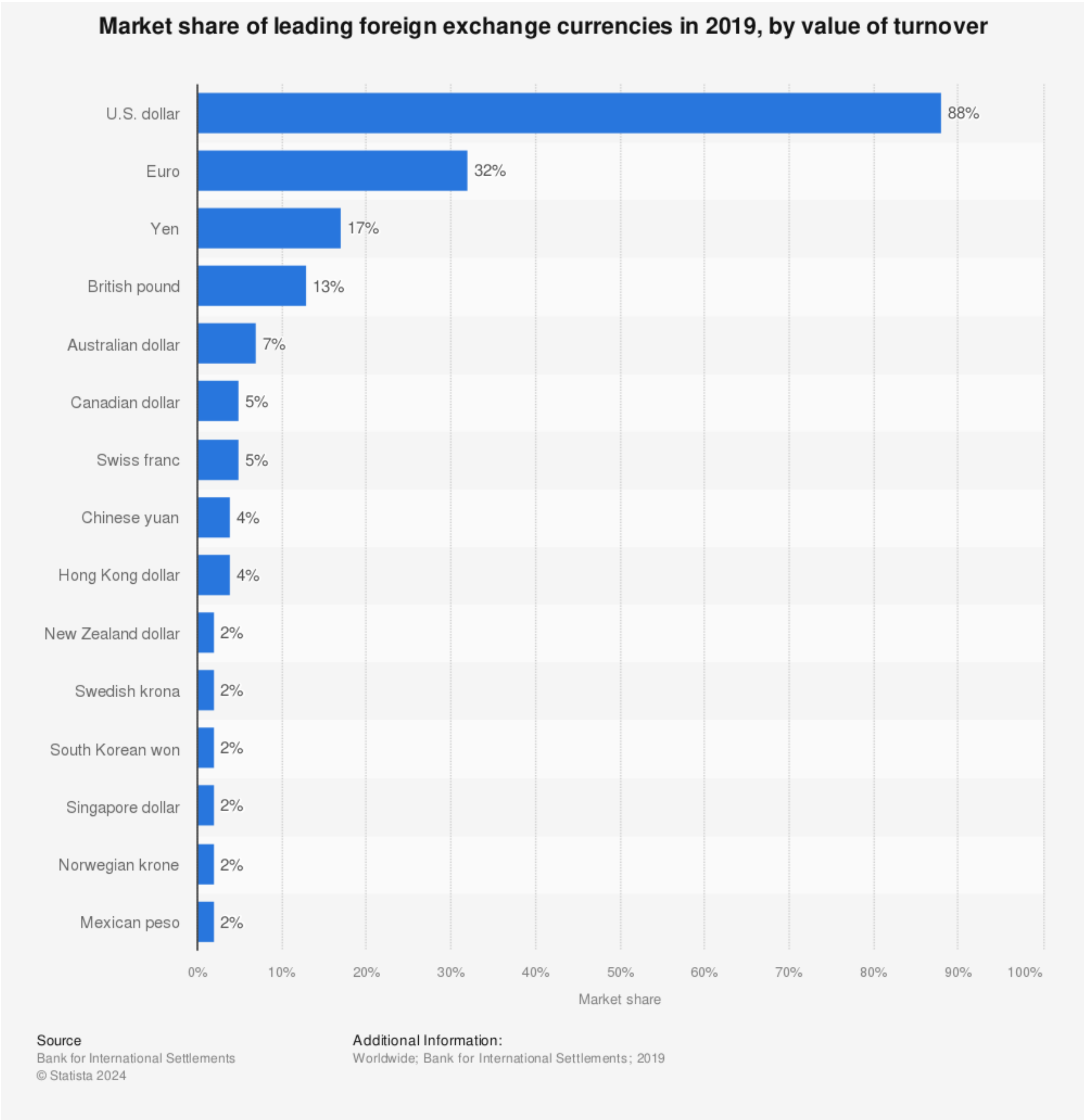
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

4.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 4.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 4.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 4.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56\text{ EUR}}{4.75\text{ USD}} \cdot \frac{6.57\text{ USD}}{6.50\text{ CHF}} = \frac{29.9592\text{ EUR}}{30.875\text{ CHF}} \approx 0.9703\frac{\text{EUR}}{\text{CHF}}$$

   and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305\frac{\text{CHF}}{\text{EUR}}.$$

   That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.
d) For 100 Euro we get

$$100\text{ EUR} \cdot \frac{4.75\text{ USD}}{4.56\text{ EUR}} \approx 104.16\text{ USD}$$

   and these can be converted to

$$104.16\text{ USD} \cdot \frac{6.50\text{ CHF}}{6.57\text{ USD}} \approx 103.05\text{ CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in \$ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09\text{ USD}}{130\text{ RUB}} = 0.016\frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65\text{ CAD}}{5.08\text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75\text{ USD}}{4.56\text{ EUR}}}_{\approx 1.0416} \approx 1.36\frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05\text{ CAD}}{5.08\text{ USD}} \approx 0.76\frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 4.6. International arbitrage

Table 4.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	\$2
Switzerland	\$6
United States of America	\$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have \$100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.
b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 4.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	\$4	EUR 2
Switzerland	\$4	CHF 6
United States of America	\$4	-

Now, calculate and elucidate the following exchange rates:
- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

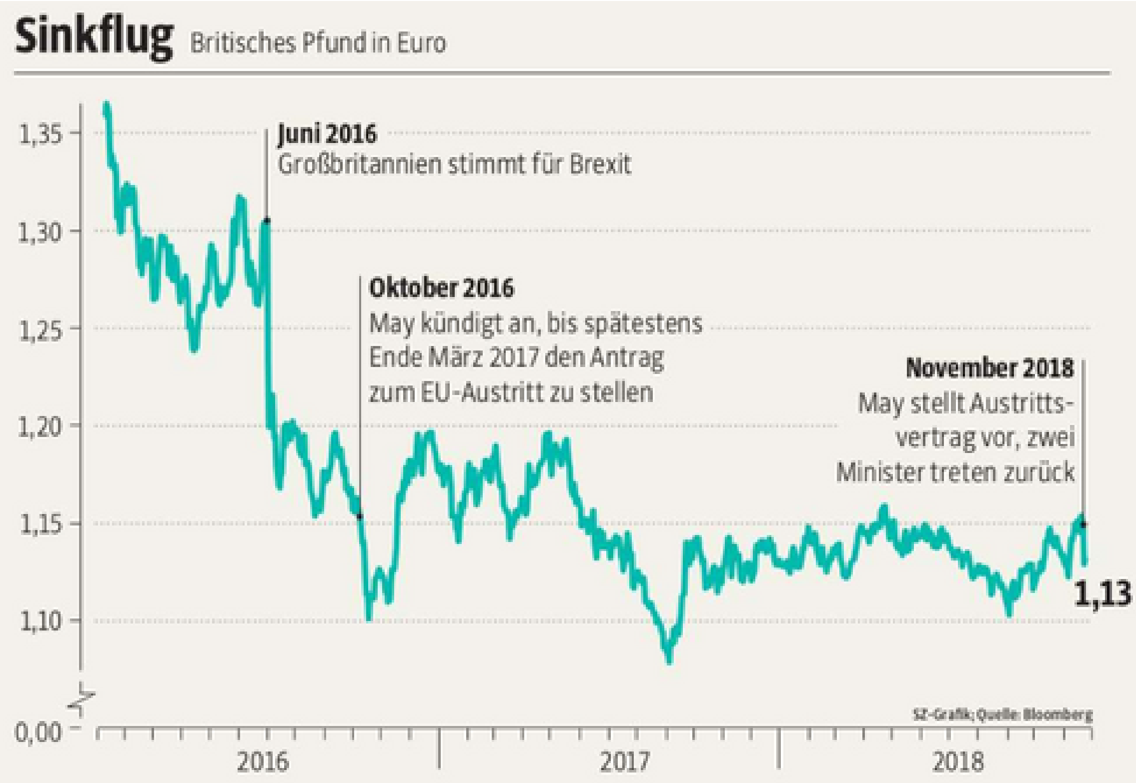
Solution

a) International arbitrage strategy
   - **Strategy**: Buy 50 units of good *08/15* in Germany for \$2 each with your \$100. Then, sell these units in Switzerland or the USA for \$6 each, making a total of \$300. This is a classic arbitrage strategy.
   - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
- **USD to EUR**: $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
- **EUR to USD**: $0.5\frac{EUR}{USD}$
- **USD to CHF**: $\frac{2}{3}\frac{USD}{CHF}$
- **CHF to USD**: $1.5\frac{CHF}{USD}$
- **CHF to EUR**: $\frac{3}{1}\frac{CHF}{USD}$
- **EUR to CHF**: $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 4.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 4.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

4.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

4.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 4.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

4.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

4.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{4.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

4.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I_{t-1}^{\text{€}} \cdot E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_{t}^{\frac{\text{€}}{\text{₺}}} = I_t^{\text{€}} \tag{4.2}$$

4.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1+\pi) \tag{4.3}$$

4.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{\text{€}} - I_{t-1}^{\text{€}}}{I_{t-1}^{\text{€}}} = \frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{\text{€}} = I_{t-1}^{\text{€}} \cdot (1+i^*) \cdot E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}} \cdot (1+\pi^*), \tag{4.4}$$

where $I_{t-1}^{\text{€}}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{\text{€}}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1+i^*)$, inflation $(1+\pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}})$:

$$\underbrace{\frac{I_t^{\text{€}^*}}{I_{t-1}^{\text{€}}}}_{r} - 1 = (1+i^*) \cdot (1+\pi^*) \cdot \underbrace{E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}}}_{\alpha} - 1$$

$$r^* = (1+i^*) \cdot (1+\pi^*) \cdot \alpha - 1 \tag{4.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned} r^* &= (1+i^*) \cdot \alpha - 1 \\ \Leftrightarrow r^* &= \alpha + \alpha i^* - 1. \end{aligned} \tag{4.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned} &\Leftrightarrow r^* = \alpha + \alpha i^* - 1 + i^* - i^* \\ &\Leftrightarrow r^* = \alpha - 1 + i^* + \alpha i^* - i^* \\ &\Leftrightarrow r^* = \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\ &\Leftrightarrow r^* = w + i^* + i^* w \end{aligned} \tag{4.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 4.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:
- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?
Solution
Exchange rates and where to invest (Exercise 10.8)
a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

Thus, it is better to invest in Europe.
b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 4.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.
a) Where should you invest, given the following informations:
- The interest rate in Germany is 1%.
- The interest rate in Turkey is 10%.
- 1€ can be converted to 7 ₺ this year in the FOREX
- You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
- You expect no inflation in Germany and Turkey.

b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.
Solution
Turkey vs. Germany (Exercise 10.9)
a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:
b) **(Exact) calculation method in four steps:**
1. exchange € to ₺ in t-1:

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$r_{GER} = 0.01$$
$$r_{TUR} = \frac{108.4507 - 100}{100} = 0.084507$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$TUR \rightarrow I_t^{€} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507$$
$$GER \rightarrow I_t^{€} = 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$

$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$r'_{GER} = 0.01$$
$$r'_{TUR} = 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$I_t^{€} = I_{t-1}^{€} E_{t-1}^{₺/€} (1+i) E_t^{€/₺*}$$
$$\Leftrightarrow E_t^{€/₺*} = \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$r_{GER} = i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1$$
$$\Leftrightarrow r_{GER} - i_{TUR} + 1 = \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}}$$
$$\Leftrightarrow E_t^{€/₺*'} = (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺}$$
$$\Leftrightarrow E_t^{€/₺*'} = (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*\prime}$:

$$\begin{aligned} r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01 \\ I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1 \\ \rightarrow r^*_{TUR} =& 0.01 \end{aligned}$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 4.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider "1 EUR to cost 1 INR more" properly. This does not mean 1 INR is equal to 1 €!

4.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{4.8}$$
$$i = w + i^* \tag{4.9}$$
$$\tag{4.10}$$
$$\Leftrightarrow w = i - i^* \tag{4.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

4.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro $(E^{\frac{CHF}{€}})$, as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

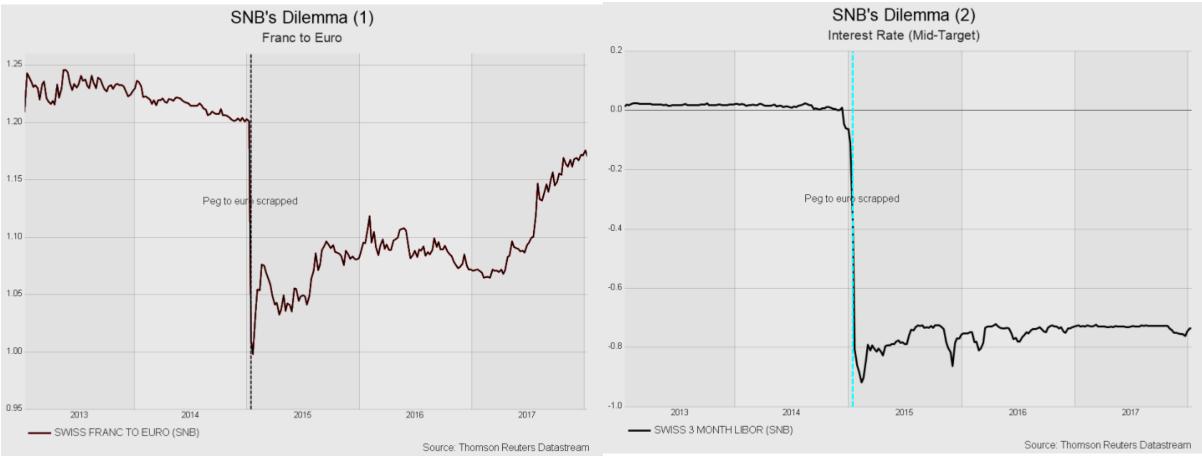
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 4.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

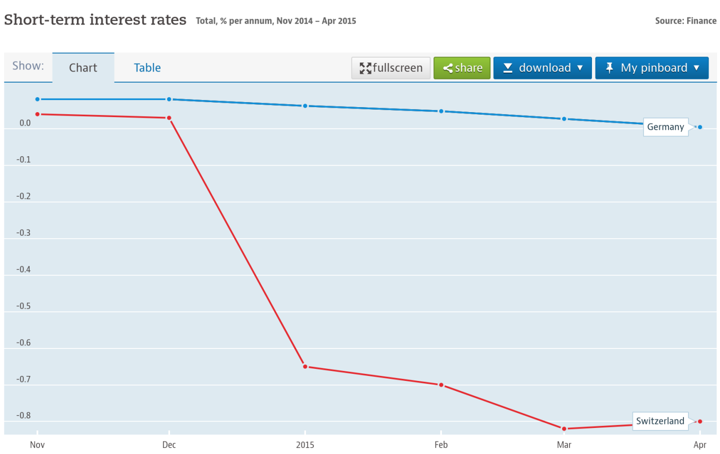
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 4.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

4.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{4.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{€}{₺}} = E_t^{\frac{€}{₺}} \Leftrightarrow \frac{E_{t-1}^{\frac{€}{₺}}}{E_t^{\frac{€}{₺}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 \tag{4.13}$$

$$\Leftrightarrow r = i + \pi + \pi i \tag{4.14}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{4.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

Recommended reading

Wikipedia (2025): Wikipedia entry to the Fisher Effect.

4.3 Balance of payments

Required reading

Council of Economic Advisers (2004, ch. 14)

4.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

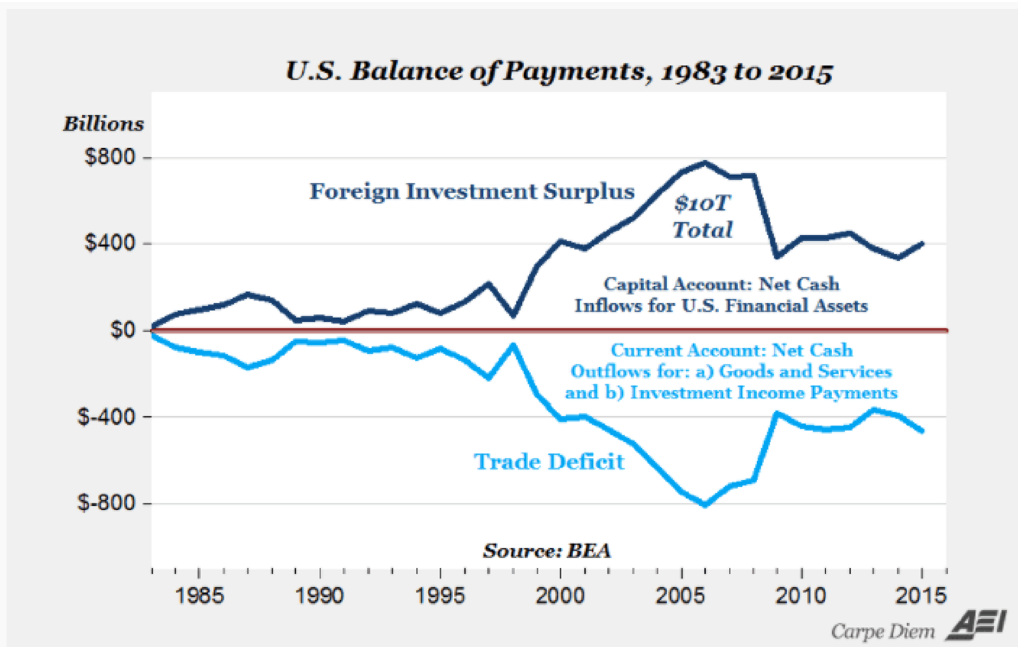
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 4.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 4.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 4.14: U.S. Balance of Payments



4.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 4.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

4.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

4.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

4.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

4.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

4.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$\begin{aligned} Y &= C + I + G \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\ \Leftrightarrow S &= I, \end{aligned}$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

4.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$\begin{aligned} Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\ \Leftrightarrow \underbrace{S - I}_{NCO} &= NEX \end{aligned}$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

4.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 4.15: Trump worries about the U.S. trade deficit

As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 4.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 4.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 4.16: The trade deficit of the United States over time

Chapter 5

Monetary international economics

Students learn to. . .

- . . . interpret exchange rates and relate their changes to the relative prices of countries' goods.
- . . . predict the impact of exchange rate changes on business decisions and national economies.
- . . . understand the linkage between interest rates and inflation in open economies.
- . . . explain the interest rate parity condition and the purchasing power parity assumption.
- . . . interpret and evaluate the balances of trade and

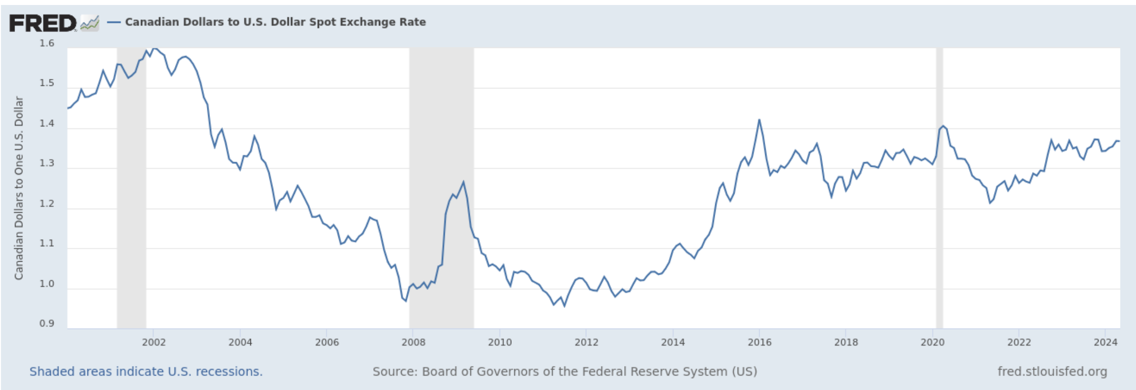
5.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 5.1. Exchange rates over time

Figure 5.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
   a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\ \text{USD} \cdot 1.6 \frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} \approx 2318.84\ \text{USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.

i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.

ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\ \text{USD} \cdot 1.38 \frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\ \text{CAD}.$$

Finally, you convert the CAD back to USD

i) at the rate 1.38 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} = 1020\ \text{USD}.$$

ii) at the rate 1.42 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.42} \frac{\text{USD}}{\text{CAD}} \approx 991.27\ \text{USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 5.2. Our relations are not good

Figure 5.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a "strong" Turkish Lira and a "weak" Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump's decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

5.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn't a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of "it depends" arguments because it is challenging to make convincing cases based on intricate relationships.

[1]The total value added of a country in a given period
[2]The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency
[3]The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

> **Exchange Rate**
>
> The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

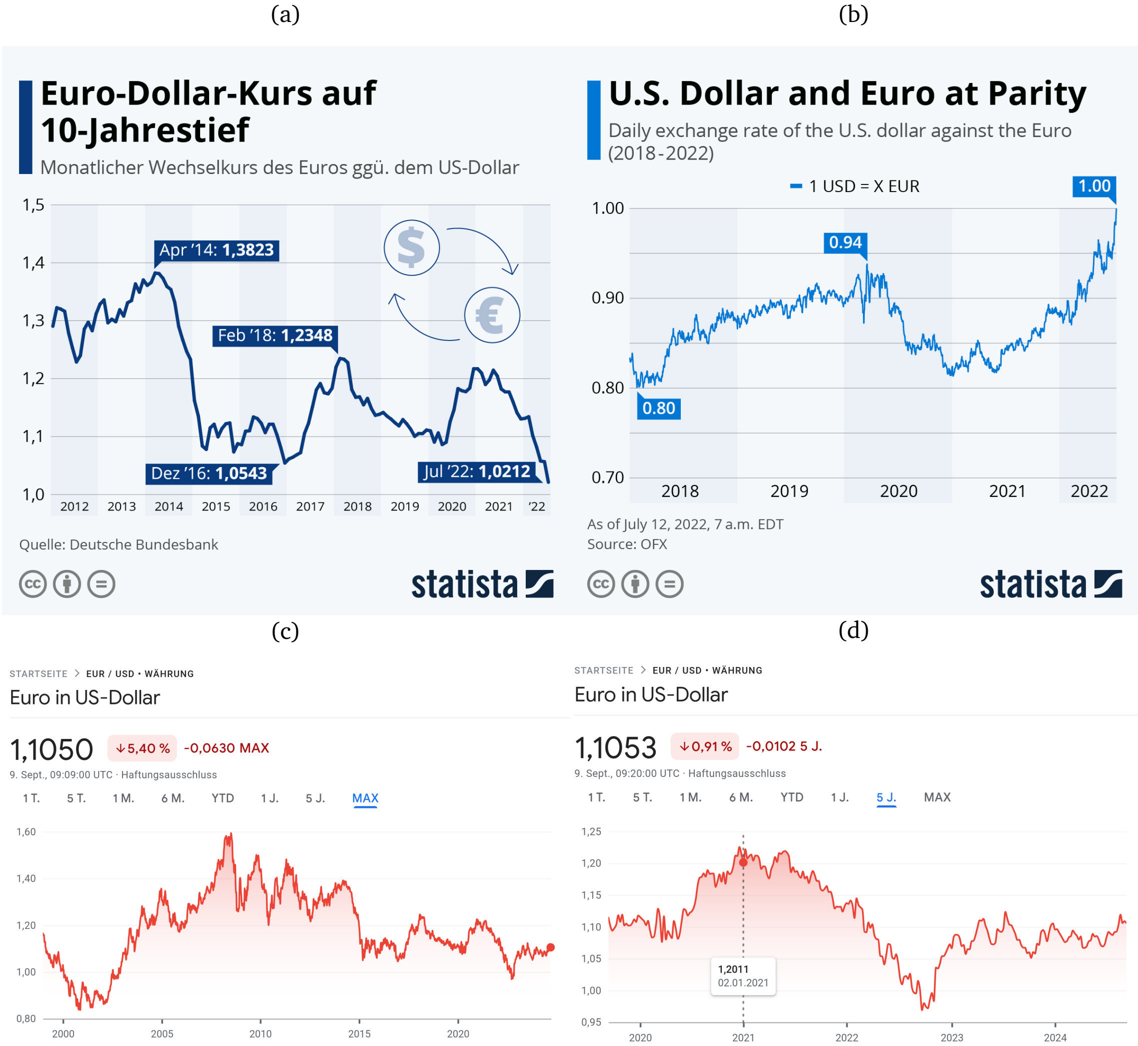
- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

> **Appreciation / Depreciation**
>
> A currency can appreciate or depreciate relative to other currencies.
> - If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
> - If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

> **Conventions to talk about exchange rates:**
>
> - *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
> - *Euro per Dollar* means $\frac{€}{\$}$
> - *Euro in Dollar* means $\frac{\$}{€}$
> - *1 Euro costs X Dollars* means X $\frac{\$}{€}$

Exercise 5.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 5.3: Euro to Dollar



Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E_{\$}^{€} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E_{\$}^{€} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E_{\$}^{€} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)

$$E^{\text{€}}_{\$} = \frac{X\text{€}}{Y\$} = \frac{1\text{€}}{1,0212\$} = 0.904731747\frac{\text{€}}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X\text{€}}{Y\$}$.

Exercise 5.4. Exchange currencies
Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.
b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.
c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?
d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:

$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:

$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:

$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:

$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

5.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **ℹ Relative prices**
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{\text{₺}}{\text{€}}} = E^{\frac{\text{€}}{\text{₺}}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 5.4: One wine per Euro

exchange 1 € → $1\text{€} \cdot 1\frac{\text{₺}}{\text{€}} = 1\text{₺}$ → buy wine → $1\text{₺} \cdot 1\frac{\text{wine}}{\text{₺}} = 1 \text{ wine}$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{\text{€}}{\text{₺}}} = 0.5$ and $E^{\frac{\text{₺}}{\text{€}}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 5.5: Two wine per Euro

exchange 1 € → $1\text{€} \cdot 2\frac{\text{₺}}{\text{€}} = 2\text{₺}$ → buy wine → $2\text{₺} \cdot 1\frac{\text{wine}}{\text{₺}} = 2 \text{ wine}$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **ℹ Exchange rates and relative prices**
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

5.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

5.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 5.6: *Who wins in the end?*

Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional \$3.2 billion per month in added tax costs and another \$1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately \$165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers."*

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

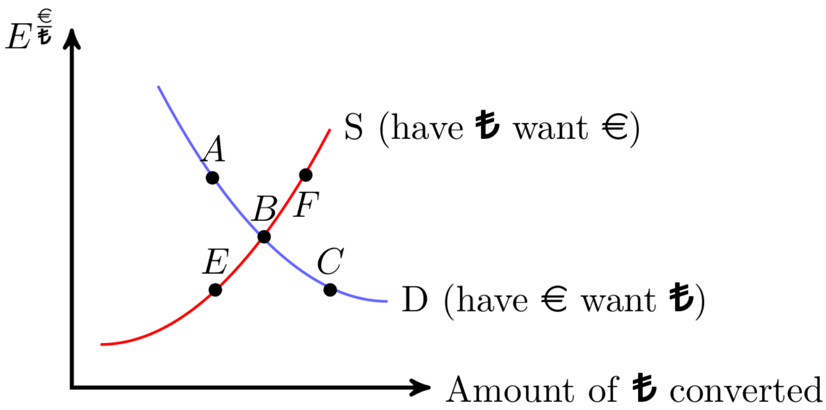
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

5.1.5 The FOREX

5.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 5.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{€}{₺}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{€}{₺}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{€}{₺}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{€}{₺}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 5.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

5.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 5.8: Players on the foreign exchange market

5.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

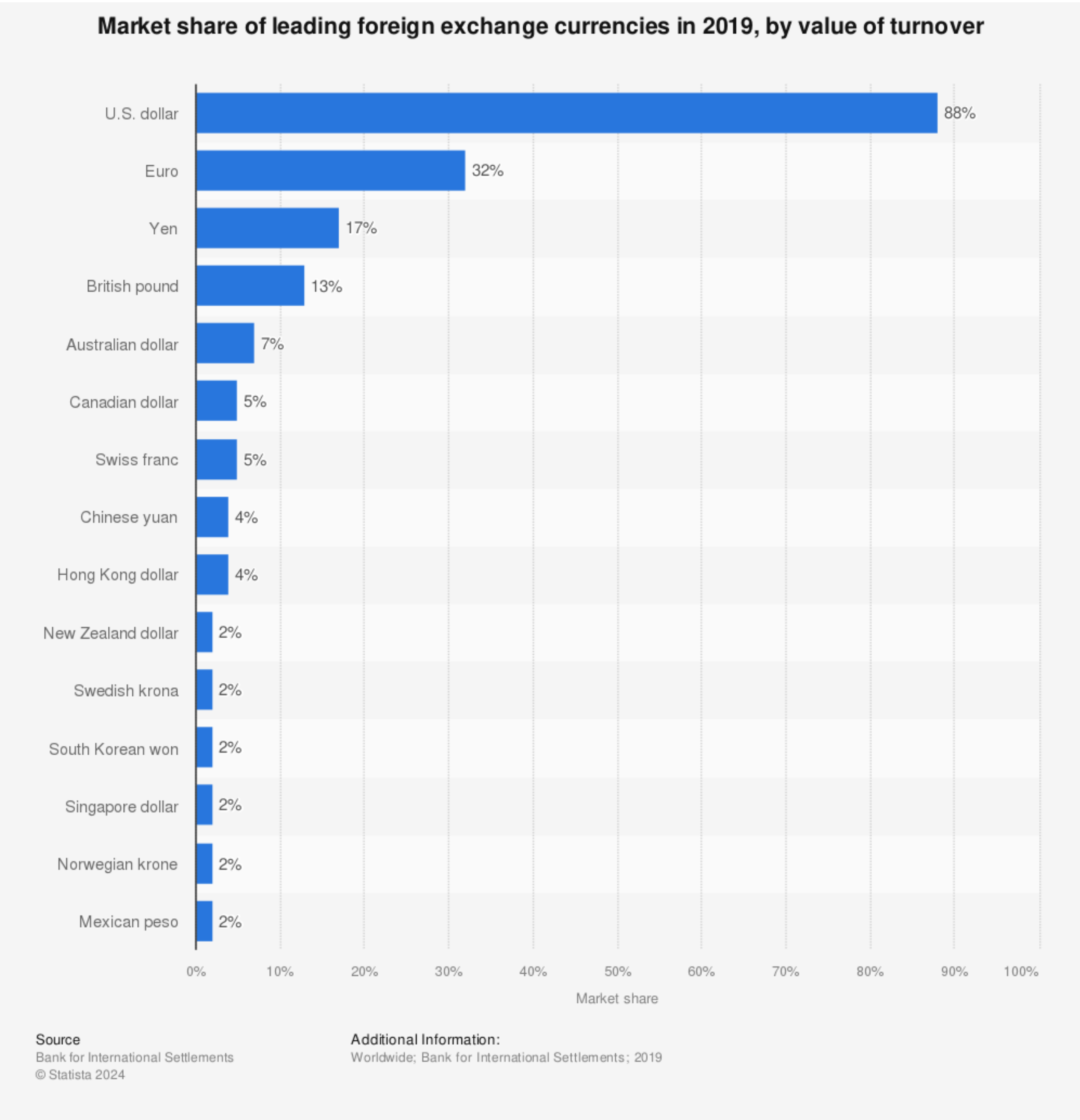
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

5.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 5.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 5.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 5.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56 \text{ EUR}}{4.75 \text{ USD}} \cdot \frac{6.57 \text{ USD}}{6.50 \text{ CHF}} = \frac{29.9592 \text{ EUR}}{30.875 \text{ CHF}} \approx 0.9703 \frac{\text{EUR}}{\text{CHF}}$$

and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305 \frac{\text{CHF}}{\text{EUR}}.$$

That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.

d) For 100 Euro we get

$$100 \text{ EUR} \cdot \frac{4.75 \text{ USD}}{4.56 \text{ EUR}} \approx 104.16 \text{ USD}$$

and these can be converted to

$$104.16 \text{ USD} \cdot \frac{6.50 \text{ CHF}}{6.57 \text{ USD}} \approx 103.05 \text{ CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in $ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09 \text{ USD}}{130 \text{ RUB}} = 0.016 \frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65 \text{ CAD}}{5.08 \text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75 \text{ USD}}{4.56 \text{ EUR}}}_{\approx 1.0416} \approx 1.36 \frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05 \text{ CAD}}{5.08 \text{ USD}} \approx 0.76 \frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 5.6. International arbitrage

Table 5.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	\$2
Switzerland	\$6
United States of America	\$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have \$100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.

b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 5.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	\$4	EUR 2
Switzerland	\$4	CHF 6
United States of America	\$4	-

Now, calculate and elucidate the following exchange rates:

- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

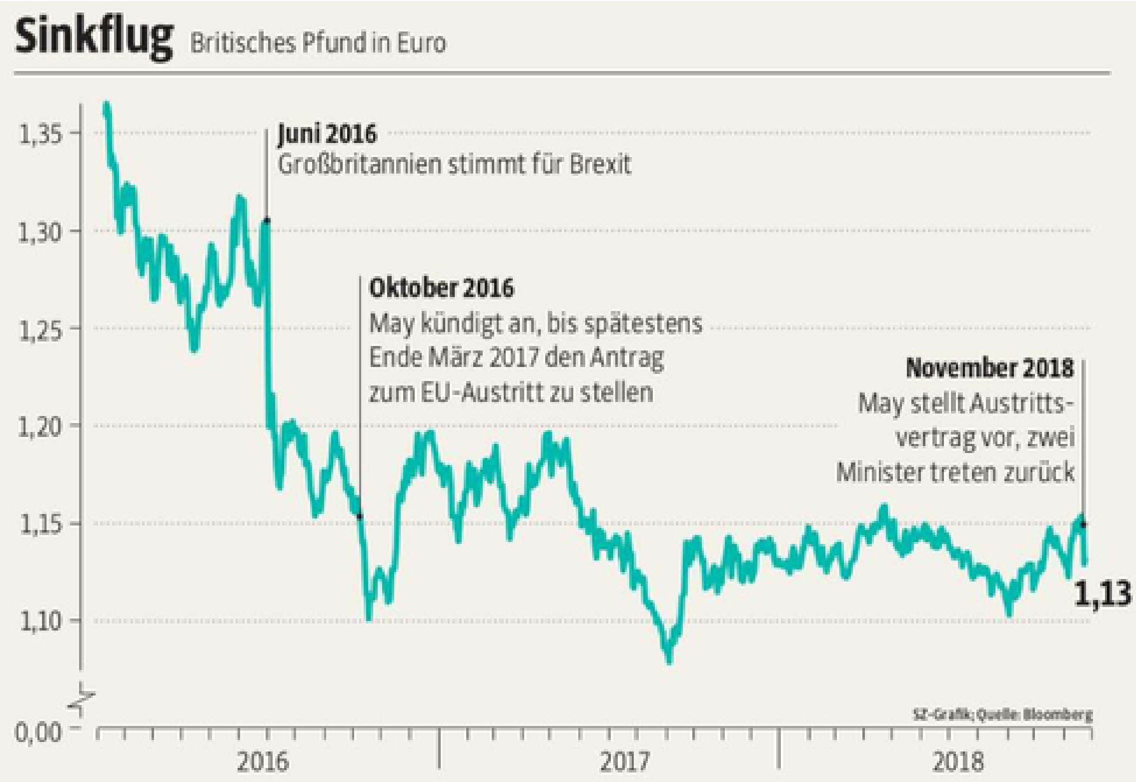
Solution

a) International arbitrage strategy
  - **Strategy**: Buy 50 units of good *08/15* in Germany for \$2 each with your \$100. Then, sell these units in Switzerland or the USA for \$6 each, making a total of \$300. This is a classic arbitrage strategy.
  - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
- **USD to EUR**: $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
- **EUR to USD**: $0.5\frac{EUR}{USD}$
- **USD to CHF**: $\frac{2}{3}\frac{USD}{CHF}$
- **CHF to USD**: $1.5\frac{CHF}{USD}$
- **CHF to EUR**: $\frac{3}{1}\frac{CHF}{USD}$
- **EUR to CHF**: $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 5.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 5.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

5.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

5.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 5.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

5.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

5.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{5.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

5.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I^{€}_{t-1} \cdot E^{\frac{₺}{€}}_{t-1} \cdot E^{\frac{€}{₺}}_{t} = I^{€}_{t} \tag{5.2}$$

5.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1+\pi) \tag{5.3}$$

5.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{\text{€}} - I_{t-1}^{\text{€}}}{I_{t-1}^{\text{€}}} = \frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{\text{€}} = I_{t-1}^{\text{€}} \cdot (1+i^*) \cdot E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}} \cdot (1+\pi^*), \tag{5.4}$$

where $I_{t-1}^{\text{€}}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{\text{€}}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1+i^*)$, inflation $(1+\pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}})$:

$$\underbrace{\frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}}^{*} - 1}_{r} = (1+i^*) \cdot (1+\pi^*) \cdot \underbrace{E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}}}_{\alpha} - 1$$

$$r^* = (1+i^*) \cdot (1+\pi^*) \cdot \alpha - 1 \tag{5.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned} r^* &= (1+i^*) \cdot \alpha - 1 \\ \Leftrightarrow r^* &= \alpha + \alpha i^* - 1. \end{aligned} \tag{5.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned} &\Leftrightarrow r^* = \alpha + \alpha i^* - 1 + i^* - i^* \\ &\Leftrightarrow r^* = \alpha - 1 + i^* + \alpha i^* - i^* \\ &\Leftrightarrow r^* = \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\ &\Leftrightarrow r^* = w + i^* + i^* w \end{aligned} \tag{5.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 5.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:

- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?

Solution
Exchange rates and where to invest (Exercise 10.8)

a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

Thus, it is better to invest in Europe.
b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 5.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.

a) Where should you invest, given the following informations:
   - The interest rate in Germany is 1%.
   - The interest rate in Turkey is 10%.
   - 1€ can be converted to 7 ₺ this year in the FOREX
   - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
   - You expect no inflation in Germany and Turkey.
b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.

Solution
Turkey vs. Germany (Exercise 10.9)

a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:
b) **(Exact) calculation method in four steps:**
   1. `exchange € to ₺ in t-1:`

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

   2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

   3. re-exchange ₺ to €:

$$770₺ \cdot E_{t}^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$r_{GER} = 0.01$$
$$r_{TUR} = \frac{108.4507 - 100}{100} = 0.084507$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$TUR \rightarrow I_t^{€} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507$$
$$GER \rightarrow I_t^{€} = 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$

$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$r'_{GER} = 0.01$$
$$r'_{TUR} = 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$I_t^{€} = I_{t-1}^{€} E_{t-1}^{₺/€}(1+i) E_t^{€/₺*}$$
$$\Leftrightarrow E_t^{€/₺*} = \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$r_{GER} = i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1$$
$$\Leftrightarrow r_{GER} - i_{TUR} + 1 = \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}}$$
$$\Leftrightarrow E_t^{€/₺*'} = (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺}$$
$$\Leftrightarrow E_t^{€/₺*'} = (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$\begin{aligned} r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01 \\ I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1 \\ \rightarrow r^*_{TUR} =& 0.01 \end{aligned}$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 5.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider “1 EUR to cost 1 INR more” properly. This does not mean 1 INR is equal to 1 €!

5.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{5.8}$$

$$i = w + i^* \tag{5.9}$$

$$\tag{5.10}$$

$$\Leftrightarrow w = i - i^* \tag{5.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

5.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro ($E^{\frac{CHF}{€}}$), as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

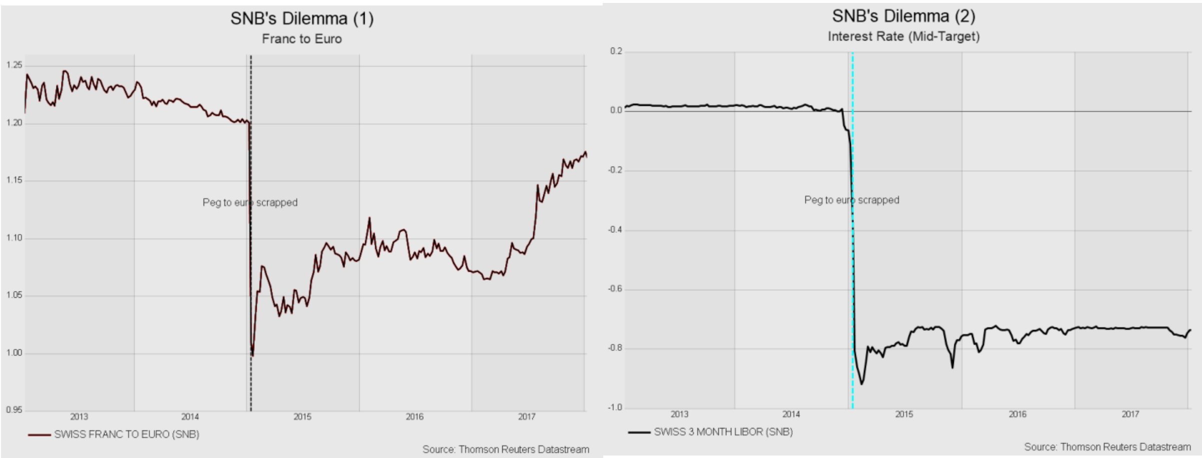
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 5.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

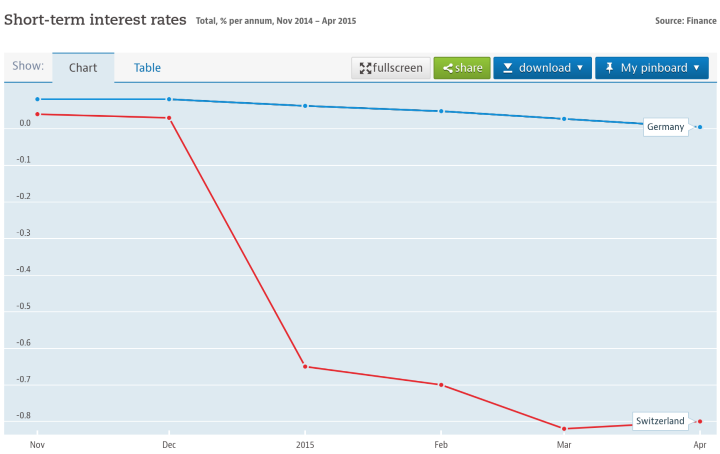
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 5.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

5.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{5.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{\text{€}}{\text{₺}}} = E_t^{\frac{\text{€}}{\text{₺}}} \Leftrightarrow \frac{E_{t-1}^{\frac{\text{€}}{\text{₺}}}}{E_t^{\frac{\text{€}}{\text{₺}}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$\begin{aligned} r^* &= (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 && (5.13) \\ \Leftrightarrow r &= i + \pi + \pi i && (5.14) \end{aligned}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{5.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

> Recommended reading
>
> Wikipedia (2025): Wikipedia entry to the Fisher Effect.

5.3 Balance of payments

> Required reading
>
> Council of Economic Advisers (2004, ch. 14)

5.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

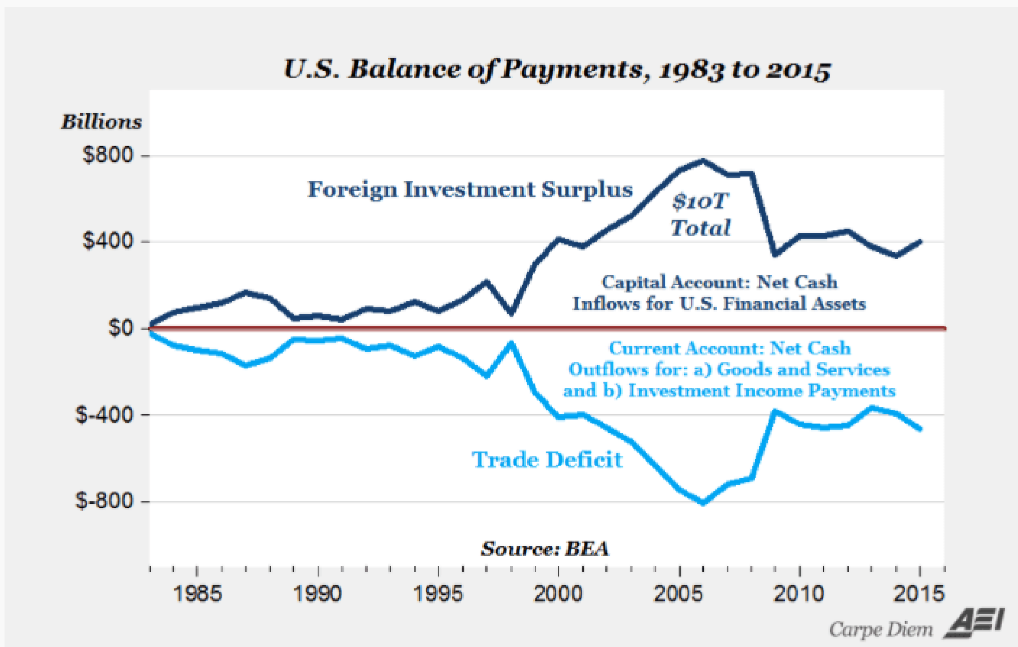
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 5.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 5.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 5.14: U.S. Balance of Payments



5.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 5.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

5.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

5.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

5.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

5.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

5.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$
\begin{aligned}
Y &= C + I + G \\
\Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\
\Leftrightarrow S &= I,
\end{aligned}
$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

5.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$
\begin{aligned}
Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\
\Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\
\Leftrightarrow \underbrace{S - I}_{NCO} &= NEX
\end{aligned}
$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

5.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 5.15: Trump worries about the U.S. trade deficit

As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 5.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 5.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 5.16: The trade deficit of the United States over time

Chapter 6

Monetary international economics

Students learn to...

- ...interpret exchange rates and relate their changes to the relative prices of countries' goods.
- ...predict the impact of exchange rate changes on business decisions and national economies.
- ...understand the linkage between interest rates and inflation in open economies.
- ...explain the interest rate parity condition and the purchasing power parity assumption.
- ...interpret and evaluate the balances of trade and

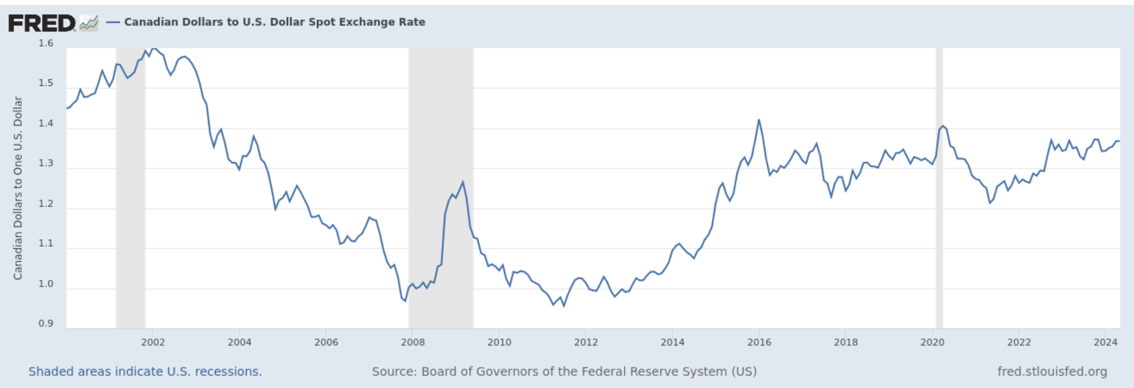
6.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 6.1. Exchange rates over time

Figure 6.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
   a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\ \text{USD} \cdot 1.6 \frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} \approx 2318.84\ \text{USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.
   i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.
   ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\ \text{USD} \cdot 1.38 \frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\ \text{CAD}.$$

Finally, you convert the CAD back to USD
   i) at the rate 1.38 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} = 1020\ \text{USD}.$$

   ii) at the rate 1.42 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.42} \frac{\text{USD}}{\text{CAD}} \approx 991.27\ \text{USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 6.2. Our relations are not good

Figure 6.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a "strong" Turkish Lira and a "weak" Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump's decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

6.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn't a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of "it depends" arguments because it is challenging to make convincing cases based on intricate relationships.

[1] The total value added of a country in a given period

[2] The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency

[3] The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.
- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

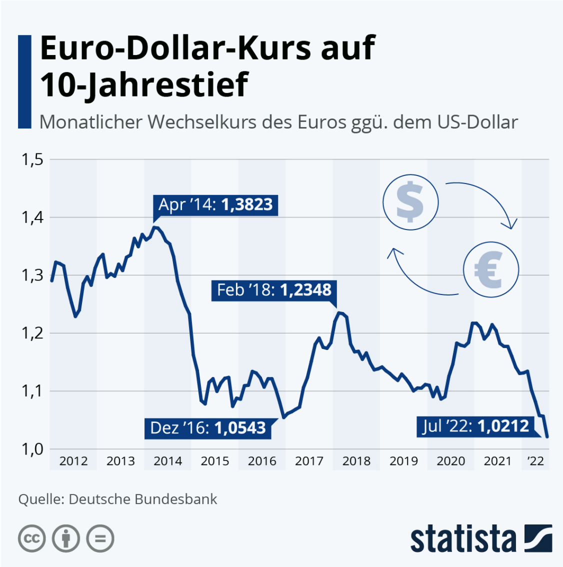
Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

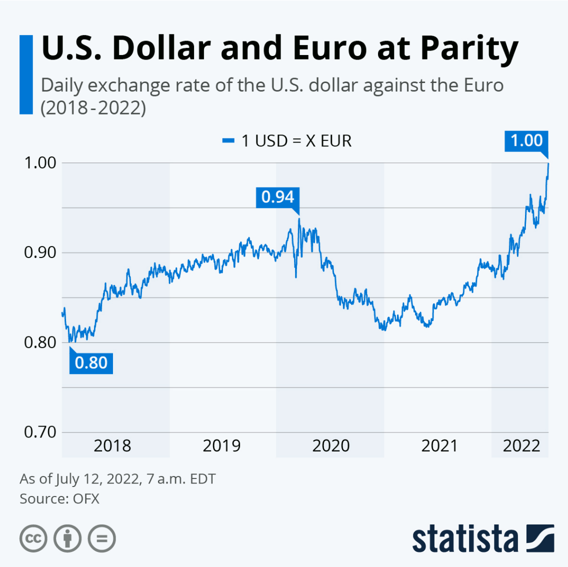
Exercise 6.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 6.3: Euro to Dollar

(a)



(b)



(c)

(d)

Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)
$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 6.4. Exchange currencies

Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.
b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.
c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?
d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:
$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$
b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:
$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$
c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:
$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$
d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:
$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

6.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **i Relative prices**
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{₺}{€}} = E^{\frac{€}{₺}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 6.4: One wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 1\frac{₺}{€} = 1₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1₺ \cdot 1\frac{\text{wine}}{₺} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{₺}} = 0.5$ and $E^{\frac{₺}{€}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 6.5: Two wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 2\frac{₺}{€} = 2₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2₺ \cdot 1\frac{\text{wine}}{₺} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **i Exchange rates and relative prices**
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

6.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

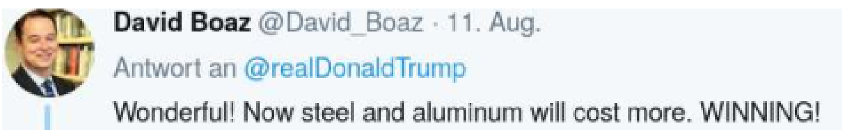
6.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 6.6: *Who wins in the end?*



Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers.*"

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

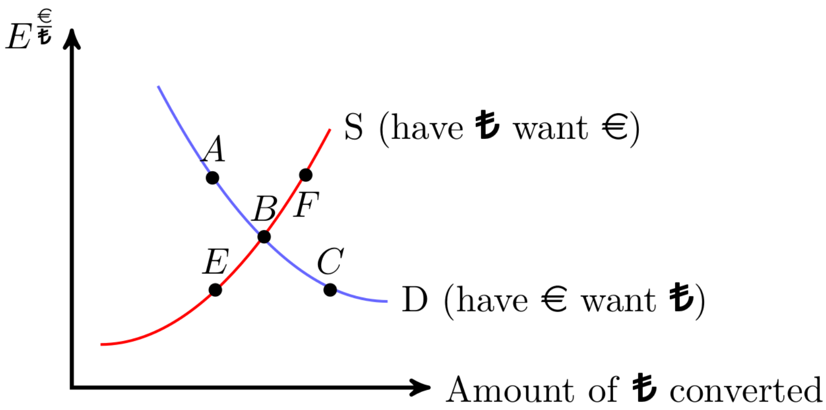
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

6.1.5 The FOREX

6.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 6.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{€}{₺}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{€}{₺}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{€}{₺}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{€}{₺}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 6.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

6.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 6.8: Players on the foreign exchange market

6.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

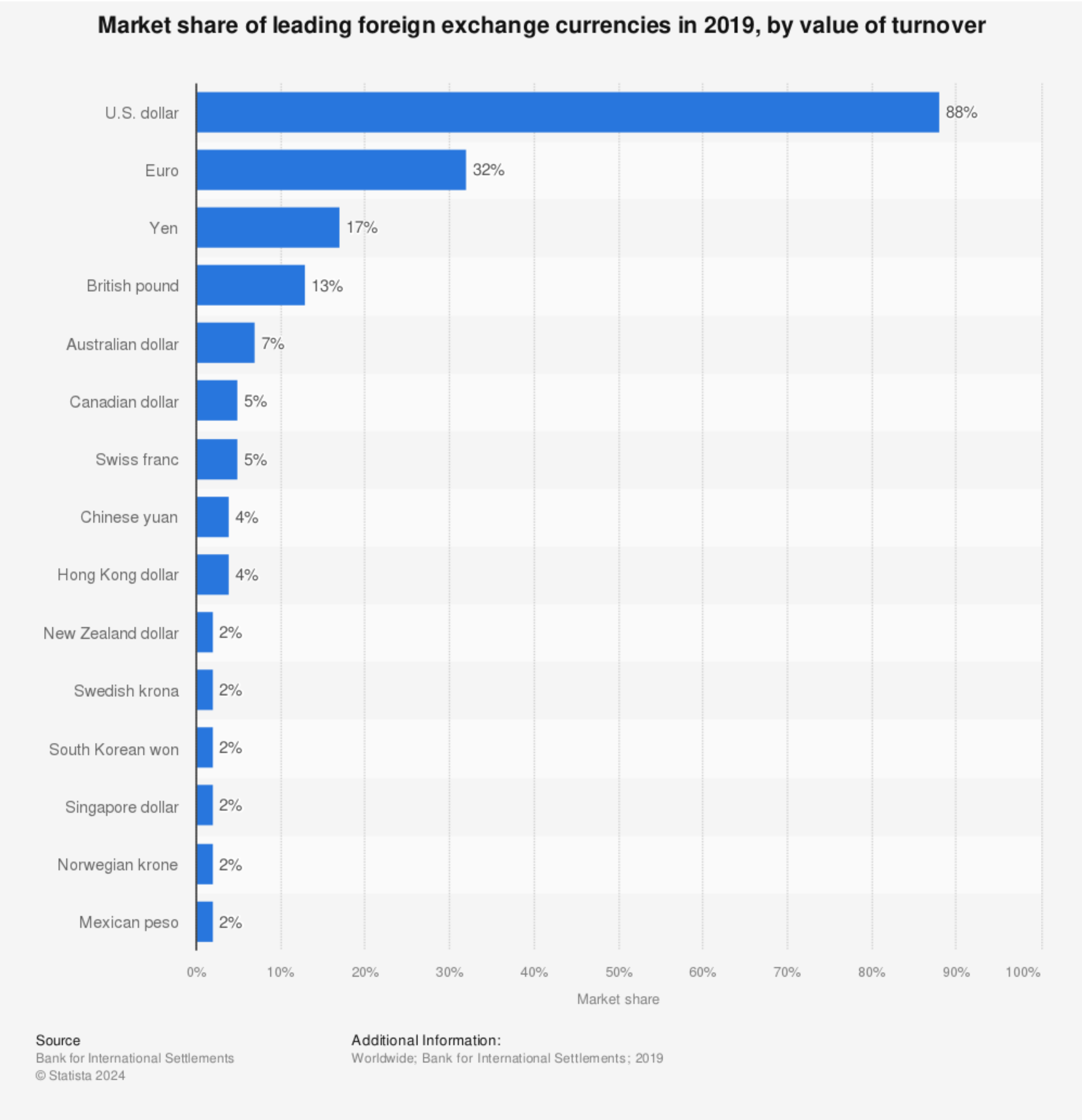
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

6.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 6.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 6.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 6.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56 \text{ EUR}}{4.75 \text{ USD}} \cdot \frac{6.57 \text{ USD}}{6.50 \text{ CHF}} = \frac{29.9592 \text{ EUR}}{30.875 \text{ CHF}} \approx 0.9703 \frac{\text{EUR}}{\text{CHF}}$$

   and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305 \frac{\text{CHF}}{\text{EUR}}.$$

   That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.
d) For 100 Euro we get

$$100 \text{ EUR} \cdot \frac{4.75 \text{ USD}}{4.56 \text{ EUR}} \approx 104.16 \text{ USD}$$

   and these can be converted to

$$104.16 \text{ USD} \cdot \frac{6.50 \text{ CHF}}{6.57 \text{ USD}} \approx 103.05 \text{ CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in $ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09 \text{ USD}}{130 \text{ RUB}} = 0.016 \frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65 \text{ CAD}}{5.08 \text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75 \text{ USD}}{4.56 \text{ EUR}}}_{\approx 1.0416} \approx 1.36 \frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05 \text{ CAD}}{5.08 \text{ USD}} \approx 0.76 \frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 6.6. International arbitrage

Table 6.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	$2
Switzerland	$6
United States of America	$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have $100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.
b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 6.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	$4	EUR 2
Switzerland	$4	CHF 6
United States of America	$4	-

Now, calculate and elucidate the following exchange rates:

- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

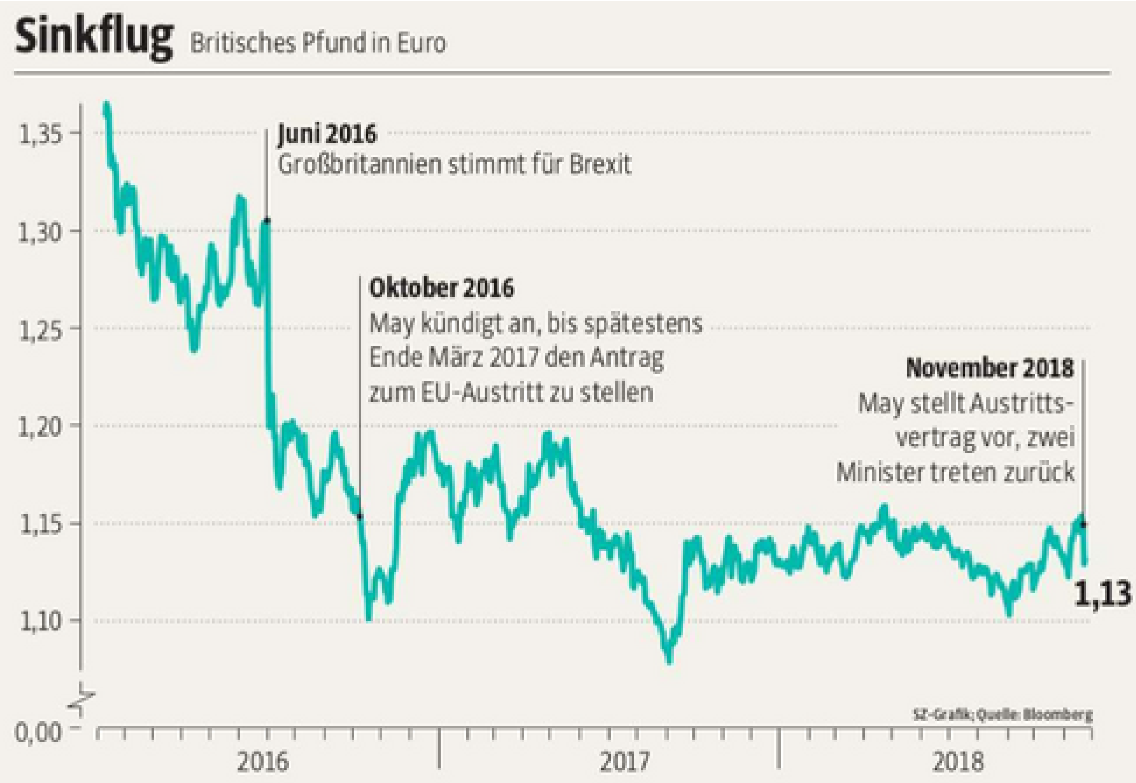
Solution

a) International arbitrage strategy
   - **Strategy**: Buy 50 units of good *08/15* in Germany for $2 each with your $100. Then, sell these units in Switzerland or the USA for $6 each, making a total of $300. This is a classic arbitrage strategy.
   - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
   - **USD to EUR:** $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
   - **EUR to USD:** $0.5\frac{EUR}{USD}$
   - **USD to CHF:** $\frac{2}{3}\frac{USD}{CHF}$
   - **CHF to USD:** $1.5\frac{CHF}{USD}$
   - **CHF to EUR:** $\frac{3}{1}\frac{CHF}{USD}$
   - **EUR to CHF:** $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 6.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 6.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

6.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

6.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 6.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

6.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

6.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{6.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

6.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I^{\text{€}}_{t-1} \cdot E^{\frac{₺}{\text{€}}}_{t-1} \cdot E^{\frac{\text{€}}{₺}}_{t} = I^{\text{€}}_{t} \tag{6.2}$$

6.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1 + \pi) \tag{6.3}$$

6.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}} = \frac{I_t^{€}}{I_{t-1}^{€}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{€} = I_{t-1}^{€} \cdot (1 + i^*) \cdot E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}} \cdot (1 + \pi^*), \tag{6.4}$$

where $I_{t-1}^{€}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{€}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1 + i^*)$, inflation $(1 + \pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}})$:

$$\underbrace{\frac{I_t^{€}}{I_{t-1}^{€}}^* - 1}_{r} = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}}}_{\alpha} - 1$$

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \alpha - 1 \tag{6.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned} r^* &= (1 + i^*) \cdot \alpha - 1 \\ \Leftrightarrow r^* &= \alpha + \alpha i^* - 1. \end{aligned} \tag{6.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned} \Leftrightarrow r^* &= \alpha + \alpha i^* - 1 + i^* - i^* \\ \Leftrightarrow r^* &= \alpha - 1 + i^* + \alpha i^* - i^* \\ \Leftrightarrow r^* &= \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\ \Leftrightarrow r^* &= w + i^* + i^* w \end{aligned} \tag{6.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 6.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:

- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to \$1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?

Solution

Exchange rates and where to invest (Exercise 10.8)

a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

Thus, it is better to invest in Europe.

b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 6.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.

a) Where should you invest, given the following informations:
   - The interest rate in Germany is 1%.
   - The interest rate in Turkey is 10%.
   - 1€ can be converted to 7 ₺ this year in the FOREX
   - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
   - You expect no inflation in Germany and Turkey.
b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.

Solution

Turkey vs. Germany (Exercise 10.9)

a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:

b) **(Exact) calculation method in four steps:**

```
1. exchange € to ₺ in t-1:
```

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$r_{GER} = 0.01$$
$$r_{TUR} = \frac{108.4507 - 100}{100} = 0.084507$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$TUR \rightarrow I_t^{€} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507$$
$$GER \rightarrow I_t^{€} = 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$
$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$r'_{GER} = 0.01$$
$$r'_{TUR} = 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$I_t^{€} = I_{t-1}^{€} E_{t-1}^{₺/€}(1+i)E_t^{€/₺*}$$
$$\Leftrightarrow E_t^{€/₺*} = \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$r_{GER} = i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1$$
$$\Leftrightarrow r_{GER} - i_{TUR} + 1 = \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}}$$
$$\Leftrightarrow E_t^{€/₺*'} = (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺}$$
$$\Leftrightarrow E_t^{€/₺*'} = (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$r'_{TUR} = 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01$$
$$I_t^{€*} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1$$
$$\rightarrow r^*_{TUR} = 0.01$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 6.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.
- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider “1 EUR to cost 1 INR more” properly. This does not mean 1 INR is equal to 1 €!

6.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{6.8}$$
$$i = w + i^* \tag{6.9}$$
$$\tag{6.10}$$
$$\Leftrightarrow w = i - i^* \tag{6.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

6.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro ($E^{\frac{CHF}{€}}$), as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

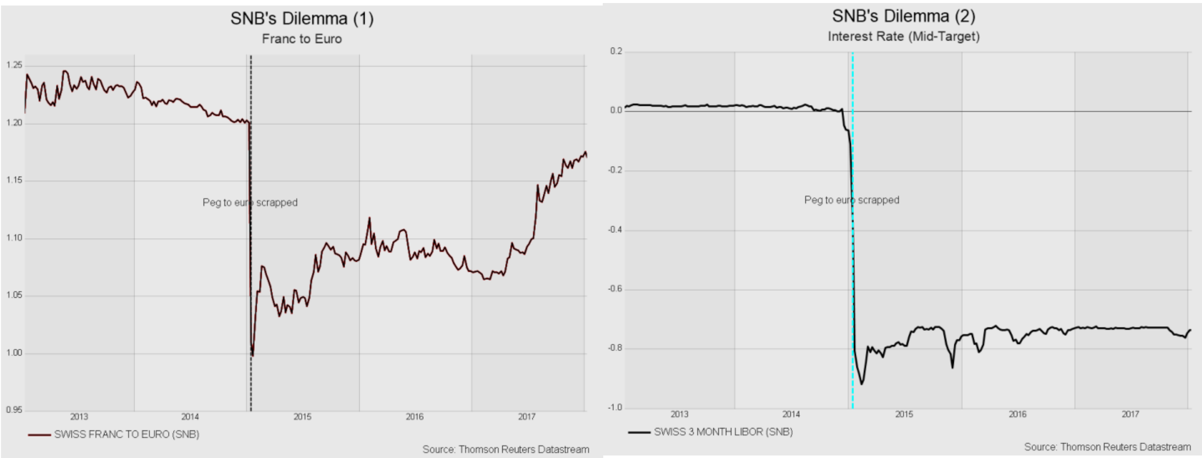
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 6.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

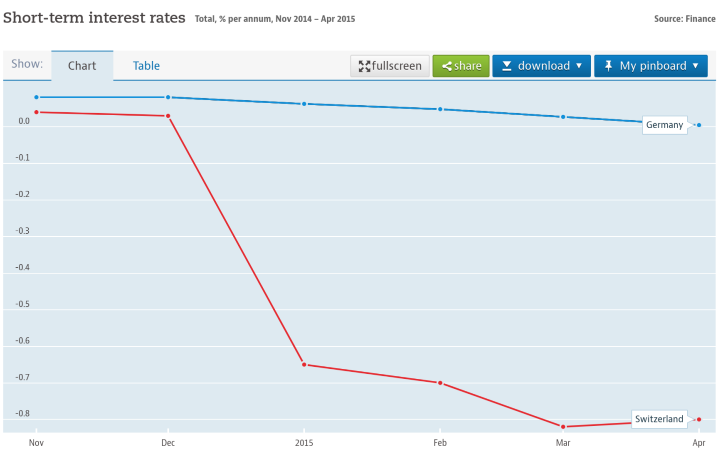
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 6.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

6.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{6.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{€}{₺}} = E_t^{\frac{€}{₺}} \Leftrightarrow \frac{E_{t-1}^{\frac{€}{₺}}}{E_t^{\frac{€}{₺}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 \tag{6.13}$$

$$\Leftrightarrow r = i + \pi + \pi i \tag{6.14}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{6.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

Recommended reading

Wikipedia (2025): Wikipedia entry to the Fisher Effect.

6.3 Balance of payments

Required reading

Council of Economic Advisers (2004, ch. 14)

6.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

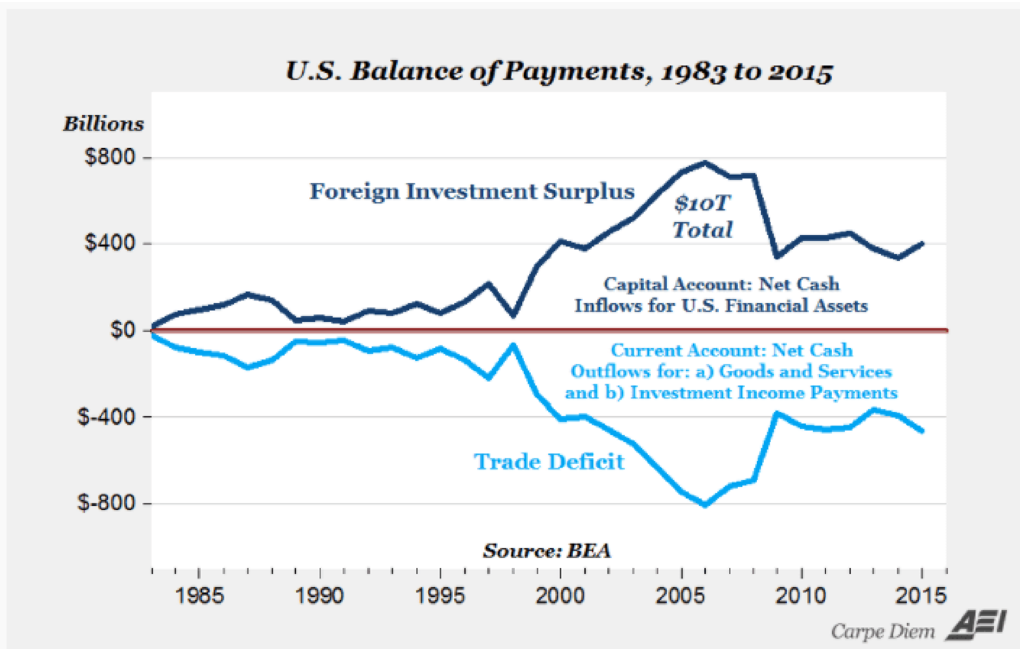
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 6.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 6.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 6.14: U.S. Balance of Payments



6.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 6.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

6.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

6.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

6.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

6.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

6.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$\begin{aligned} Y &= C + I + G \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\ \Leftrightarrow S &= I, \end{aligned}$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

6.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$\begin{aligned} Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\ \Leftrightarrow \underbrace{S - I}_{NCO} &= NEX \end{aligned}$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

6.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 6.15: Trump worries about the U.S. trade deficit

As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 6.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 6.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 6.16: The trade deficit of the United States over time

Chapter 7

Monetary international economics

Students learn to. . .

- . . . interpret exchange rates and relate their changes to the relative prices of countries' goods.
- . . . predict the impact of exchange rate changes on business decisions and national economies.
- . . . understand the linkage between interest rates and inflation in open economies.
- . . . explain the interest rate parity condition and the purchasing power parity assumption.
- . . . interpret and evaluate the balances of trade and

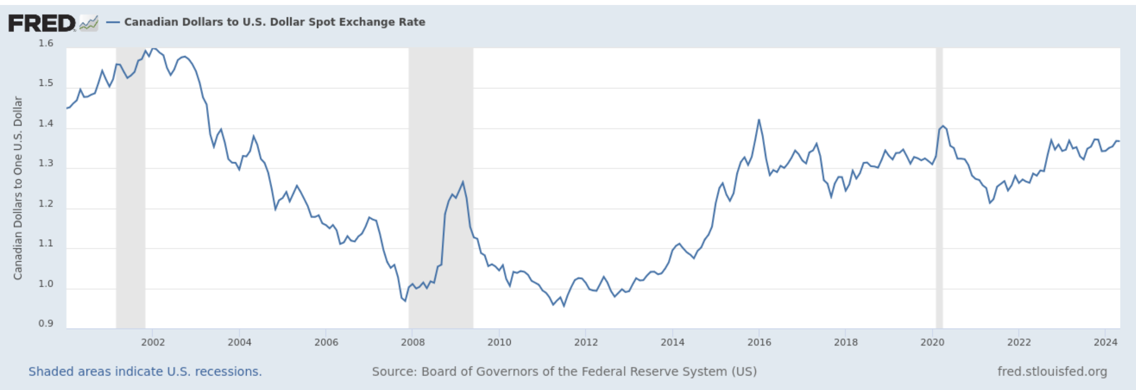
7.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 7.1. Exchange rates over time

Figure 7.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
   a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\ \text{USD} \cdot 1.6 \frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} \approx 2318.84\ \text{USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.
   i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.
   ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\ \text{USD} \cdot 1.38 \frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\ \text{CAD}.$$

Finally, you convert the CAD back to USD
   i) at the rate 1.38 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.38} \frac{\text{USD}}{\text{CAD}} = 1020\ \text{USD}.$$

   ii) at the rate 1.42 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.42} \frac{\text{USD}}{\text{CAD}} \approx 991.27\ \text{USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 7.2. Our relations are not good

Figure 7.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a "strong" Turkish Lira and a "weak" Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump's decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

7.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn't a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of "it depends" arguments because it is challenging to make convincing cases based on intricate relationships.

[1]The total value added of a country in a given period
[2]The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency
[3]The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.
- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

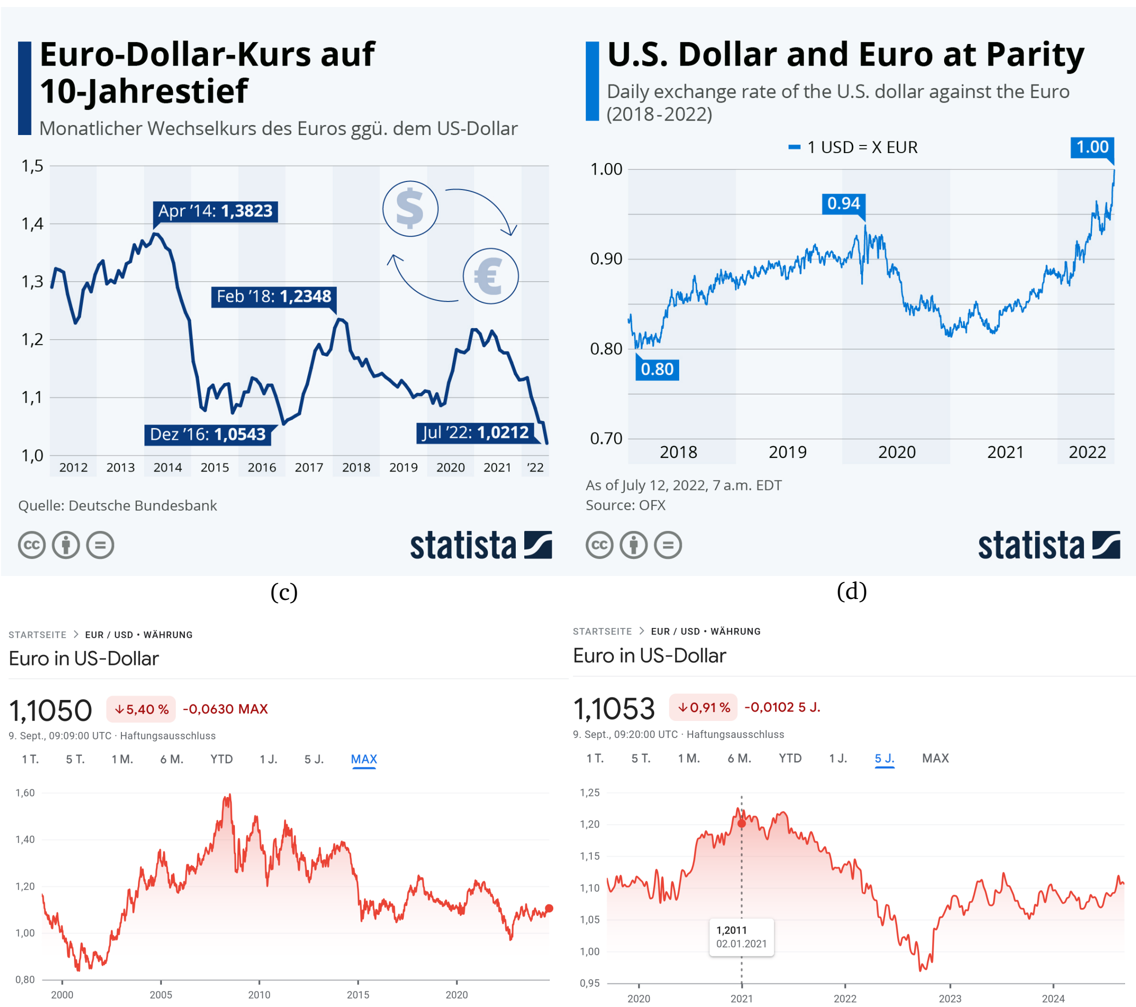
Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

Exercise 7.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 7.3: Euro to Dollar

(a) (b)



Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)
$$E_{\$}^{€} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 7.4. Exchange currencies

Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.

b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.

c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?

d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:

$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:

$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:

$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:

$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

7.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **i** Relative prices
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{₺}{€}} = E^{\frac{€}{₺}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 7.4: One wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 1\frac{₺}{€} = 1₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1₺ \cdot 1\frac{\text{wine}}{₺} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{₺}} = 0.5$ and $E^{\frac{₺}{€}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 7.5: Two wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 2\frac{₺}{€} = 2₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2₺ \cdot 1\frac{\text{wine}}{₺} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **i** Exchange rates and relative prices
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

7.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

7.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 7.6: *Who wins in the end?*

Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> *"We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional \$3.2 billion per month in added tax costs and another \$1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately \$165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers."*

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

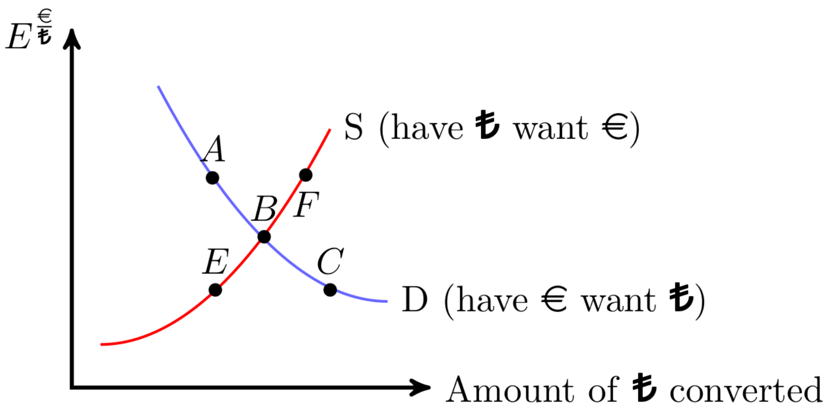
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

7.1.5 The FOREX

7.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 7.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{\text{€}}{\text{₺}}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{\text{€}}{\text{₺}}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{\text{€}}{\text{₺}}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{\text{€}}{\text{₺}}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 7.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

7.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 7.8: Players on the foreign exchange market

7.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

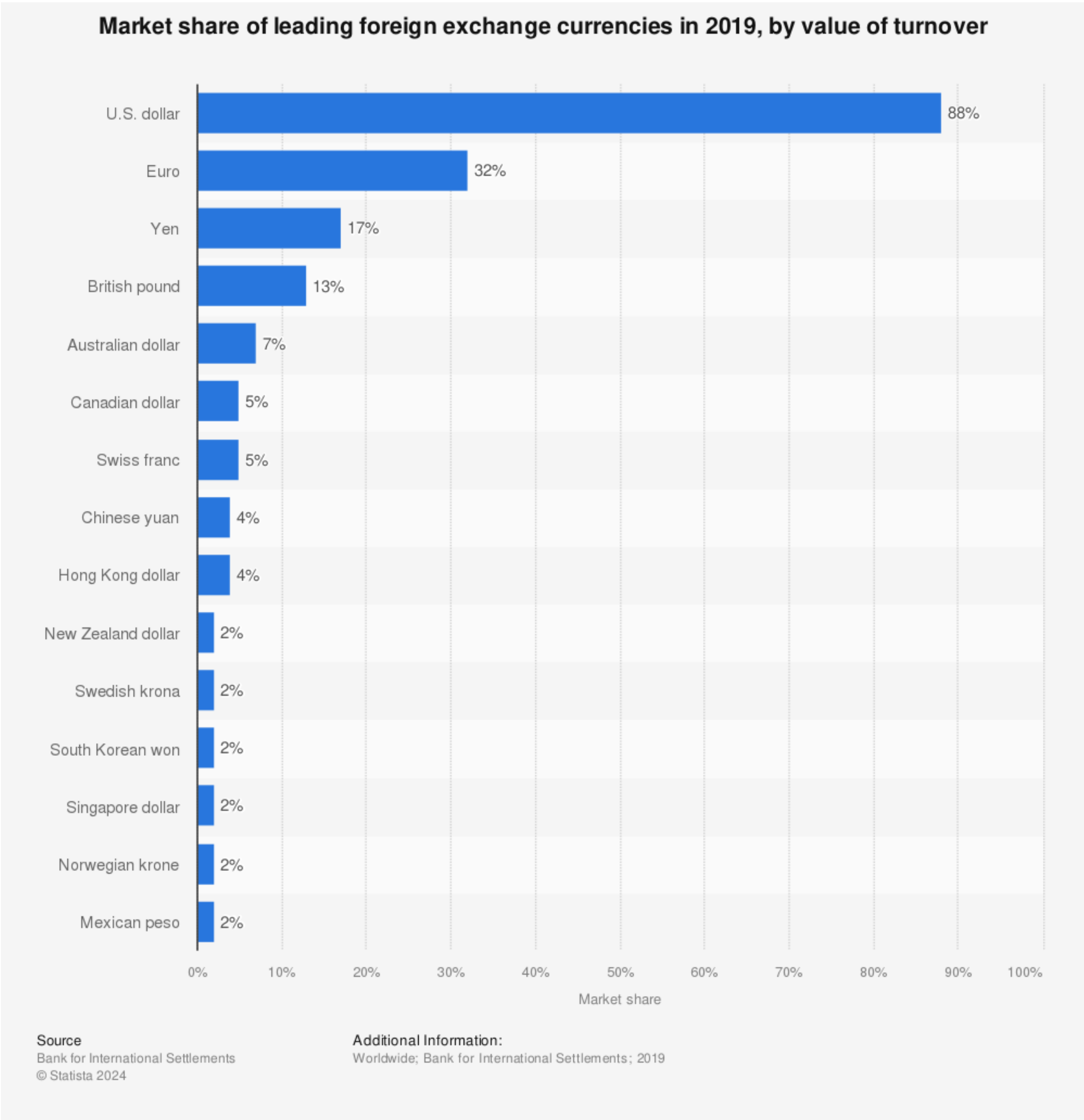
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

7.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 7.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 7.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 7.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56 \text{ EUR}}{4.75 \text{ USD}} \cdot \frac{6.57 \text{ USD}}{6.50 \text{ CHF}} = \frac{29.9592 \text{ EUR}}{30.875 \text{ CHF}} \approx 0.9703 \frac{\text{EUR}}{\text{CHF}}$$

and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305 \frac{\text{CHF}}{\text{EUR}}.$$

That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.
d) For 100 Euro we get

$$100 \text{ EUR} \cdot \frac{4.75 \text{ USD}}{4.56 \text{ EUR}} \approx 104.16 \text{ USD}$$

and these can be converted to

$$104.16 \text{ USD} \cdot \frac{6.50 \text{ CHF}}{6.57 \text{ USD}} \approx 103.05 \text{ CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in $ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09 \text{ USD}}{130 \text{ RUB}} = 0.016 \frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65 \text{ CAD}}{5.08 \text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75 \text{ USD}}{4.56 \text{ EUR}}}_{\approx 1.0416} \approx 1.36 \frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05 \text{ CAD}}{5.08 \text{ USD}} \approx 0.76 \frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 7.6. International arbitrage

Table 7.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	\$2
Switzerland	\$6
United States of America	\$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have \$100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.

b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 7.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	\$4	EUR 2
Switzerland	\$4	CHF 6
United States of America	\$4	-

Now, calculate and elucidate the following exchange rates:

- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

Solution

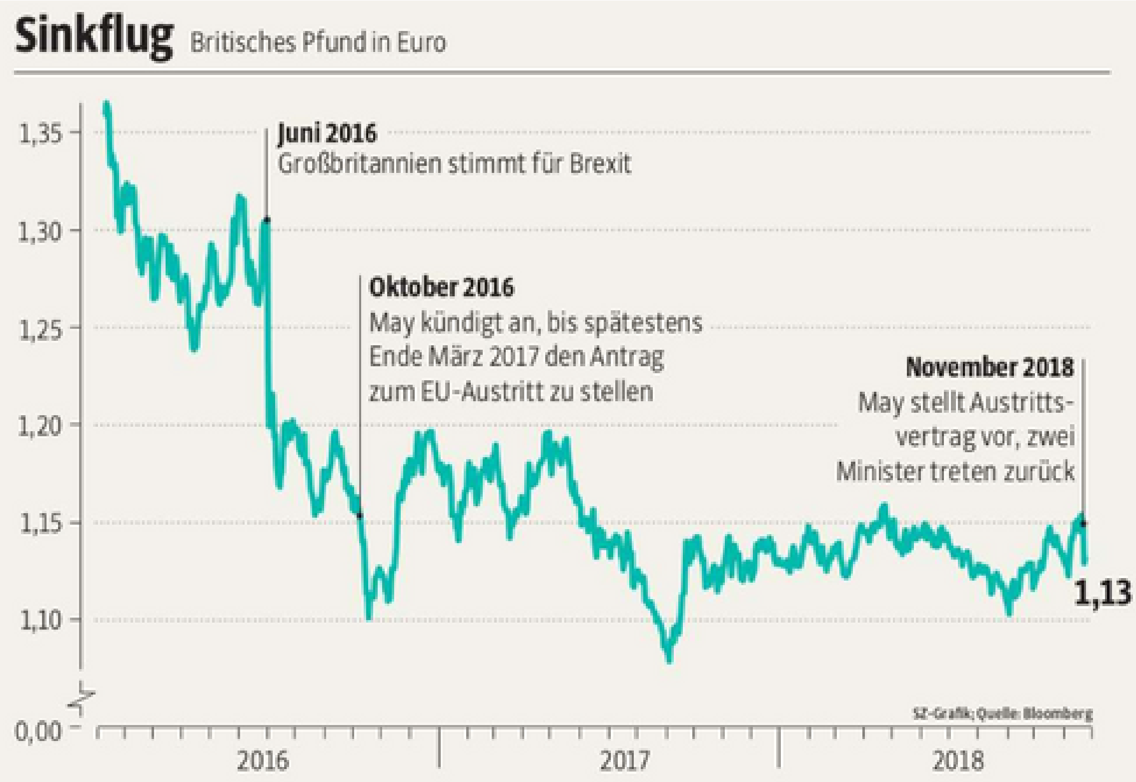
a) International arbitrage strategy
   - **Strategy**: Buy 50 units of good *08/15* in Germany for \$2 each with your \$100. Then, sell these units in Switzerland or the USA for \$6 each, making a total of \$300. This is a classic arbitrage strategy.
   - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
   - **USD to EUR:** $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
   - **EUR to USD:** $0.5\frac{EUR}{USD}$
   - **USD to CHF:** $\frac{2}{3}\frac{USD}{CHF}$
   - **CHF to USD:** $1.5\frac{CHF}{USD}$
   - **CHF to EUR:** $\frac{3}{1}\frac{CHF}{USD}$
   - **EUR to CHF:** $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 7.7. Brexit and the exchange rate

Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 7.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

7.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

7.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 7.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

7.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

7.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{7.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

7.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I^{\text{€}}_{t-1} \cdot E^{\frac{\text{₺}}{\text{€}}}_{t-1} \cdot E^{\frac{\text{€}}{\text{₺}}}_{t} = I^{\text{€}}_{t} \tag{7.2}$$

7.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1+\pi) \tag{7.3}$$

7.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{\text{€}} - I_{t-1}^{\text{€}}}{I_{t-1}^{\text{€}}} = \frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{\text{€}} = I_{t-1}^{\text{€}} \cdot (1+i^*) \cdot E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}} \cdot (1+\pi^*), \tag{7.4}$$

where $I_{t-1}^{\text{€}}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{\text{€}}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1+i^*)$, inflation $(1+\pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}})$:

$$\begin{aligned}
\underbrace{\frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}}^{*} - 1}_{r} &= (1+i^*) \cdot (1+\pi^*) \cdot \underbrace{E_{t-1}^{\frac{\text{₺}}{\text{€}}} \cdot E_t^{\frac{\text{€}}{\text{₺}}}}_{\alpha} -1 \\
r^* &= (1+i^*) \cdot (1+\pi^*) \cdot \alpha - 1
\end{aligned} \tag{7.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned}
r^* &= (1+i^*) \cdot \alpha - 1 \\
\Leftrightarrow r^* &= \alpha + \alpha i^* - 1.
\end{aligned} \tag{7.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned}
\Leftrightarrow r^* &= \alpha + \alpha i^* - 1 + i^* - i^* \\
\Leftrightarrow r^* &= \alpha - 1 + i^* + \alpha i^* - i^* \\
\Leftrightarrow r^* &= \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\
\Leftrightarrow r^* &= w + i^* + i^* w
\end{aligned} \tag{7.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 7.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:

- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?

Solution

Exchange rates and where to invest (Exercise 10.8)

a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

Thus, it is better to invest in Europe.

b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 7.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.

a) Where should you invest, given the following informations:
   - The interest rate in Germany is 1%.
   - The interest rate in Turkey is 10%.
   - 1€ can be converted to 7 ₺ this year in the FOREX
   - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
   - You expect no inflation in Germany and Turkey.
b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.

Solution

Turkey vs. Germany (Exercise 10.9)

a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:
b) **(Exact) calculation method in four steps:**
   `1. exchange € to ₺ in t-1:`

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

   2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

   3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$r_{GER} = 0.01$$
$$r_{TUR} = \frac{108.4507 - 100}{100} = 0.084507$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$TUR \rightarrow I_t^{€} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507$$
$$GER \rightarrow I_t^{€} = 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$

$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$r'_{GER} = 0.01$$
$$r'_{TUR} = 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$I_t^{€} = I_{t-1}^{€} E_{t-1}^{₺/€} (1+i) E_t^{€/₺*}$$
$$\Leftrightarrow E_t^{€/₺*} = \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$r_{GER} = i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1$$
$$\Leftrightarrow r_{GER} - i_{TUR} + 1 = \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}}$$
$$\Leftrightarrow E_t^{€/₺*'} = (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺}$$
$$\Leftrightarrow E_t^{€/₺*'} = (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$\begin{aligned} r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01 \\ I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1 \\ \rightarrow r^*_{TUR} =& 0.01 \end{aligned}$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 7.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider “1 EUR to cost 1 INR more” properly. This does not mean 1 INR is equal to 1 €!

7.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{7.8}$$
$$i = w + i^* \tag{7.9}$$
$$\tag{7.10}$$
$$\Leftrightarrow w = i - i^* \tag{7.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

7.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro ($E^{\frac{CHF}{€}}$), as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

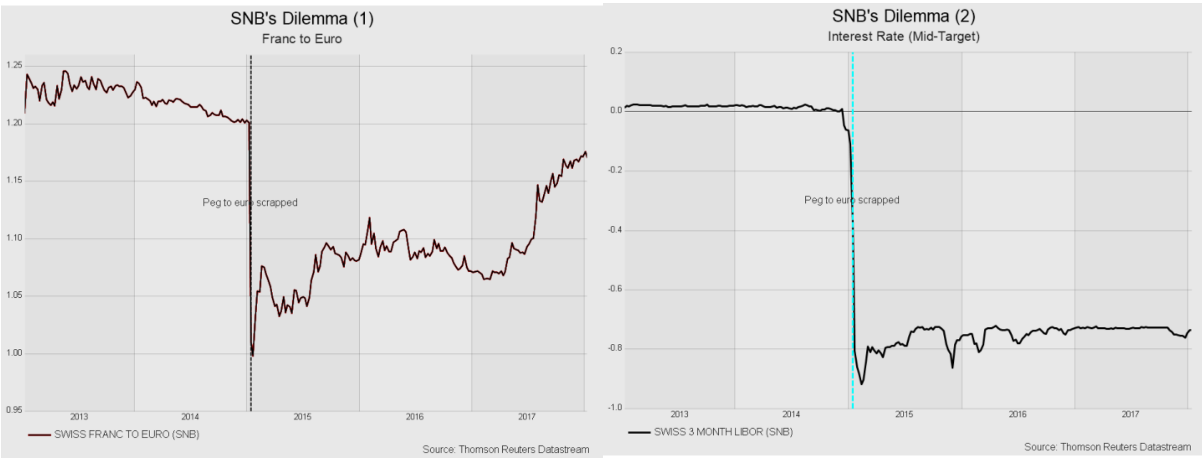
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 7.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

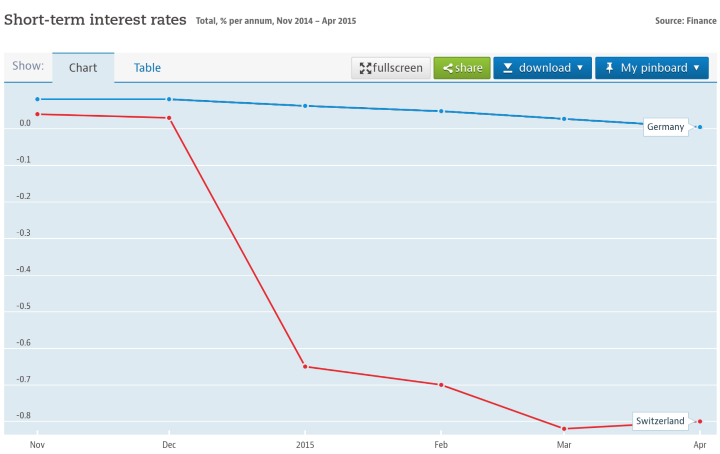
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 7.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

7.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{7.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{\text{€}}{\text{₺}}} = E_{t}^{\frac{\text{€}}{\text{₺}}} \Leftrightarrow \frac{E_{t-1}^{\frac{\text{€}}{\text{₺}}}}{E_{t}^{\frac{\text{€}}{\text{₺}}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$\begin{aligned} r^* &= (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 && (7.13) \\ \Leftrightarrow r &= i + \pi + \pi i && (7.14) \end{aligned}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{7.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

> Recommended reading
>
> Wikipedia (2025): Wikipedia entry to the Fisher Effect.

7.3 Balance of payments

> Required reading
>
> Council of Economic Advisers (2004, ch. 14)

7.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

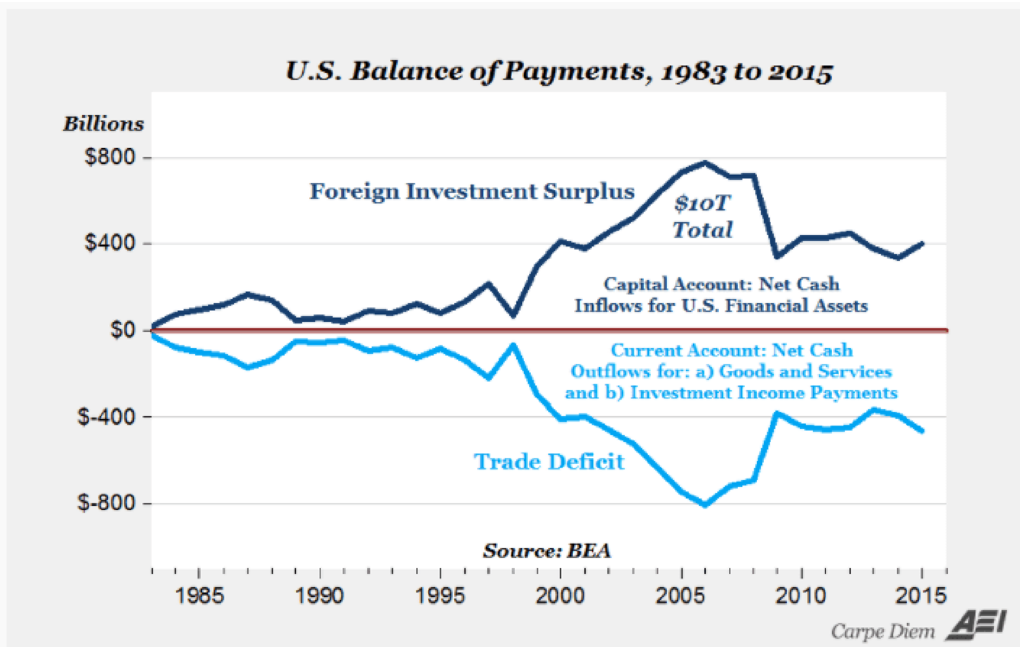
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 7.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 7.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 7.14: U.S. Balance of Payments



7.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

> Example
>
> Imagine Boeing, an American company, sells airplanes to a Japanese airline:
> 1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
> 2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
> 3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

> Example
>
> Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 7.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

7.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

7.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

7.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

7.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

7.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$
\begin{aligned}
Y &= C + I + G \\
\Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\
\Leftrightarrow S &= I,
\end{aligned}
$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

7.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$
\begin{aligned}
Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\
\Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\
\Leftrightarrow \underbrace{S - I}_{NCO} &= NEX
\end{aligned}
$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

7.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 7.15: Trump worries about the U.S. trade deficit

As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 7.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 7.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 7.16: The trade deficit of the United States over time

Part III

TRADE POLICY

Chapter 8

Monetary international economics

Students learn to. . .

- . . . interpret exchange rates and relate their changes to the relative prices of countries' goods.
- . . . predict the impact of exchange rate changes on business decisions and national economies.
- . . . understand the linkage between interest rates and inflation in open economies.
- . . . explain the interest rate parity condition and the purchasing power parity assumption.
- . . . interpret and evaluate the balances of trade and

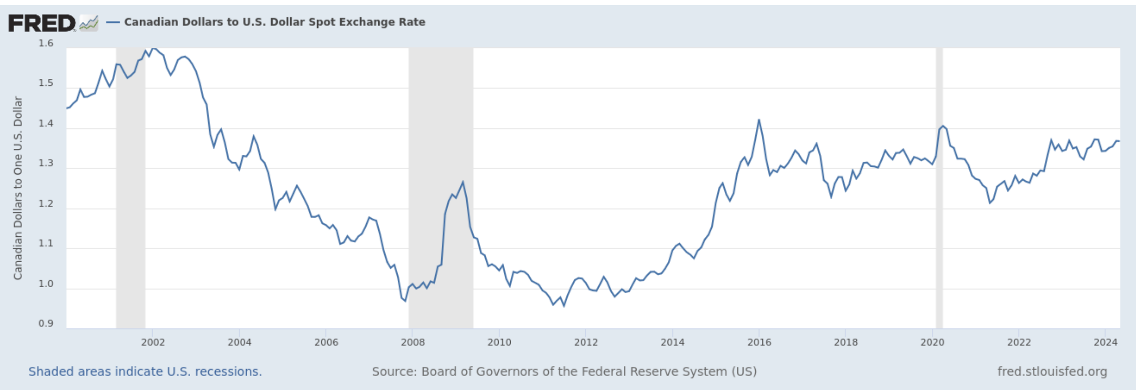
8.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 8.1. Exchange rates over time

Figure 8.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
 a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\text{ USD} \cdot 1.6\frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38}\frac{\text{USD}}{\text{CAD}} \approx 2318.84\text{ USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.

i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.

ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\text{ USD} \cdot 1.38\frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\text{ CAD}.$$

Finally, you convert the CAD back to USD

i) at the rate 1.38 CAD per USD:

$$1407.6\text{ CAD} \cdot \frac{1}{1.38}\frac{\text{USD}}{\text{CAD}} = 1020\text{ USD}.$$

ii) at the rate 1.42 CAD per USD:

$$1407.6\text{ CAD} \cdot \frac{1}{1.42}\frac{\text{USD}}{\text{CAD}} \approx 991.27\text{ USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 8.2. Our relations are not good

Figure 8.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a “strong” Turkish Lira and a “weak” Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump’s decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

8.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn’t a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of “it depends” arguments because it is challenging to make convincing cases based on intricate relationships.

[1]The total value added of a country in a given period
[2]The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency
[3]The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.

- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

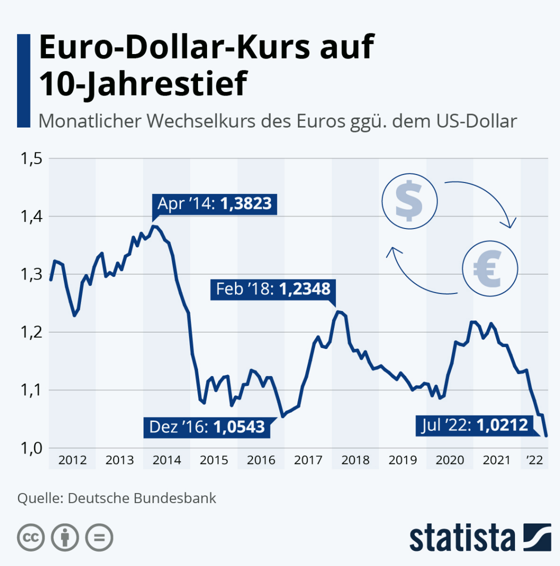
Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

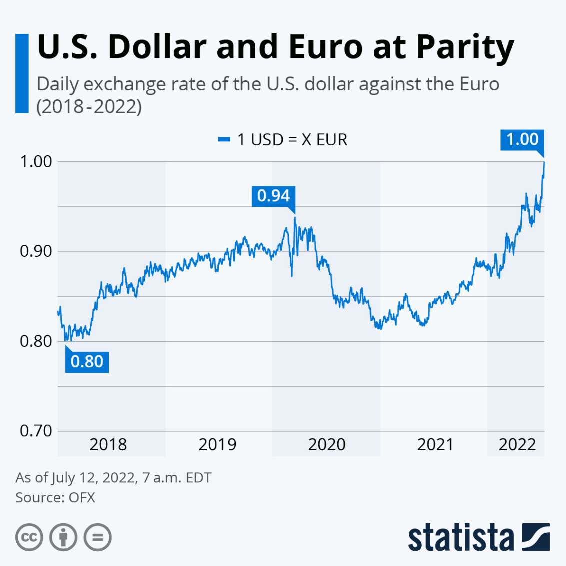
Exercise 8.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 8.3: Euro to Dollar

(a)



(b)



(c)

(d)

Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E_{\$}^{€} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E_{\$}^{€} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E_{\$}^{€} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)
$$E^{€}_{\$} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 8.4. Exchange currencies
Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.
b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.
c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?
d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:

$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:

$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:

$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:

$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

8.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **i Relative prices**
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{\text{₺}}{\text{€}}} = E^{\frac{\text{€}}{\text{₺}}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 8.4: One wine per Euro

$$\boxed{\text{exchange } 1\text{ €}} \longrightarrow \boxed{1\text{€} \cdot 1\tfrac{\text{₺}}{\text{€}} = 1\text{₺}} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1\text{₺} \cdot 1\tfrac{\text{wine}}{\text{₺}} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{\text{€}}{\text{₺}}} = 0.5$ and $E^{\frac{\text{₺}}{\text{€}}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 8.5: Two wine per Euro

$$\boxed{\text{exchange } 1\text{ €}} \longrightarrow \boxed{1\text{€} \cdot 2\tfrac{\text{₺}}{\text{€}} = 2\text{₺}} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2\text{₺} \cdot 1\tfrac{\text{wine}}{\text{₺}} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **i Exchange rates and relative prices**
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

8.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

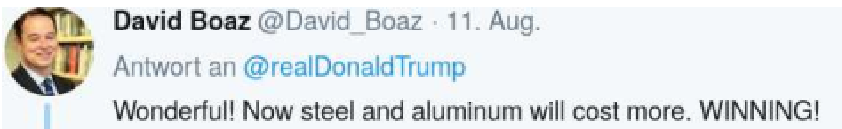
8.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 8.6: *Who wins in the end?*



Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers.*"

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

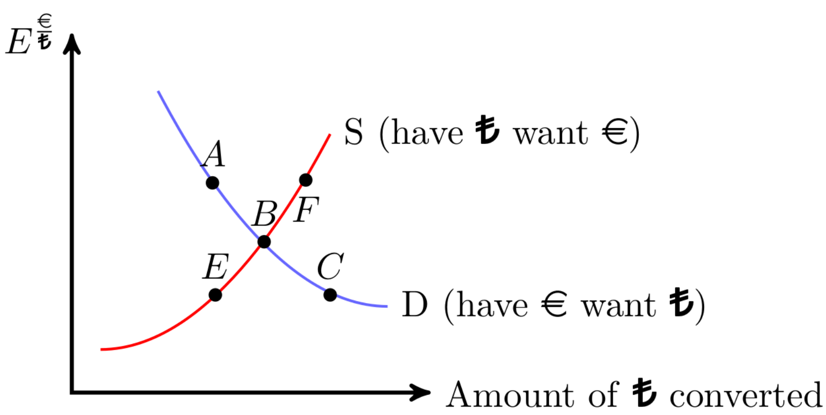
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

8.1.5 The FOREX

8.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 8.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{\text{€}}{\text{₺}}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{\text{€}}{\text{₺}}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{\text{€}}{\text{₺}}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{\text{€}}{\text{₺}}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 8.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

8.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 8.8: Players on the foreign exchange market

8.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

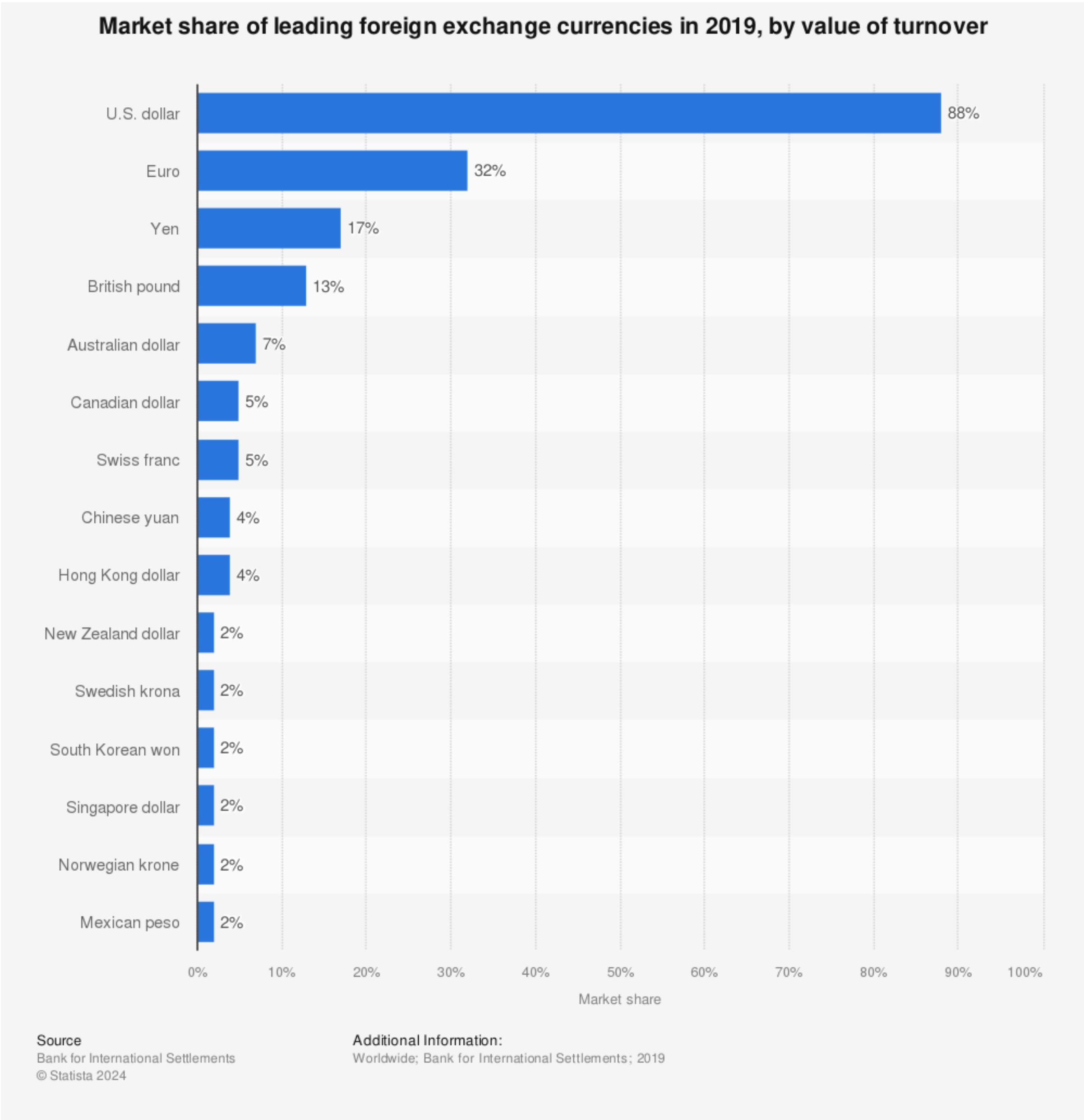
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

8.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 8.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 8.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 8.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56 \text{ EUR}}{4.75 \text{ USD}} \cdot \frac{6.57 \text{ USD}}{6.50 \text{ CHF}} = \frac{29.9592 \text{ EUR}}{30.875 \text{ CHF}} \approx 0.9703 \frac{\text{EUR}}{\text{CHF}}$$

   and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305 \frac{\text{CHF}}{\text{EUR}}.$$

   That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.
d) For 100 Euro we get

$$100 \text{ EUR} \cdot \frac{4.75 \text{ USD}}{4.56 \text{ EUR}} \approx 104.16 \text{ USD}$$

   and these can be converted to

$$104.16 \text{ USD} \cdot \frac{6.50 \text{ CHF}}{6.57 \text{ USD}} \approx 103.05 \text{ CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in $ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09 \text{ USD}}{130 \text{ RUB}} = 0.016 \frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65 \text{ CAD}}{5.08 \text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75 \text{ USD}}{4.56 \text{ EUR}}}_{\approx 1.0416} \approx 1.36 \frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05 \text{ CAD}}{5.08 \text{ USD}} \approx 0.76 \frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 8.6. International arbitrage

Table 8.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	$2
Switzerland	$6
United States of America	$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have $100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.
b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 8.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	$4	EUR 2
Switzerland	$4	CHF 6
United States of America	$4	-

Now, calculate and elucidate the following exchange rates:

- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

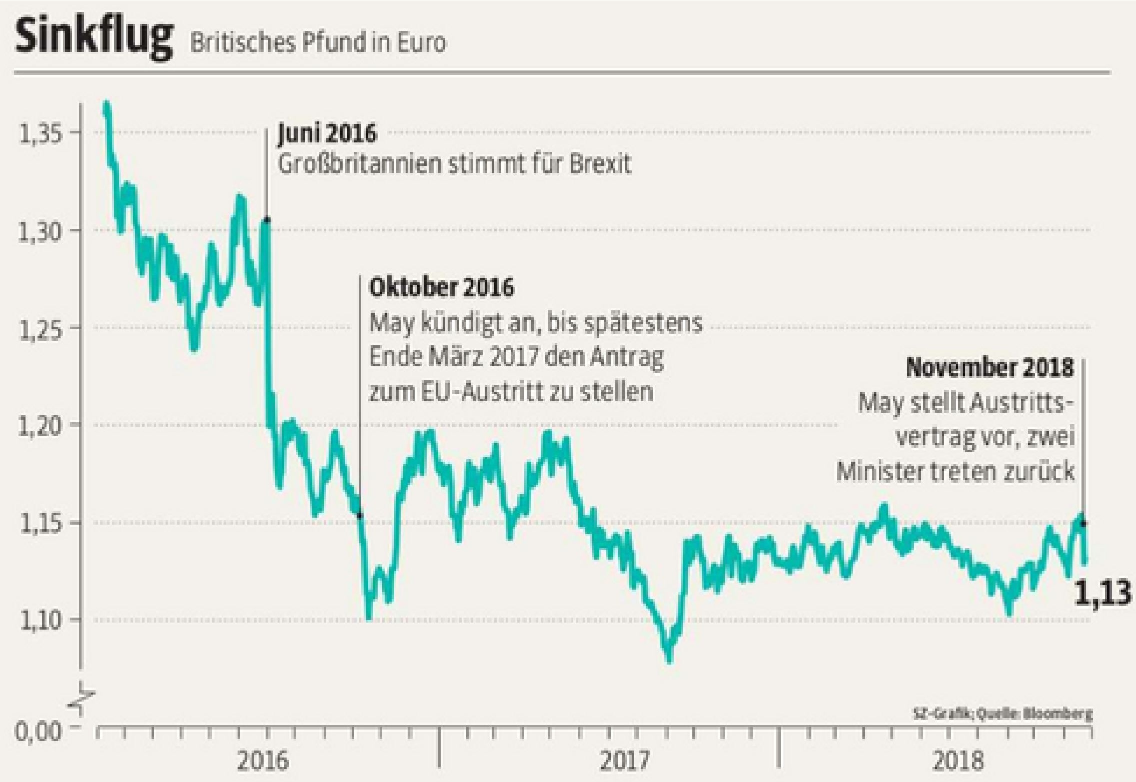
Solution

a) International arbitrage strategy
   - **Strategy**: Buy 50 units of good *08/15* in Germany for $2 each with your $100. Then, sell these units in Switzerland or the USA for $6 each, making a total of $300. This is a classic arbitrage strategy.
   - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
   - **USD to EUR:** $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
   - **EUR to USD:** $0.5\frac{EUR}{USD}$
   - **USD to CHF:** $\frac{2}{3}\frac{USD}{CHF}$
   - **CHF to USD:** $1.5\frac{CHF}{USD}$
   - **CHF to EUR:** $\frac{3}{1}\frac{CHF}{USD}$
   - **EUR to CHF:** $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 8.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 8.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

8.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

8.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 8.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

8.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

8.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{8.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

8.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I^{\text{€}}_{t-1} \cdot E^{\frac{\text{₺}}{\text{€}}}_{t-1} \cdot E^{\frac{\text{€}}{\text{₺}}}_{t} = I^{\text{€}}_{t} \tag{8.2}$$

8.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1 + \pi) \tag{8.3}$$

8.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}} = \frac{I_t^{€}}{I_{t-1}^{€}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{€} = I_{t-1}^{€} \cdot (1 + i^*) \cdot E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}} \cdot (1 + \pi^*), \tag{8.4}$$

where $I_{t-1}^{€}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{€}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1 + i^*)$, inflation $(1 + \pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}})$:

$$\underbrace{\frac{I_t^{€^*}}{I_{t-1}^{€}} - 1}_{r} = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}}}_{\alpha} - 1$$

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \alpha - 1 \tag{8.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned} r^* &= (1 + i^*) \cdot \alpha - 1 \\ \Leftrightarrow r^* &= \alpha + \alpha i^* - 1. \end{aligned} \tag{8.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned} &\Leftrightarrow r^* = \alpha + \alpha i^* - 1 + i^* - i^* \\ &\Leftrightarrow r^* = \alpha - 1 + i^* + \alpha i^* - i^* \\ &\Leftrightarrow r^* = \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\ &\Leftrightarrow r^* = w + i^* + i^* w \end{aligned} \tag{8.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 8.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:
- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?

Solution
Exchange rates and where to invest (Exercise 10.8)

a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

Thus, it is better to invest in Europe.

b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 8.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.

a) Where should you invest, given the following informations:
   - The interest rate in Germany is 1%.
   - The interest rate in Turkey is 10%.
   - 1€ can be converted to 7 ₺ this year in the FOREX
   - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
   - You expect no inflation in Germany and Turkey.
b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.

Solution
Turkey vs. Germany (Exercise 10.9)

a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:

b) **(Exact) calculation method in four steps:**
   1. exchange € to ₺ in t-1:

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

   2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

   3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$\begin{aligned} r_{GER} =& 0.01 \\ r_{TUR} =& \frac{108.4507-100}{100} = 0.084507 \end{aligned}$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{\text{₺}/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/\text{₺}}}^{\text{exchange rate in t}}$$

$$\begin{aligned} TUR \rightarrow I_t^{€} =& 100€ \cdot 7\frac{\text{₺}}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1\text{₺}} = 108.4507 \rightarrow r_{TUR} = 0.084507 \\ GER \rightarrow I_t^{€} =& 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01 \end{aligned}$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$

$$\text{with} \quad w = \frac{E_t^{€/\text{₺}}}{E_{t-1}^{€/\text{₺}}} - 1$$

$$\begin{aligned} r'_{GER} =& 0.01 \\ r'_{TUR} =& 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591 \end{aligned}$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/\text{₺}*}$, is calculated as follows:

$$\begin{aligned} I_t^{€} &= I_{t-1}^{€} E_{t-1}^{\text{₺}/€}(1+i) E_t^{€/\text{₺}*} \\ \Leftrightarrow E_t^{€/\text{₺}*} &= \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{\text{₺}/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311 \end{aligned}$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/\text{₺}*'}$, is calculated as follows:

$$\begin{aligned} r_{GER} =& i_{TUR} + \frac{E_t^{€/\text{₺}*'}}{E_{t-1}^{€/\text{₺}}} - 1 \\ \Leftrightarrow r_{GER} - i_{TUR} + 1 =& \frac{E_t^{€/\text{₺}*'}}{E_{t-1}^{€/\text{₺}}} \\ \Leftrightarrow E_t^{€/\text{₺}*'} =& (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/\text{₺}} \\ \Leftrightarrow E_t^{€/\text{₺}*'} =& (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13 \end{aligned}$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$\begin{aligned}
r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01\\
I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1\\
\rightarrow r^*_{TUR} =& 0.01
\end{aligned}$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 8.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider "1 EUR to cost 1 INR more" properly. This does not mean 1 INR is equal to 1 €!

8.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{8.8}$$
$$i = w + i^* \tag{8.9}$$
$$\tag{8.10}$$
$$\Leftrightarrow w = i - i^* \tag{8.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

8.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro $(E^{\frac{CHF}{€}})$, as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

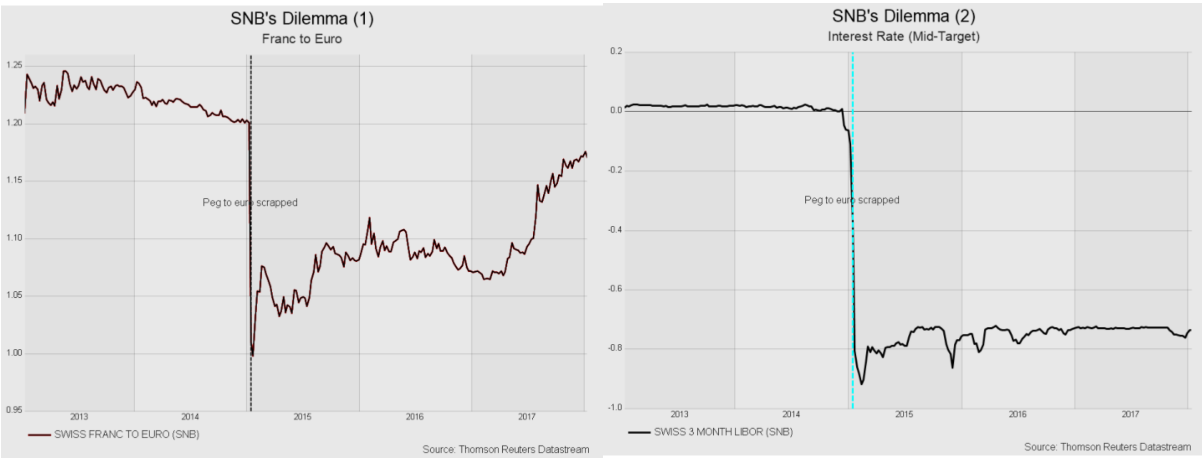
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 8.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

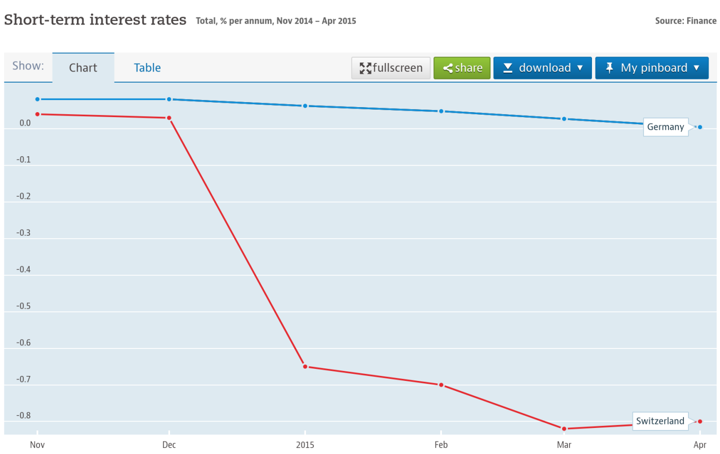
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 8.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

8.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{8.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{€}{₺}} = E_{t}^{\frac{€}{₺}} \Leftrightarrow \frac{E_{t-1}^{\frac{€}{₺}}}{E_{t}^{\frac{€}{₺}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 \tag{8.13}$$

$$\Leftrightarrow r = i + \pi + \pi i \tag{8.14}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{8.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

Recommended reading

Wikipedia (2025): Wikipedia entry to the Fisher Effect.

8.3 Balance of payments

Required reading

Council of Economic Advisers (2004, ch. 14)

8.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

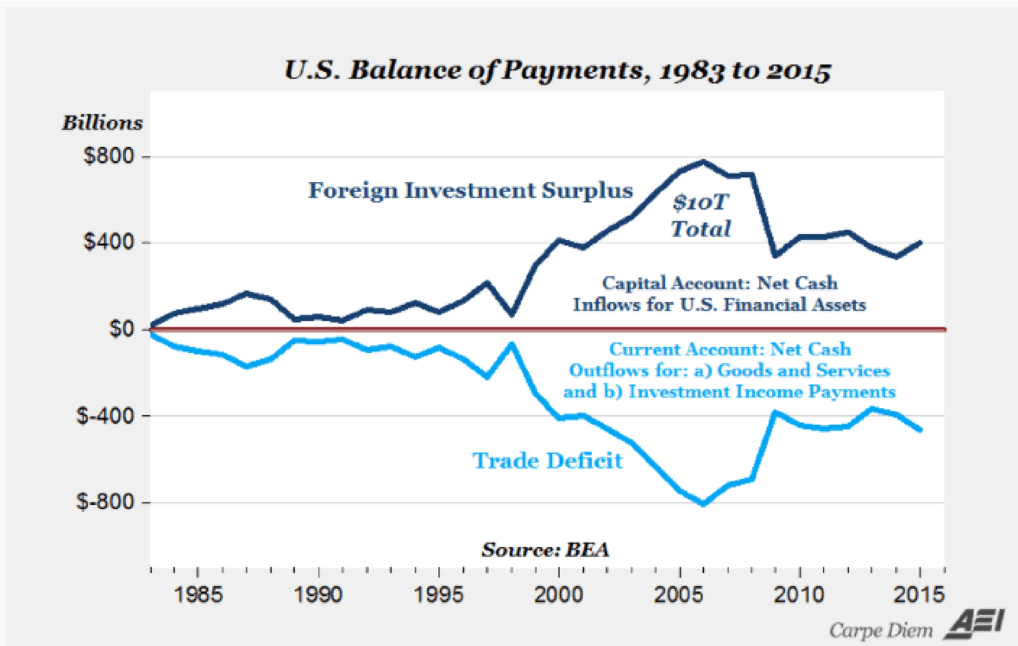
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 8.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 8.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 8.14: U.S. Balance of Payments



8.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 8.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

8.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

8.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

8.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

8.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

8.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$\begin{aligned} Y &= C + I + G \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\ \Leftrightarrow S &= I, \end{aligned}$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

8.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$\begin{aligned} Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\ \Leftrightarrow \underbrace{S - I}_{NCO} &= NEX \end{aligned}$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

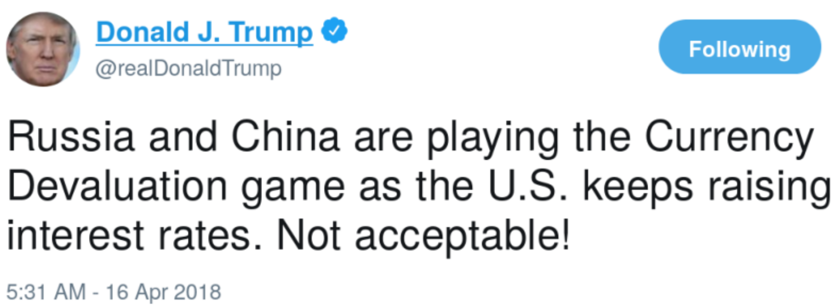
8.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 8.15: Trump worries about the U.S. trade deficit



As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 8.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 8.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 8.16: The trade deficit of the United States over time

Chapter 9

Monetary international economics

Students learn to...

- ...interpret exchange rates and relate their changes to the relative prices of countries' goods.
- ...predict the impact of exchange rate changes on business decisions and national economies.
- ...understand the linkage between interest rates and inflation in open economies.
- ...explain the interest rate parity condition and the purchasing power parity assumption.
- ...interpret and evaluate the balances of trade and

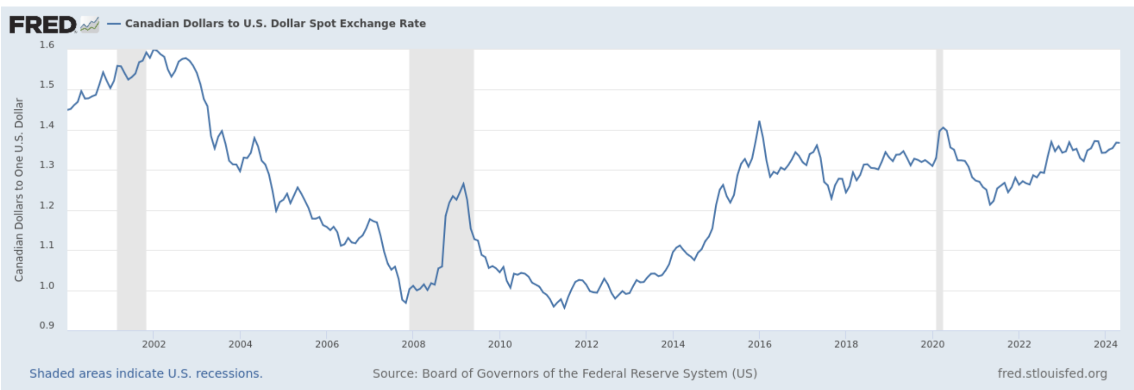
9.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 9.1. Exchange rates over time

Figure 9.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.
Solution
a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\ \text{USD} \cdot 1.6\frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38}\frac{\text{USD}}{\text{CAD}} \approx 2318.84\ \text{USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.
   i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.
   ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\ \text{USD} \cdot 1.38\frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\ \text{CAD}.$$

Finally, you convert the CAD back to USD
   i) at the rate 1.38 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.38}\frac{\text{USD}}{\text{CAD}} = 1020\ \text{USD}.$$

   ii) at the rate 1.42 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.42}\frac{\text{USD}}{\text{CAD}} \approx 991.27\ \text{USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 9.2. Our relations are not good

Figure 9.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a "strong" Turkish Lira and a "weak" Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump's decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

9.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn't a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of "it depends" arguments because it is challenging to make convincing cases based on intricate relationships.

[1]The total value added of a country in a given period
[2]The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency
[3]The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.
- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

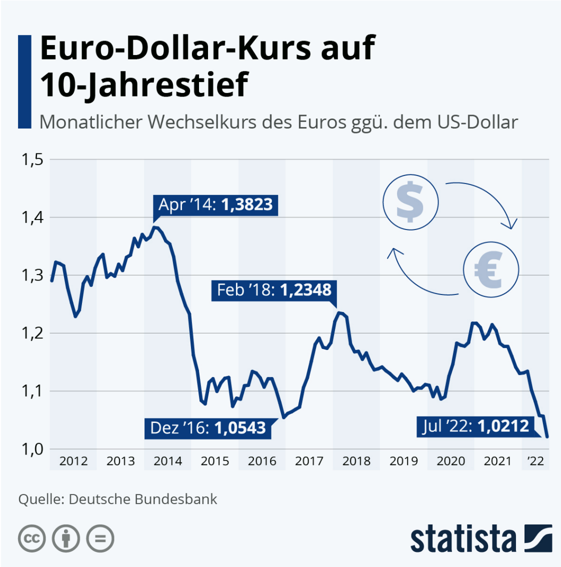
Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

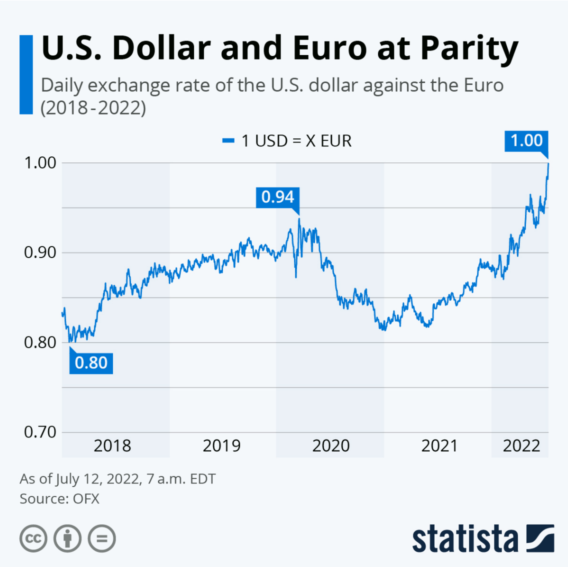
Exercise 9.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 9.3: Euro to Dollar

(a)



(b)



(c)

(d)

Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 9.4. Exchange currencies
Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.
b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.
c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?
d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:

$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:

$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:

$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:

$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

9.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **i** Relative prices
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{₺}{€}} = E^{\frac{€}{₺}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 9.4: One wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 1\frac{₺}{€} = 1₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1₺ \cdot 1\frac{\text{wine}}{₺} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{₺}} = 0.5$ and $E^{\frac{₺}{€}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 9.5: Two wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 2\frac{₺}{€} = 2₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2₺ \cdot 1\frac{\text{wine}}{₺} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **i** Exchange rates and relative prices
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

9.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

9.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 9.6: *Who wins in the end?*

Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers.”*

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

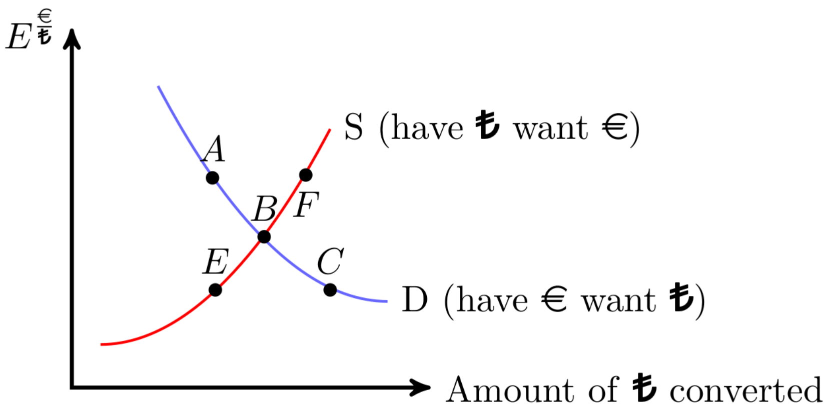
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

9.1.5 The FOREX

9.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 9.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{€}{₺}}$ is low:
  - At this lower exchange rate, there’s a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{€}{₺}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{€}{₺}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{€}{₺}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately \$ 7,506 billion, as highlighted in Table 10.1.

Table 9.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

9.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 9.8: Players on the foreign exchange market

9.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

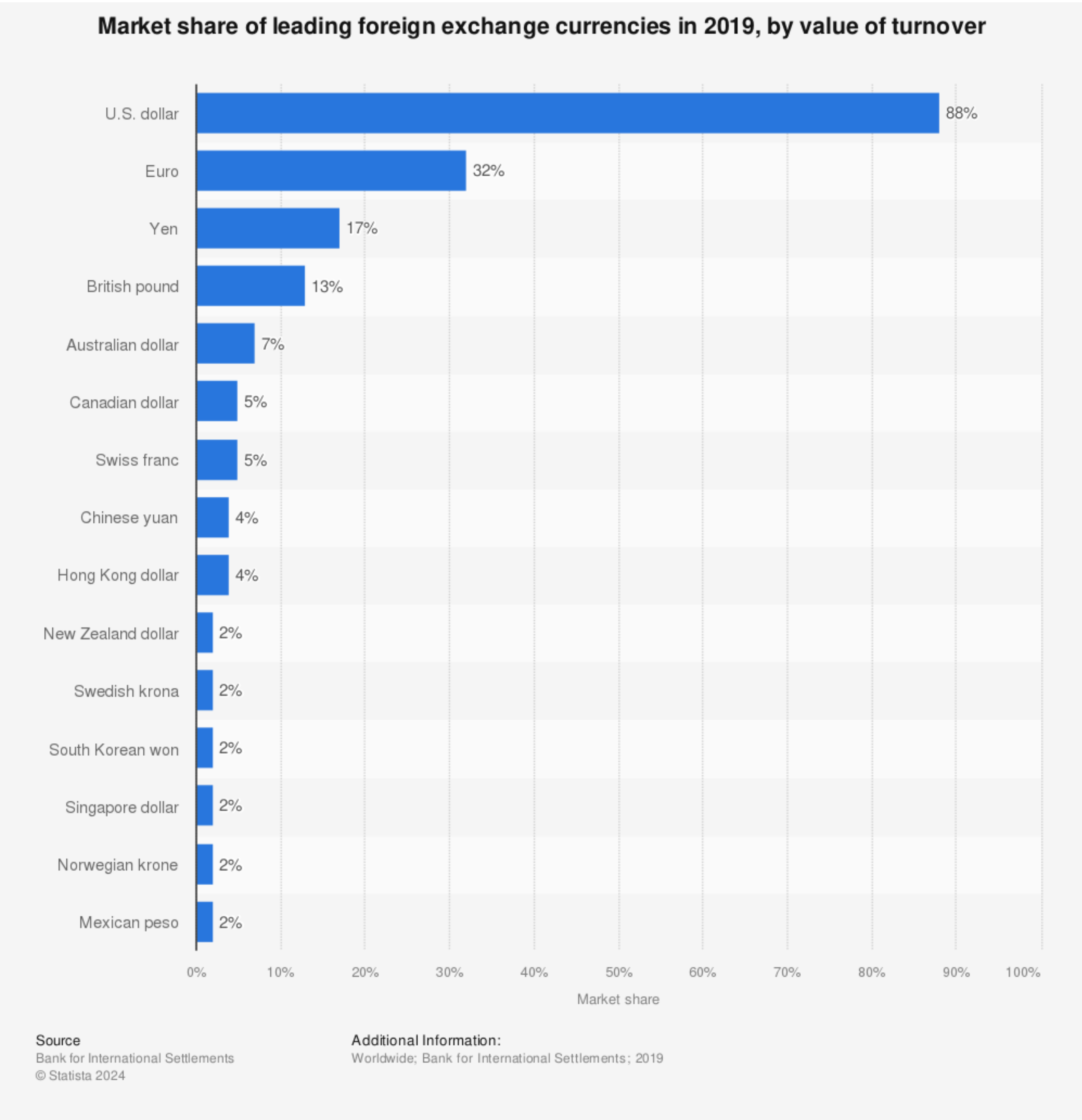
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

9.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 9.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 9.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 9.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
    i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
    ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
    iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
    iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
    v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56 \text{ EUR}}{4.75 \text{ USD}} \cdot \frac{6.57 \text{ USD}}{6.50 \text{ CHF}} = \frac{29.9592 \text{ EUR}}{30.875 \text{ CHF}} \approx 0.9703 \frac{\text{EUR}}{\text{CHF}}$$

and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305 \frac{\text{CHF}}{\text{EUR}}.$$

That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.
d) For 100 Euro we get

$$100 \text{ EUR} \cdot \frac{4.75 \text{ USD}}{4.56 \text{ EUR}} \approx 104.16 \text{ USD}$$

and these can be converted to

$$104.16 \text{ USD} \cdot \frac{6.50 \text{ CHF}}{6.57 \text{ USD}} \approx 103.05 \text{ CHF}$$

e) Here are the answers:
    i) is false: The price of a Big Mac in $ is different across countries.
    ii) is correct.
    iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09 \text{ USD}}{130 \text{ RUB}} = 0.016 \frac{\text{USD}}{\text{RUB}}.$$

    iv) is incorrect:

$$\underbrace{\frac{6.65 \text{ CAD}}{5.08 \text{ USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75 \text{ USD}}{4.56 \text{ EUR}}}_{\approx 1.0416} \approx 1.36 \frac{\text{CAD}}{\text{EUR}}.$$

    v) is incorrect:

$$\frac{6.05 \text{ CAD}}{5.08 \text{ USD}} \approx 0.76 \frac{\text{CAD}}{\text{USD}}.$$

Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 9.6. International arbitrage

Table 9.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	$2
Switzerland	$6
United States of America	$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have $100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.
b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 9.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	$4	EUR 2
Switzerland	$4	CHF 6
United States of America	$4	-

Now, calculate and elucidate the following exchange rates:
- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

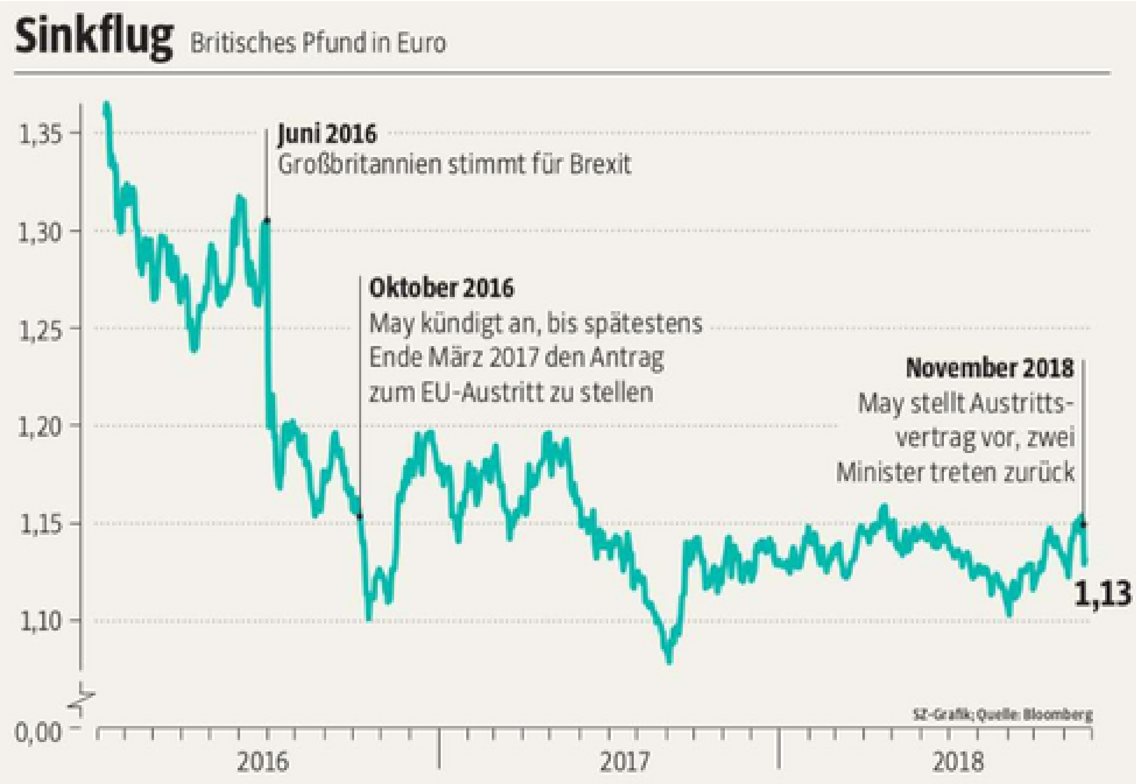
Solution

a) International arbitrage strategy
   - **Strategy**: Buy 50 units of good *08/15* in Germany for $2 each with your $100. Then, sell these units in Switzerland or the USA for $6 each, making a total of $300. This is a classic arbitrage strategy.
   - **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
   - **USD to EUR:** $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
   - **EUR to USD:** $0.5\frac{EUR}{USD}$
   - **USD to CHF:** $\frac{2}{3}\frac{USD}{CHF}$
   - **CHF to USD:** $1.5\frac{CHF}{USD}$
   - **CHF to EUR:** $\frac{3}{1}\frac{CHF}{USD}$
   - **EUR to CHF:** $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 9.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 9.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

9.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

9.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 9.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

9.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

9.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{9.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

9.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I^{€}_{t-1} \cdot E^{\frac{₺}{€}}_{t-1} \cdot E^{\frac{€}{₺}}_{t} = I^{€}_{t} \tag{9.2}$$

9.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1+\pi) \tag{9.3}$$

9.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}} = \frac{I_t^{€}}{I_{t-1}^{€}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{€} = I_{t-1}^{€} \cdot (1+i^*) \cdot E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}} \cdot (1+\pi^*), \tag{9.4}$$

where $I_{t-1}^{€}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{€}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1+i^*)$, inflation $(1+\pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}})$:

$$\underbrace{\frac{I_t^{€}}{I_{t-1}^{€}}^{*} - 1}_{r} = (1+i^*) \cdot (1+\pi^*) \cdot \underbrace{E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}}}_{\alpha} - 1$$

$$r^* = (1+i^*) \cdot (1+\pi^*) \cdot \alpha - 1 \tag{9.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned} r^* &= (1+i^*) \cdot \alpha - 1 \\ \Leftrightarrow r^* &= \alpha + \alpha i^* - 1. \end{aligned} \tag{9.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned} &\Leftrightarrow r^* = \alpha + \alpha i^* - 1 + i^* - i^* \\ &\Leftrightarrow r^* = \alpha - 1 + i^* + \alpha i^* - i^* \\ &\Leftrightarrow r^* = \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\ &\Leftrightarrow r^* = w + i^* + i^* w \end{aligned} \tag{9.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 9.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:

- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?
Solution
Exchange rates and where to invest (Exercise 10.8)
   a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

   Thus, it is better to invest in Europe.
   b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 9.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.
a) Where should you invest, given the following informations:
   - The interest rate in Germany is 1%.
   - The interest rate in Turkey is 10%.
   - 1€ can be converted to 7 ₺ this year in the FOREX
   - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
   - You expect no inflation in Germany and Turkey.

b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.
Solution
Turkey vs. Germany (Exercise 10.9)
   a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:
   b) **(Exact) calculation method in four steps:**
      1. exchange € to ₺ in t-1:

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

      2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

      3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$r_{GER} = 0.01$$
$$r_{TUR} = \frac{108.4507 - 100}{100} = 0.084507$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$TUR \rightarrow I_t^{€} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507$$
$$GER \rightarrow I_t^{€} = 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$
$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$r'_{GER} = 0.01$$
$$r'_{TUR} = 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$I_t^{€} = I_{t-1}^{€} E_{t-1}^{₺/€}(1+i) E_t^{€/₺*}$$
$$\Leftrightarrow E_t^{€/₺*} = \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$r_{GER} = i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1$$
$$\Leftrightarrow r_{GER} - i_{TUR} + 1 = \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}}$$
$$\Leftrightarrow E_t^{€/₺*'} = (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺}$$
$$\Leftrightarrow E_t^{€/₺*'} = (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$
\begin{aligned}
r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01 \\
I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1 \\
\rightarrow r^*_{TUR} =& 0.01
\end{aligned}
$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 9.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$
50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}
$$

To calculate the rate of return calculate

$$
\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.
$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider “1 EUR to cost 1 INR more” properly. This does not mean 1 INR is equal to 1 €!

9.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$
r < r^*.
$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$
i < w + i^*.
$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{9.8}$$

$$i = w + i^* \tag{9.9}$$

$$\tag{9.10}$$

$$\Leftrightarrow w = i - i^* \tag{9.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

9.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro ($E^{\frac{CHF}{€}}$), as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

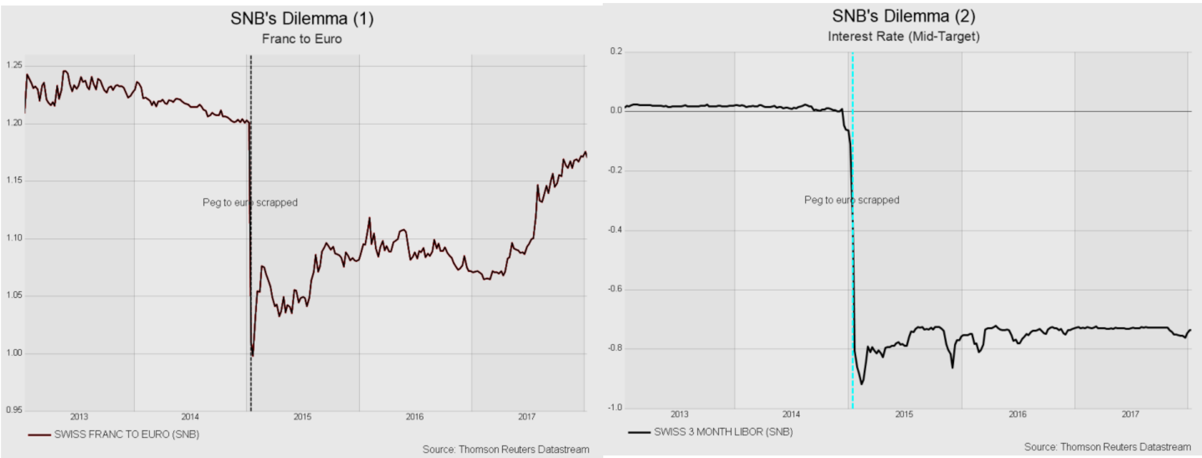
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 9.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

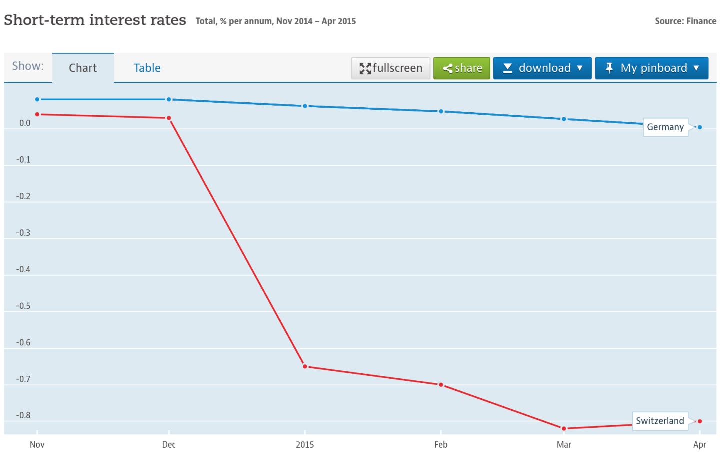
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 9.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

9.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{9.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{€}{₺}} = E_t^{\frac{€}{₺}} \Leftrightarrow \frac{E_{t-1}^{\frac{€}{₺}}}{E_t^{\frac{€}{₺}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 \tag{9.13}$$

$$\Leftrightarrow r = i + \pi + \pi i \tag{9.14}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{9.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

Recommended reading

Wikipedia (2025): Wikipedia entry to the Fisher Effect.

9.3 Balance of payments

Required reading

Council of Economic Advisers (2004, ch. 14)

9.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

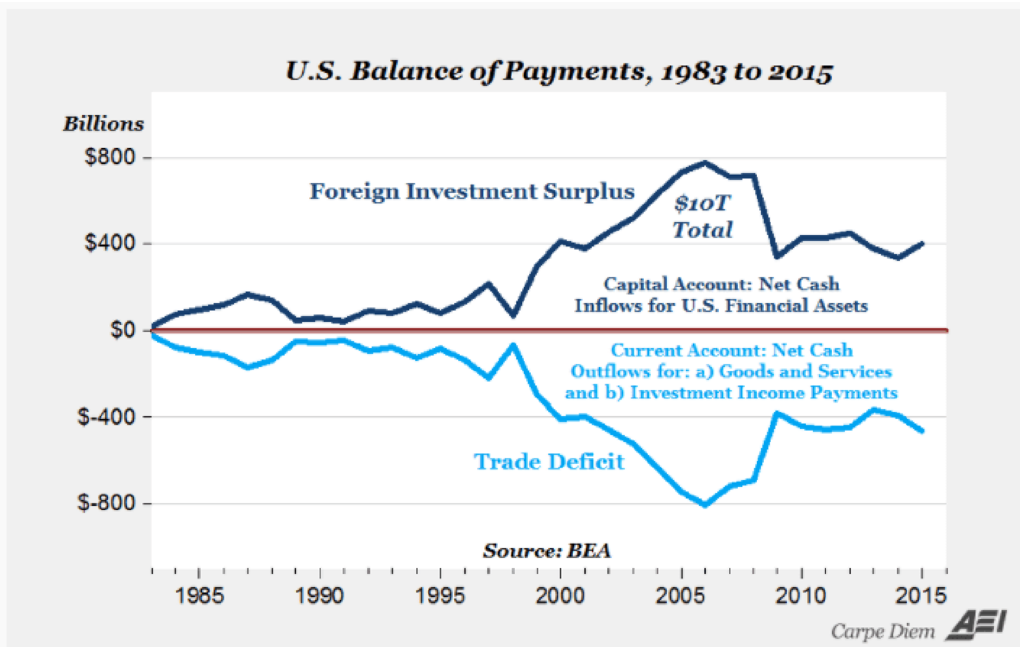
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 9.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 9.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 9.14: U.S. Balance of Payments



9.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 9.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

9.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

9.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

9.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

9.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

9.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$\begin{aligned} Y &= C + I + G \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\ \Leftrightarrow S &= I, \end{aligned}$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

9.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$\begin{aligned} Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\ \Leftrightarrow \underbrace{S - I}_{NCO} &= NEX \end{aligned}$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

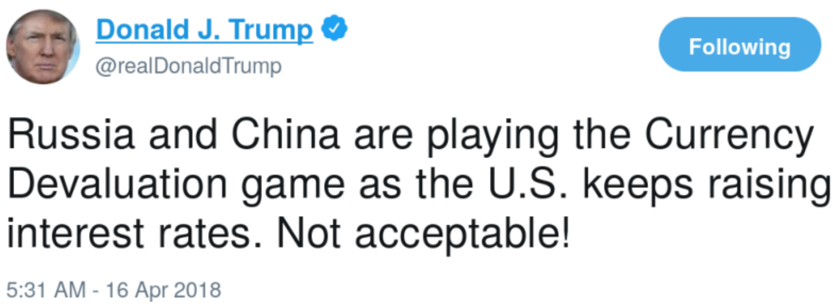
9.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 9.15: Trump worries about the U.S. trade deficit



As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 9.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 9.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 9.16: The trade deficit of the United States over time

Chapter 10

Monetary international economics

Students learn to...

- ...interpret exchange rates and relate their changes to the relative prices of countries' goods.
- ...predict the impact of exchange rate changes on business decisions and national economies.
- ...understand the linkage between interest rates and inflation in open economies.
- ...explain the interest rate parity condition and the purchasing power parity assumption.
- ...interpret and evaluate the balances of trade and

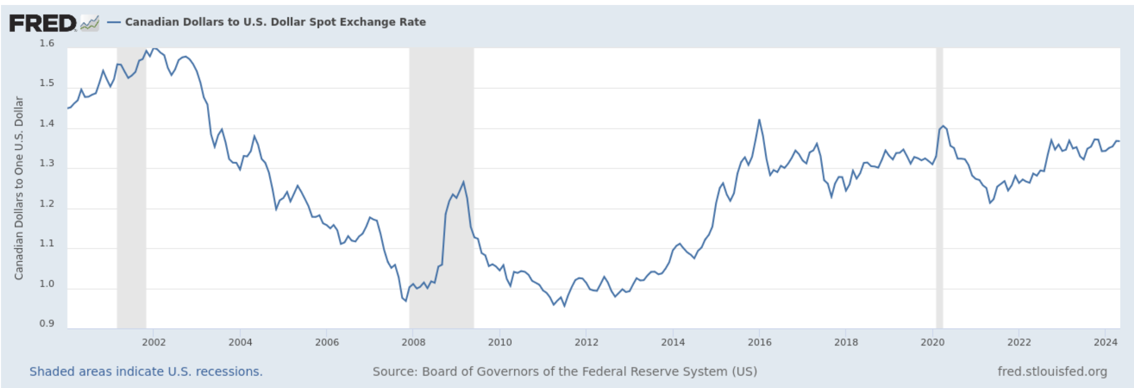
10.1 Currencies

An exchange rate indicates the value of one currency in relation to another. Exchange rate fluctuations have a significant impact on the revenues, costs, and profits of businesses; they affect how much you can afford to spend and can even influence job security.

Please work on the questions posed in Exercise 10.1 and Exercise 10.2. They are designed to motivate an introduction the topic.

Exercise 10.1. Exchange rates over time

Figure 10.1: Canadian Dollars to U.S. Dollar Exchange Rate



a) As can be seen in Figure 10.1, 1 United States Dollar (USD) equals about 1.38 Canadian Dollar (CAD) today. Since January 2002, has the USD depreciated (lost value) or appreciated (gained value) against the CAD? Explain your decision.

Solution

a) To determine whether the USD has depreciated or appreciated against the CAD

since January 2002, we need to compare the current exchange rate to the rate from January 2002. The exchange rate in January 2002 was about

$$1\text{USD} = 1.6\text{CAD}.$$

The exchange rate in January 2024 is about

$$1\text{USD} = 1.38\text{CAD}.$$

That means, if you convert 1 USD in 2024, you get less CAD as compared to converting 1 USD in January 2002. In other words, it takes less CAD in 2024 to get 1 USD compared to the year 2002. Thus, the USD has *depreciated* against the CAD. In turn, the CAD has *appreciated*.

b) Assume that in January 2002, you exchanged a total of 2000 USD to Canadian Dollars (CAD) at a rate of 1.6 CAD per USD. Calculate how much that amount is worth today in USD.

Solution

b) Having exchanged 2000 CAD into USD in 2002 at an exchange rate of $ 1 USD = 1.6 CAD$ leaves you with

$$2000\ \text{USD} \cdot 1.6\frac{\text{CAD}}{\text{USD}} = 3200\,\text{CAD}.$$

If you convert these 3200 CAD to USD in 2024 at an exchange rate of USD $=$ 1.38CAD you end up with

$$3200\text{CAD} \cdot \frac{1}{1.38}\frac{\text{USD}}{\text{CAD}} \approx 2318.84\ \text{USD}.$$

This means that you end up with USD 318.84 more, which corresponds to an increase of around 15.9%. The reason for this gain is that you have invested in a currency that has appreciated. Therefore, holding a currency can be considered a form of investment.

c) Suppose you have 1000 USD today, that is January 2024, and you plan to invest it in a Canadian fund that assures you a 2% annual interest rate.

i) Calculate how much USD you'll have after one year if the exchange rate remains on its current level of 1.38 CAD per USD.

ii) Calculate how much USD you'll have after one year if the exchange rate slightly chances to 1.42 CAD per USD.

Solution

c) First, you convert your USD to CAD in January 2024:

$$1000\ \text{USD} \cdot 1.38\frac{\text{CAD}}{\text{USD}} = 1380\,\text{CAD}.$$

Then, you invest the CAD receiving 2% of interest after 1 year:

$$1380\text{CAD} \cdot 1.02 = 1407.6\ \text{CAD}.$$

Finally, you convert the CAD back to USD

i) at the rate 1.38 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.38}\frac{\text{USD}}{\text{CAD}} = 1020\ \text{USD}.$$

ii) at the rate 1.42 CAD per USD:

$$1407.6\ \text{CAD} \cdot \frac{1}{1.42}\frac{\text{USD}}{\text{CAD}} \approx 991.27\ \text{USD}.$$

This means that if you expect the exchange rate to remain unchanged, the Canadian fund could be a reasonable investment, offering a 2% return. However, if you anticipate that the CAD will depreciate by more than 2%, it would not be a profitable investment.

Exercise 10.2. Our relations are not good

Figure 10.2: Trump doubles metal tariffs on Turkey by 20%

Source: Twitter

Why is Trump implicitly expressing concerns about the weak Lira and the strong Dollar? Would he prefer a "strong" Turkish Lira and a "weak" Dollar? What factors actually contribute to his satisfaction? Can you understand the logic behind President Trump's decision to double metal tariffs in response to the decline of the Turkish Lira (see Figure 10.2)? Discuss.

10.1.1 Exchange rates

The most important economic indicators frequently discussed in the media and politics are Gross Domestic Product (GDP)[1], the policy rate[2], and the inflation rate[3]. These measures are designed to explain the functioning of economic markets and guide policymakers. However, the exchange rate is used less frequently in political and public debates, which I believe is a significant oversight for several reasons.

Firstly, similar to the aforementioned measures, exchange rate movements have a substantial impact on both markets and individuals. Moreover, the exchange rate serves as an accurate measure that reflects real market movements more quickly than most other indicators. Overall, a solid understanding of exchange rates is crucial for making informed decisions, managing financial risks, optimizing operations, and strategically positioning companies in the global marketplace.

Before I explain this in greater detail, let me share my explanations for why the exchange rate is relatively unnoticed in public debates:

- **Complexity of interpretation:** It is comparatively difficult to interpret. GDP should be rising, while the inflation and policy rates should ideally be low. In contrast, the exchange rate is not so straightforward because there isn't a universally optimal exchange rate that everyone hopes for. The ideal rate depends on many factors, such as whether you want to buy goods from abroad or sell them to the rest of the world. Different stakeholders and investors will have varying preferences about the exchange rate. Many people, especially politicians, avoid the complexities of "it depends" arguments because it is challenging to make convincing cases based on intricate relationships.

[1] The total value added of a country in a given period

[2] The interest rate set by a central bank that influences the lending and borrowing rates of commercial banks to control inflation, manage employment levels, and stabilize the currency

[3] The percentage increase in the general price level of goods and services in an economy over a given period

- **Volatility:** The exchange rate is comparatively volatile, and its changes are difficult to predict.
- **Multiple exchange rates:** There isn't just one exchange rate; there are many, as any currency can be exchanged for any other currency. This means that a country's exchange rate may rise against currency A but fall against currency B.
- **Limited political influence:** The power of politics to directly and measurably influence a country's exchange rate is limited.
- **Understanding requirements:** The impact of exchange rate movements on our lives requires a solid understanding of economic markets, which many people lack.

While I cannot change the factors that contribute to the limited discussion of exchange rates, I can work to help you make sense of this topic. Before discussing the importance of the exchange rate in Section 10.1.3, let's first define the rate:

Exchange Rate

The price of one currency in terms of another is called an exchange rate. Exchange rates allow us to compare the prices of goods and services across countries, determining a country's relative prices for exports and imports.

To define the rate more formally, suppose the Euro (€) is the home currency and Turkish Lira (₺) the foreign currency, then the exchange rate in direct quotation (Preisnotierung) is

$$E^{\frac{€}{₺}} = \frac{X€}{Y₺}$$

and the exchange rate in indirect quotation (Mengennotierung) is

$$E^{\frac{₺}{€}} = \frac{Y₺}{X€}.$$

Both rates contain the same information, but have different interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give X € to receive Y ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give Y ₺ to receive X €.

Alternative interpretations:

- $E^{\frac{€}{₺}}$ tells that we have to give $\frac{X}{Y}$€ to receive 1 ₺, whereas
- $E^{\frac{₺}{€}}$ tells that we have to give $\frac{Y}{X}$₺ to receive 1 €.

Appreciation / Depreciation

A currency can appreciate or depreciate relative to other currencies.

- If the € appreciates, $E^{\frac{€}{₺}}$ decreases and $E^{\frac{₺}{€}}$ increases.
- If the € depreciates, $E^{\frac{€}{₺}}$ increases and $E^{\frac{₺}{€}}$ decreases.

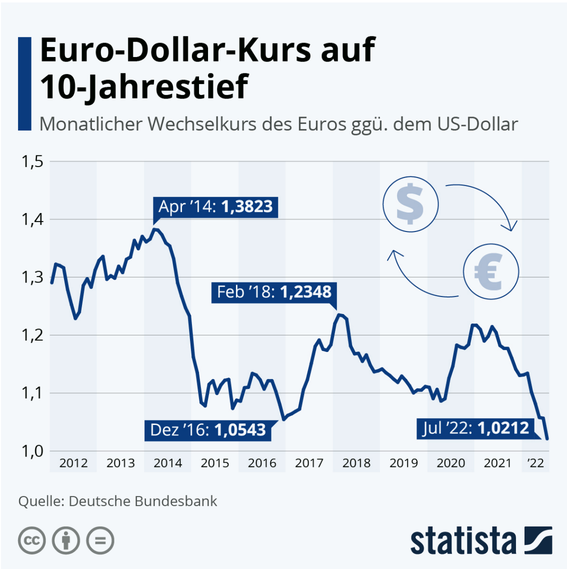
Conventions to talk about exchange rates:

- *Euro to Dollar* means $\frac{€}{\$}$ (This is especially confusing and it can also be understood the other way round but the first currency mentioned is *usually* interpreted as the numerator)
- *Euro per Dollar* means $\frac{€}{\$}$
- *Euro in Dollar* means $\frac{\$}{€}$
- *1 Euro costs X Dollars* means X $\frac{\$}{€}$

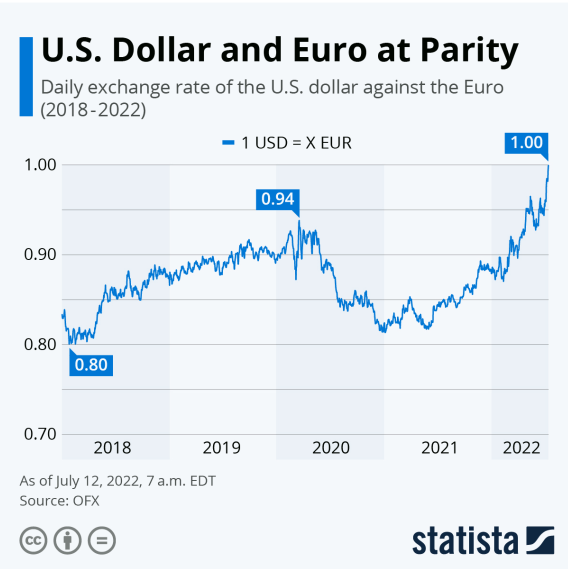
Exercise 10.3. Interpret the exchange rate representations shown in Figure 10.3. Consider the Euro as the home currency and write the most recent currency rates of the four figures in direct quotation.

Figure 10.3: Euro to Dollar

(a)



(b)



(c)

(d)

Source: Subfigures (c) and (d) are taken from Google.

Solution

The exchange rate in direct quotation is:

a)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.97924011\frac{€}{\$}$$

Figure 10.3a is denoted in indirect quotation. From April 2014 to July 2022 the Euro depreciated as one Euro was equivalent to 1.3823 Dollar in April 2014 and only 1.0212 Dollar in July 2022.

b)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = 1$$

Figure 10.3b is denoted in direct quotation. From early 2018 to mid 2022 the Euro depreciated as one Dollar was equivalent to 0.80 Euro in early 2018 and 1.00 Euro in mid 2022.

c)

$$E^{\frac{€}{\$}} = \frac{X€}{Y\$} = \frac{1€}{1,1050\$} = 0.904977376\frac{€}{\$}$$

Figure 10.3c is denoted in indirect quotation. From the beginning of the graph somewhen 2019 till 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.1680 Dollar in 2019 and is now worth 1.1050 Dollar in July 2022.

d)
$$E^{€}_{\$} = \frac{X€}{Y\$} = \frac{1€}{1,0212\$} = 0.904731747\frac{€}{\$}$$

Figure 10.3d is denoted in indirect quotation. For example, from the 2nd of January 2021 to the 9th of September 2024 the Euro depreciated as one Euro was equivalent to 1.2011 Dollar in January 2021 and 1.1053 Dollar in July 2022.

Please note that Googles "EUR / USD" notation is misleading as it does not mean that the exchange rate is denoted in direct quotation, that is, $\frac{X€}{Y\$}$.

Exercise 10.4. Exchange currencies
Suppose 1 US Dollar (USD) is equivalent to 1.20 Euros (EUR).

a) Calculate the equivalent amount in Euros if a person exchanges 500 US Dollars.
b) If the exchange rate changes to $1.15\frac{USD}{EUR}$, recalculate the equivalent amount in Euros for the same 500 US Dollars.
c) If the exchange rate changes to $1.15\frac{USD}{EUR}$, has the Euro appreciated or depreciated?
d) A European tourist plans to spend 1,000 Euros during a trip to the United States. Calculate the equivalent amount in US Dollars at the exchange rate of $1.15\frac{EUR}{USD}$.

Solution

a) The equivalent amount in Euros for exchanging 500 US Dollars at the initial exchange rate of (1.20 , USD/EUR) is given by:
$$\text{Equivalent Euros} = \frac{500\,\text{USD}}{1.20\,\text{USD/EUR}}$$

b) If the exchange rate changes to (1.15 , USD/EUR), the new equivalent amount in Euros is:
$$\text{New Equivalent Euros} = \frac{500\,\text{USD}}{1.15\,\text{USD/EUR}}$$

c) The equivalent amount in US Dollars for spending 1,000 Euros at the initial exchange rate is:
$$\text{Equivalent USD} = 1,000\,\text{EUR} \times 1.20\,\text{USD/EUR}$$

d) If the European tourist exchanges their money at the changed rate of (1.15 , USD/EUR), the new equivalent amount in US Dollars is:
$$\text{New Equivalent USD} = 1,000\,\text{EUR} \times 1.15\,\text{USD/EUR}$$

10.1.2 Relative prices and exchange rates

After understanding the concept of exchange rates, let us consider how trade in goods between two countries operates when each country uses a different currency as its legal tender.

Let us consider a stylized example: Assume the home country produces beer and the foreign country produces wine. If you want to exchange a beer for wine, the relative price indicates the amount of beer you need to provide in order to receive a unit of wine (in direct quotation) or the quantity of wine you will receive for a unit of beer (in indirect quotation).

For example, a relative price of 1 means you can exchange 1 liter of beer for 1 liter of wine. However, if we assume that beer is measured in 500 ml cans and wine in 1-liter bottles, the relative price denoted with $P^{\frac{beer}{wine}}$ would be represented as:

$$P^{\frac{beer}{wine}} = \frac{\text{2 cans of beer}}{\text{1 bottle of wine}}.$$

This means you can exchange 2 cans of beer for one bottle of wine.

If the relative price increases, you will need to provide more beer to receive a bottle of wine. Conversely, if the relative price decreases, you will need to provide less beer to obtain a bottle of wine.

> **i** Relative prices
>
> Relative prices determine the relative price of commodities across countries. For example, an increase in the price of foreign commodities makes imported commodities relatively more expensive and home commodities relatively cheaper for buyers at home.

Relative prices are (directly) determined by exchange rates. To logically prove this statement, let us assume for simplicity an exchange rate of 1,

$$E^{\frac{₺}{€}} = E^{\frac{€}{₺}} = 1$$

and that a liter of beer costs 1 € at home and a wine costs 1 ₺ abroad. Thus, we can buy both a wine or a beer for 1 €. Due to the fact that we must pay the wine producer with ₺, we must convert the € beforehand. The process goes like visualized in Figure 10.4:

Figure 10.4: One wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 1\frac{₺}{€} = 1₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{1₺ \cdot 1\frac{\text{wine}}{₺} = 1 \text{ wine}}$$

Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{₺}} = 0.5$ and $E^{\frac{₺}{€}} = 2$, respectively. Then, you receive more than one wine if we assume that the price of wine in ₺ remains unchanged. The process is visualized in Figure 10.5:

Figure 10.5: Two wine per Euro

$$\boxed{\text{exchange } 1\ €} \longrightarrow \boxed{1€ \cdot 2\frac{₺}{€} = 2₺} \longrightarrow \boxed{\text{buy wine}} \longrightarrow \boxed{2₺ \cdot 1\frac{\text{wine}}{₺} = 2 \text{ wine}}$$

That means, exchange rates determine the relative prices. If the home currency appreciates (depreciates), buying goods and services abroad becomes relative cheaper (more expensive).

Of course, if many people now buy wine and aim to convert € to ₺, this may impact the exchange rate and the price of wine. We come back to that later.

> **i** Exchange rates and relative prices
>
> The exchange rate determines the relative price of commodities across countries. For example, an appreciation of a currency makes commodities more expensive for foreign buyers and in turn makes foreign commodities cheaper for buyers at home.

10.1.3 The importance of exchange rates

Here is an incomplete list of arguments to emphasize the importance of exchange rates for economies, businesses, and individuals:

- **Import/export costs**: Exchange rate fluctuations determine the relative prices and hence affect the cost of importing goods and materials and the global demand for domestic products. An appreciation of the home currency makes imports relatively cheaper but exports more expensive for the rest of the world, while depreciation has the opposite effect.
- **Revenue conversion**: Multinational companies earn revenues in multiple currencies. Exchange rate changes can significantly impact the value of these revenues when converted back to the home currency, affecting overall profitability.

- **Foreign investments**: Companies investing in foreign assets or operations need to understand exchange rates to forecast returns accurately and manage exchange rate risk.
- **Risk management**: Knowledge of exchange rates enables businesses to hedge against currency risk using financial instruments like forwards, futures, options, and swaps. This is crucial for stabilizing cash flows and protecting profit margins.
- **Market competitiveness**: Exchange rates affect the relative cost competitiveness of goods and services in international markets. Companies need to understand these implications to price their products competitively and make strategic decisions about entering or exiting markets.
- **Macroeconomic insights**: Exchange rates are influenced by and also affect economic indicators such as inflation, interest rates, and economic growth. Understanding these relationships helps in making informed predictions about market conditions.
- **Contractual agreements**: Businesses engaged in international trade must understand exchange rates to negotiate and structure contracts effectively, determining terms such as the currency of payment and exchange rate clauses.
- **Government and Policy Understanding**: Exchange rates are often influenced by governmental and central bank policies. Understanding the dynamics between exchange rates and policy decisions is vital for anticipating regulatory changes and their potential impact on business operations.

10.1.4 Trump, relative prices, and trade policy

Let's return to Trump's Twitter message . Steel producers in the U.S. (and Donald Trump himself) are unhappy about a strong dollar (and a weak Turkish Lira) because it makes their products relatively expensive for Turkish buyers while making Turkish steel relatively cheap for U.S. consumers.

Trump had two options to address this issue: altering the exchange rates or adjusting the relative prices of goods between countries. Changing the exchange rate directly is a challenging task. Although buying or selling currencies on the foreign exchange market can influence exchange rates, the market is so large that the actions Trump could take as President would have minimal impact (see Section 10.1.5). Adjusting policy rates could influence exchange rates more effectively, as we will discuss in Section 10.2. However, the Federal Reserve, which sets policy rates and thus has an impact on interest rates, operates independently from political orders. Consequently, Trump's influence over their decisions is limited.

As a result, Trump chose to increase the price of foreign steel in the U.S. by introducing or raising tariffs. The approach works, American steel producing companies get protected from foreign competition and might sell more domestically. However, there many negative consequences that detoriate the overall welfare. Foremost, everybody in the U.S. must pay more for steel (and for products made with steel and aluminum). David Boaz, Executive Vice President of the Cato Institute, a libertarian think tank, highlights this issue in his response on Twitter (see Figure 10.6).

Figure 10.6: *Who wins in the end?*

Source: Twitter

To quantify the costs of Mr. Trumps's tariffs, let me quote the well-written article by Amiti et al. (2019) (p. 188-189):

> "*We find that by December 2018, import tariffs were costing US consumers and the firms that import foreign goods an additional $3.2 billion per month in added tax costs and another $1.4 billion per month in deadweight welfare (efficiency) losses. Tariffs have also changed the pricing behavior of US producers by protecting them from foreign competition and enabling them to raise prices and markups, and we estimate that the combined effects of input and output tariffs have raised the average price of US manufacturing by 1 percentage point, which compares with an annual average rate of producer price inflation from 1990 to 2018 of just over 2 percentage points. US tariffs and the foreign retaliatory tariffs also affect international supply chains, and we estimate that if the tariffs that were in place by the end of 2018 were to continue, approximately $165 billion of trade per year will continue to be*

> *redirected in order to avoid the tariffs. We also show that the rise in tariffs has reduced the variety of products available to consumers."*

In addition, it can be argued that increased tariffs might actually make the dollar stronger. If buyers stop purchasing steel from Turkey due to higher tariffs, they will need fewer Turkish lira and therefore will exchange fewer U.S. dollars for Turkish lira. This reduced demand for Turkish lira could lead to a stronger dollar.

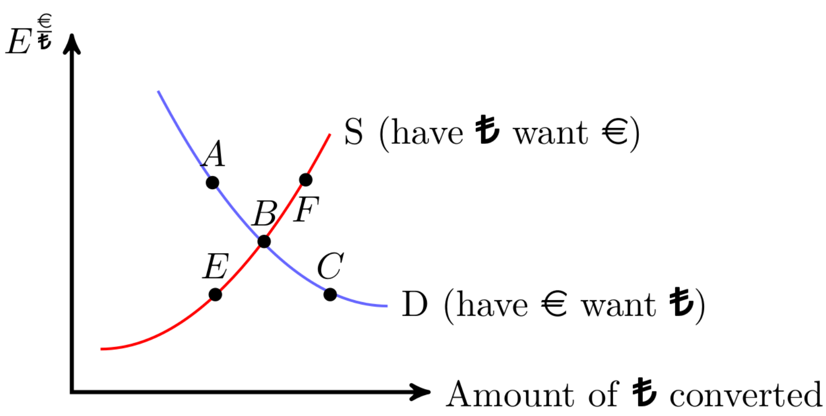
While raising tariffs and initiating trade disputes could be a strategy to gain political support and possibly get re-elected, there is a general consensus among economists that raising tariffs usually leads to economic losses and detrimental outcomes for all countries involved.

10.1.5 The FOREX

10.1.5.1 The market

In a market, individuals exchange goods and services, offering something to receive something else in return. In the FOREX (foreign exchange market), participants exchange currencies. Like all markets, the price here is influenced by the supply and demand dynamics of currencies.

Figure 10.7: Example of a foreign exchange market



- **When the Euro (€) is considered strong, the exchange rate** $E^{\frac{€}{₺}}$ is low:
  - At this lower exchange rate, there's a high demand for Turkish Lira (₺) (point C), but the supply of ₺ is scarce (point E).
  - Consequently, the Euro faces depreciation pressure, leading to an increase in the exchange rate $E^{\frac{€}{₺}} \uparrow$.
- **Conversely, when the Euro (€) is weak, the exchange rate** $E^{\frac{€}{₺}}$ is high:
  - With the exchange rate high, the demand for ₺ drops (point A), while its supply burgeons (point F).
  - As a result, the Euro is under appreciation pressure, causing the exchange rate to decrease $E^{\frac{€}{₺}} \downarrow$.
- **Point B represents the equilibrium exchange rate**, where the demand for ₺ meets its supply. At this juncture, holders of ₺ are unwilling to part with more, and similarly, Euro holders are not inclined to exchange more.

In 2022, the daily (!) traded volume of currencies averaged approximately $ 7,506 billion, as highlighted in Table 10.1.

Table 10.1: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

name	2001	2004	2007	2010	2013	2016	2019	2022
Total	1.239	1.934	3.324	3.973	5.357	5.066	6.581	7.506
USD	1.114	1.702	2.845	3.371	4.662	4.437	5.811	6.639

name	2001	2004	2007	2010	2013	2016	2019	2022
EUR	470	724	1.231	1.551	1.790	1.590	2.126	2.292
JPY	292	403	573	754	1.235	1.096	1.108	1.253
GBP	162	319	494	512	633	649	843	968
CNY	0	2	15	34	120	202	285	526
AUD	54	116	220	301	463	349	446	479
CAD	56	81	143	210	244	260	332	466
CHF	74	117	227	250	276	243	326	390
All others combined	170	251	568	786	1124	1223	1921	2093

Note: All others combined are: HKD, SGD, SEK, KRW, NOK, NZD, INR, MXN, TWD, ZAR, BRL, DKK, PLN, THB, ILS, IDR, CZK, AED, TRY, HUF, CLP, SAR, PHP, MYR.
Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

10.1.5.2 Actors on the FOREX

As indicated in Figure 10.8, there are several major players involved in trading on the foreign exchange market. In particular, commercial banks, multinational corporations and non-bank financial institutions, such as investment funds, play an important role in trading and speculation. Central banks also play a crucial role as they intervene to stabilize their national currency and thus influence the direction of the market.

Figure 10.8: Players on the foreign exchange market

10.1.5.3 The vehicle currency

Instead of converting directly between two less common currencies, it's more efficient to use a broadly accepted and stable currency as a vehicle. That means, if you want to exchange currency A to B. You do not exchange currency A directly to B but you convert currency A first to the vehicle currency C and then from C to B.

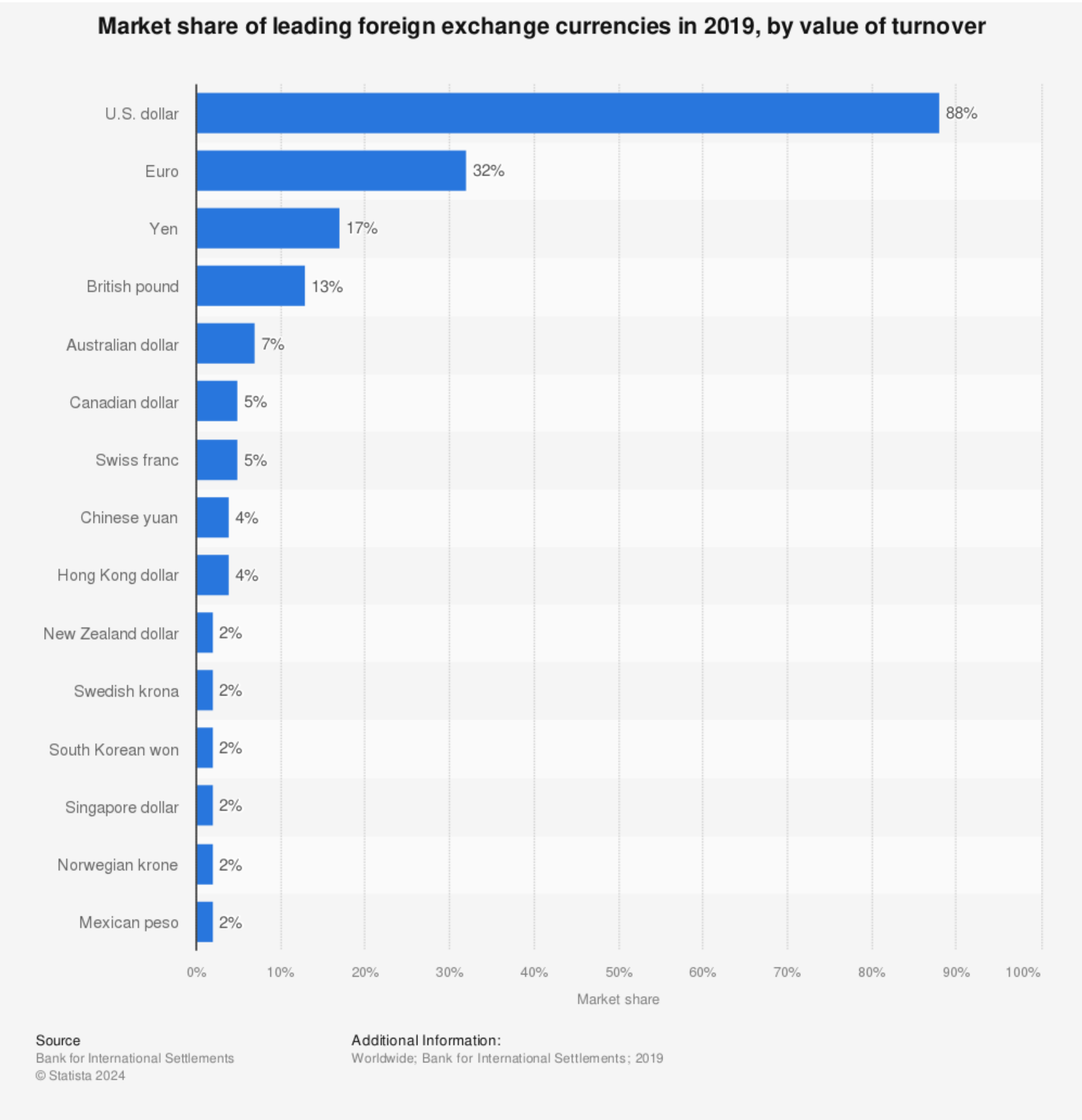
As depicted in Figure 10.9, around 32% of all currency transactions included the Euro while a notable 88% involved the U.S. Dollar which makes the Dollar the standard vehicle currency. The Dollar acts as a medium in transactions between currencies that do not directly trade with high volume. This can reduce transaction costs and streamline the process.

10.1.6 Purchasing power parity assumption

The **P**urchasing **P**ower **P**arity (PPP) assumption is also know as the **law of one price**. It says that in competitive markets with zero transportation costs and no trade barriers, identical goods have the same price all over the world when expressed in terms of the same currency. The idea behind this is that if differences in prices exist, profits can be made through **international arbitrage**, that is, the process of buying a good cheap in one country and selling the good with a profit in another country. This process can quickly equalize real price differences across countries.

However, in the real world, prices differ substantially across countries (see the Big Mac Index in Table 10.2 and Exercise 10.5). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and

Figure 10.9: Market share of leading foreign exchange currencies in 2019



services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero. Here are more reasons, why the PPP does not always apply, especially in the short run:

- Transportation costs are not zero. Shipping goods can be time consuming and expensive.
- Many goods and services, such as real estate or personal services, cannot be traded.
- International markets may be segmented due to regulatory barriers, tariffs and other trade restrictions.
- Countries have different consumption preferences. That means, the same basket of goods is not necessarily equally demanded. The willingness to pay for goods vary across countries often significantly.
- Countries impose different taxes and provide different subsidies on goods and services, which affects their prices and leads to deviations from PPPs.
- Short-term fluctuations in exchange rates may deviate from the values predicted by PPPs due to speculation, interest rate differentials and other factors.
- Differences in inflation rates between countries may lead to deviations from PPP, especially in the short run.
- The same product may be perceived differently in different countries due to brand names, quality differences or local customization, resulting in different prices.
- Regulations like warranty and product classifications are different and have an impact on the product and the willingness to pay for it.
- Political instability, war or economic sanctions can affect currency values and prices and lead to deviations from PPP.
- Prices of goods and services do not always adjust immediately to changes in the exchange rate, leading to short-term deviations from PPP.

Exercise 10.5. Big Mac Index
The differences of prices across countries can be illustrated with the Economist's *Big Mac Index*. It indicates the price of a Big Mac in different countries in terms of the US Dollar. Table 10.2 shows some countries with on average expensive and cheap Big Macs.

Table 10.2: The price of a Big Mac across countries

Country	Price
Switzerland	\$6.57 (6.50 CHF)
Sweden	\$5.83 (51.00 SEK)
United States	\$5.51 (5.51 USD)
Norway	\$5.22 (42 NOK)
Canada	\$5.08 (6.65 CAD)
Euro area	\$4.75 (4.56 EUR)
...	...
Egypt	\$1.75 (31.37 EGP)
Ukraine	\$1.91 (50 UAH)
Russia	\$2.09 (130 RUB)
Malaysia	\$2.10 (8.45 MYR)
Indonesia	\$2.19 (31,500 IDR)
Taiwan	\$2.27 (69 TWD)

Source: https://github.com/TheEconomist/big-mac-data (July 18, 2018).

a) Read Wikipedia's page on the Big Mac Index and discuss the *Big-Mac-Index* critically. Is it really a reasonable real-world measurement of purchasing power parity?
b) Compare the *Big-Mac-Index* to the *Mac-Index* (see: themacindex.com) looking for price differences of the *Mac mini M1 256GB*. Why are the price differences for Apple products so much smaller compared to McDonald's *Big Mac*? *In case the website offline, here is a snapshot of it.)*
c) Using the data of Table 10.2, calculate the exchange rate of Euros (EUR) to Swiss Francs (CHF) in both the direct and the indirect quotation. Interpret your result.
d) Calculate how many Dollars you can buy with 100€. Then, use that dollars to buy Swiss Francs. How many Swiss Francs do you get?
e) *Multiple choice:* Which of the following statements is true?
   i) The table indicates that the *Purchasing Power Parity Assumption* is fulfilled.
   ii) The exchange rate of US Dollar to Swiss Franc (CHF) is close to one.
   iii) The exchange rate of US Dollar to the Russian Ruble (RUB) is about $62.2\frac{\$}{RUB}$.
   iv) The exchange rate of Canadian Dollar (CAD) to the Euro (EUR) is about 0.73.
   v) With one Canadian Dollar (CAD) you can buy 0.73 US Dollars.

Solution: Big Mac Index

a) Please take part in the discussion in class.
b) Please take part in the discussion in class.
c) The exchange rate of Euros to Swiss Francs in direct quotation is:

$$E^{\frac{\text{EUR}}{\text{CHF}}} = \frac{4.56\ \text{EUR}}{4.75\ \text{USD}} \cdot \frac{6.57\ \text{USD}}{6.50\ \text{CHF}} = \frac{29.9592\ \text{EUR}}{30.875\ \text{CHF}} \approx 0.9703\frac{\text{EUR}}{\text{CHF}}$$

and in indirect quotation:

$$E^{\frac{\text{CHF}}{\text{EUR}}} \approx 1.0305\frac{\text{CHF}}{\text{EUR}}.$$

That means, we have to pay about 0.97 Euro for one Swiss Franc or one Euro costs about 1.03 Swiss Franc.
d) For 100 Euro we get

$$100\ \text{EUR} \cdot \frac{4.75\ \text{USD}}{4.56\ \text{EUR}} \approx 104.16\ \text{USD}$$

and these can be converted to

$$104.16\ \text{USD} \cdot \frac{6.50\ \text{CHF}}{6.57\ \text{USD}} \approx 103.05\ \text{CHF}$$

e) Here are the answers:
   i) is false: The price of a Big Mac in $ is different across countries.
   ii) is correct.
   iii) is false: 1 Ruble costs 0.0160 Dollar:

$$\frac{2.09\ \text{USD}}{130\ \text{RUB}} = 0.016\frac{\text{USD}}{\text{RUB}}.$$

   iv) is incorrect:

$$\underbrace{\frac{6.65\ \text{CAD}}{5.08\ \text{USD}}}_{\approx 1.309} \cdot \underbrace{\frac{4.75\ \text{USD}}{4.56\ \text{EUR}}}_{\approx 1.0416} \approx 1.36\frac{\text{CAD}}{\text{EUR}}.$$

   v) is incorrect:

$$\frac{6.05\ \text{CAD}}{5.08\ \text{USD}} \approx 0.76\frac{\text{CAD}}{\text{USD}}.$$

   Thus, with one Canadian Dollar you can buy 0.76 U.S. Dollar.

Exercise 10.6. International arbitrage

Table 10.3: Table of price variations across countries

Country	Price of Good *08/15*
Germany	\$2
Switzerland	\$6
United States of America	\$6

a) Consider a scenario where the good *08/15* is freely tradeable across countries without any cost (akin to digital software). You have \$100, and upon examining the prices of *08/15* in three different countries, you notice discrepancies as depicted in Table 10.3. Discuss how you could profit from *international arbitrage*, the practice of exploiting price differences of a good across countries. Describe the potential impact on the prices of the good once arbitrage begins.

b) Assuming *08/15* can be traded freely across borders like software, imagine your arbitrage efforts have harmonized the prices of the good worldwide, as illustrated in the Table 10.4:

Table 10.4: Table of prices and currencies across countries post-arbitrage

Country	Price in USD	Price in Local Currency
Germany	\$4	EUR 2
Switzerland	\$4	CHF 6
United States of America	\$4	-

Now, calculate and elucidate the following exchange rates:

- $\frac{\text{USD}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{USD}}$
- $\frac{\text{USD}}{\text{CHF}}$
- $\frac{\text{CHF}}{\text{USD}}$
- $\frac{\text{CHF}}{\text{EUR}}$
- $\frac{\text{EUR}}{\text{CHF}}$

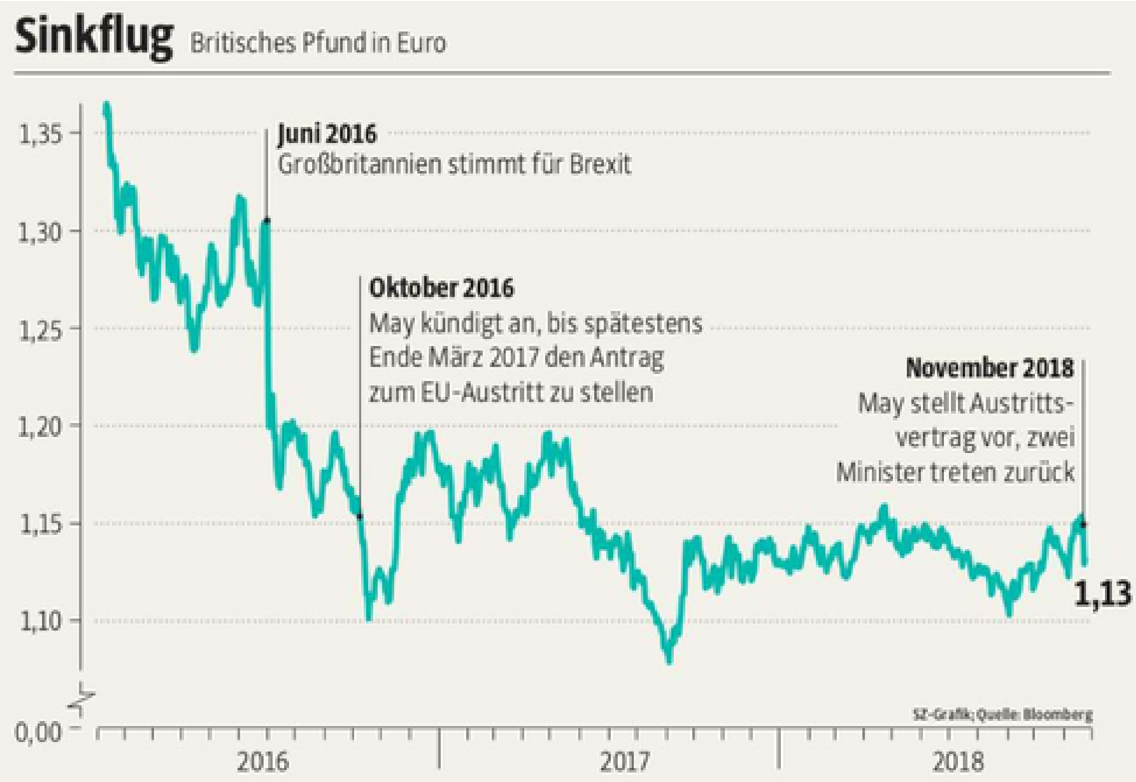
Solution

a) International arbitrage strategy
- **Strategy**: Buy 50 units of good *08/15* in Germany for \$2 each with your \$100. Then, sell these units in Switzerland or the USA for \$6 each, making a total of \$300. This is a classic arbitrage strategy.
- **Impact on Prices**: Consider that you repeat that winning strategy to buy in Germany and sell in some other country, prices will change: The increased demand in Germany will cause the price there to rise, while the increased supply in Switzerland and the USA will cause the price to drop. Eventually, the price differences will equalize, eliminating the arbitrage opportunity.

b) Calculating exchange rates
- **USD to EUR:** $\frac{4USD}{2EUR} = 2\frac{USD}{EUR}$
- **EUR to USD:** $0.5\frac{EUR}{USD}$
- **USD to CHF:** $\frac{2}{3}\frac{USD}{CHF}$
- **CHF to USD:** $1.5\frac{CHF}{USD}$
- **CHF to EUR:** $\frac{3}{1}\frac{CHF}{USD}$
- **EUR to CHF:** $\frac{1}{3}\frac{EUR}{CHF}$

Exercise 10.7. Brexit and the exchange rate
Examine Figure 10.10 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 10.10: The Price of the British Pound (€/£)



Source: Süddeutsche Zeitung am Wochenende, 17./18. November 2018, year 74, week 46, No. 265, p. 1 (front page).

10.2 International investments

Investing, whether through holding a currency or storing purchasing power, is inherently speculative, regardless of whether the investment is domestic or international. When you hold a foreign currency, it's crucial to acknowledge that its value can both appreciate and depreciate. Currency values can fluctuate significantly over time due to factors such as economic policy, market sentiment, and global events. In the following sections, I will present a framework to help understand the key determinants of the rate of return on your investment. As illustrated in Figure 10.11, we will explore how a country's interest rates, trade balances, price levels, and exchange rates are interconnected and must be analyzed together, rather than in isolation.

10.2.1 Foreign exchange reserves

Currencies serve as a store of value, an important function in the financial world. Foreign exchange reserves are assets held on reserve by a central bank in foreign currencies, which can include bonds, treasury bills, and other government securities. The primary purpose of holding foreign exchange reserves is to manage the exchange rate of the national currency and ensure the stability of the country's financial system.

Accordingly to the *Currency Composition of Official Foreign Exchange Reserves (COVER)* database of the *International Moentary Fund (IMF)*, the total foreign exchange reserves in Q3 2023 had been 11,901,53 billion U.S. Dollar. That is, $ 11,901,530,000,000!

The size of a country's foreign exchange reserves can be influenced by various factors, including its balance of trade, exchange rate policies, capital flows, and the overall health of its economy. While having substantial reserves is generally seen as a sign of economic strength and stability, excessively accumulating reserves can also indicate underlying economic imbalances or protectionist policies.

Figure 10.11: Illustration of Interest Rate, Exchange Rate, and Trade Balance

Source: Generated using OpenAI (2025).

10.2.2 Three components of the rate of return

An investment usually has different characteristics such as the default risk, opportunities, and liquidity. These characteristics and individual preferences are important to decide which investment is superior. In this course, however, we mostly refrain from discussing sophisticated features of investments here. We focus on the most important feature of an investment, that is, the rate of return. In particular, three components are important to calculate the rate of return:

10.2.2.1 Interest rate

The interest rate of an investment is a crucial factor that determines the return earned on invested capital over a specific period. It represents the percentage of the initial investment that is paid back to the investor as interest or profit. Formally, we can write:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{10.1}$$

where I denotes the value of an asset measured in € in the respective time period t.

10.2.2.2 Exchange rate

When investing in assets denominated in foreign currencies, investors need to convert their domestic currency into the foreign currency at the prevailing exchange rate. After the investment has been paid out in the foreign country, the investor must convert the foreign currency back to his home currency. Thus, the initial cost of the investment and the subsequent returns are influenced by the exchange rate at the beginning and the end of the investment.

Formally, we can write if the an investment takes in foreign country, that is, Turkey between $t-1$ and t:

$$I_{t-1}^{€} \cdot E_{t-1}^{\frac{₺}{€}} \cdot E_t^{\frac{€}{₺}} = I_t^{€} \tag{10.2}$$

10.2.2.3 Inflation

Inflation refers to the quantitative measure of the rate at which prices, represented by a basket of goods and services, increase within an economy over a specific period. Conversely, negative inflation is termed deflation. Mathematically, inflation can be defined as follows:

$$\pi = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{P_t}{P_{t-1}} - 1$$

Where π represents the inflation rate and P_t denotes the price at time t. When inflation affects all prices, it also impacts the value of assets in which investors are invested. This relationship can be expressed as:

$$I_t = I_{t-1} \cdot (1 + \pi) \tag{10.3}$$

10.2.3 Rate of return of an investment abroad

The rate of return, r, is the growth rate of an investment over time and can be described as follows:

$$r = \frac{I_t^{\text{€}} - I_{t-1}^{\text{€}}}{I_{t-1}^{\text{€}}} = \frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}} - 1,$$

Combining Equation 10.1, Equation 10.2, and Equation 10.3, we can describe the value of our investment in period t as follows:

$$I_t^{\text{€}} = I_{t-1}^{\text{€}} \cdot (1 + i^*) \cdot E_{t-1}^{\frac{₺}{\text{€}}} \cdot E_t^{\frac{\text{€}}{₺}} \cdot (1 + \pi^*), \tag{10.4}$$

where $I_{t-1}^{\text{€}}$ denotes the initial investment, i^* denotes the interest rate abroad and π^* the inflation abroad. Dividing by $I_{t-1}^{\text{€}}$ and subtracting 1 from both sides of Equation 10.4, we see that the rate of return for an investment abroad, r^*, has three determining factors, that are: interest rate $(1 + i^*)$, inflation $(1 + \pi)$, and the change of exchange rates over time $(E_{t-1}^{\frac{₺}{\text{€}}} \cdot E_t^{\frac{\text{€}}{₺}})$:

$$\begin{aligned}
\underbrace{\frac{I_t^{\text{€}}}{I_{t-1}^{\text{€}}}^* - 1}_{r} &= (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{E_{t-1}^{\frac{₺}{\text{€}}} \cdot E_t^{\frac{\text{€}}{₺}}}_{\alpha} - 1 \\
r^* &= (1 + i^*) \cdot (1 + \pi^*) \cdot \alpha - 1
\end{aligned} \tag{10.5}$$

with

- $\alpha = 1$ if the exchange rate does not change over time and
- $\alpha > 1$ if the home currency € depreciates or
- $\alpha < 1$ if the home currency € appreciates.

So the exchange rate changes over time work as a third factor of your rate of return.

By assuming no inflation ($\pi^* = 0$), we can write

$$\begin{aligned}
r^* &= (1 + i^*) \cdot \alpha - 1 \\
\Leftrightarrow r^* &= \alpha + \alpha i^* - 1.
\end{aligned} \tag{10.6}$$

Reorganizing Equation 10.6 helps to interpret it. Firstly, let us expand the right hand side of this equation adding and subtracting i^* which obviously does not change the sum of the right hand side of the equation. Secondly, re-write the equation and thirdly, set $(\alpha - 1) = w$:

$$\begin{aligned}
&\Leftrightarrow r^* = \alpha + \alpha i^* - 1 + i^* - i^* \\
&\Leftrightarrow r^* = \alpha - 1 + i^* + \alpha i^* - i^* \\
&\Leftrightarrow r^* = \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\
&\Leftrightarrow r^* = w + i^* + i^* w
\end{aligned} \tag{10.7}$$

This equation outlines the rate of return on an investment in a foreign country, influenced by two primary factors: i^* and w.

Assuming that the product iw is very small, we can say that the rate of return equals approximately the interest rate plus the rate of depreciation:

$$r^* = w + i^*.$$

This approximation is often called the *simple rule for* r.

Exercise 10.8. Exchange rates and where to invest
Suppose you want to buy a new car in Germany in one year, i.e, t=2023. Today, i.e., t=2022, you have €10,000 to invest for one year.
Given the following conditions:

- The annual interest rate in Europe is 1%.
- The annual interest rate in the U.S.A. is 2%.
- One US-Dollar can be converted to €0.93 this year.
- You expect that €1 can be converted to $1.09 next year.
- Moreover, you expect no inflation in Germany and the U.S.
- No banking fees or alike.

a) Calculate the return on an investment in the U.S. and Germany, respectively.
b) Do you expect the euro to appreciate or depreciate from 2022 to 2023?
Solution
Exchange rates and where to invest (Exercise 10.8)
    a) Rate of return in the EU is 1 percent and hence you will have € 10,100 in 2023. Rate of return in the US is about 0.62 percent:

$$10000€ \cdot \frac{1\$}{0.93€} \cdot 1.02 \cdot \frac{1€}{1.09\$} = 10062.1485€$$

    Thus, it is better to invest in Europe.
    b) In 2022 you have to pay 93 Cent for a dollar and in 2023 you expect to pay about 91 Cent for a dollar. Thus, you expect the Euro to appreciate.

Exercise 10.9. Turkey vs. Germany
You have 100€ this year, $t-1$, which you like to invest till next year, t.
a) Where should you invest, given the following informations:
    - The interest rate in Germany is 1%.
    - The interest rate in Turkey is 10%.
    - 1€ can be converted to 7 ₺ this year in the FOREX
    - You expect that 1 € can be converted to 7.1 ₺ next year in the FOREX.
    - You expect no inflation in Germany and Turkey.
b) Calculate the exchange rate in period t that makes investing in Germany and Turkey equal profitable.
c) Explain why the Turkish Lira is under appreciation pressure in t-1.
Solution
Turkey vs. Germany (Exercise 10.9)
    a) When focusing solely on the interest rate, investing in Turkey appears more advantageous. However, if we consider only the development of the exchange rate, investing in Germany becomes more appealing due to the Euro appreciating relative to the Lira from period $t-1$ to t. Therefore, it's essential to calculate the return on investment to determine which of the two effects predominates. This can be done in three different ways:
    b) **(Exact) calculation method in four steps:**
        1. `exchange € to ₺ in t-1:`

$$100€ \cdot E_{t-1}^{₺/€} = 100€ \cdot 7\frac{₺}{€} = 700₺$$

        2. invest in either Germany or Turkey:

$$GER \rightarrow 100€ \cdot (1+0.01) = 101€$$

$$TUR \rightarrow 700₺ \cdot (1+0.1) = 770₺$$

        3. re-exchange ₺ to €:

$$770₺ \cdot E_t^{€/₺} = 770₺ \cdot \frac{1€}{7\frac{1}{10}₺} = \frac{7700}{71} \approx 108.4507$$

4. calculate the return on investment, r:

$$r_{GER} = 0.01$$
$$r_{TUR} = \frac{108.4507 - 100}{100} = 0.084507$$

Answer: The return on investment is lower in Germany. Thus, it is superior to invest the 100€ in Turkey.

ii) **(Exact) Calculation method in one step:**

$$\overbrace{r}^{\text{rate of return}} = \frac{I_t^{€} - I_{t-1}^{€}}{I_{t-1}^{€}}$$

$$\text{with } I_t^{€} = \overbrace{I_{t-1}^{€}}^{\text{investment in t-1}} \cdot \overbrace{E_{t-1}^{₺/€}}^{\text{exchange rate in t-1}} \cdot \overbrace{(1+i)}^{\text{1+interest rate}} \cdot \overbrace{E_t^{€/₺}}^{\text{exchange rate in t}}$$

$$TUR \rightarrow I_t^{€} = 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{1€}{7.1₺} = 108.4507 \rightarrow r_{TUR} = 0.084507$$
$$GER \rightarrow I_t^{€} = 100€ \cdot 1 \cdot (1+0.01) \cdot 1 = 101€ \rightarrow r_{GER} = 0.01$$

iii) **(Approximative) calculation method:** Steps a) to c) can be summarized as two rates of changes:

$$\underbrace{r'}_{\text{approximative rate of return}} = \underbrace{i}_{\text{interest rate}} + \underbrace{w}_{\text{rate of depreciation}}$$

$$\text{with} \quad w = \frac{E_t^{€/₺}}{E_{t-1}^{€/₺}} - 1$$

$$r'_{GER} = 0.01$$
$$r'_{TUR} = 0.1 + \frac{\frac{10}{71}}{\frac{10}{70}} - 1 = 0.1 + \frac{700}{710} - 1 = 0.1 - \frac{10}{710} = \frac{61}{710} \approx 0.08591$$

b) Both investments are equal profitable if

$$r_{GER} = r_{TUR}.$$

Given the information in period $t-1$, the exact exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*}$, is calculated as follows:

$$I_t^{€} = I_{t-1}^{€} E_{t-1}^{₺/€} (1+i) E_t^{€/₺*}$$
$$\Leftrightarrow E_t^{€/₺*} = \frac{I_t^{€}}{(I_{t-1}^{€} E_{t-1}^{₺/€}(1+i))} = \frac{101}{(100 \cdot 7 \cdot 1.1)} = \frac{101}{770} \approx 0.1311$$

The approximate exchange rate in period t that makes investments are equal profitable, $E_t^{€/₺*'}$, is calculated as follows:

$$r_{GER} = i_{TUR} + \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}} - 1$$
$$\Leftrightarrow r_{GER} - i_{TUR} + 1 = \frac{E_t^{€/₺*'}}{E_{t-1}^{€/₺}}$$
$$\Leftrightarrow E_t^{€/₺*'} = (r_{GER} - i_{TUR} + 1) \cdot E_{t-1}^{€/₺}$$
$$\Leftrightarrow E_t^{€/₺*'} = (0.01 - 0.1 + 1) \cdot \frac{1}{7} = \frac{91}{100} \cdot \frac{1}{7} = \frac{91}{700} = 0.13$$

Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/₺*}$ and $E_t^{€/₺*'}$:

$$
\begin{aligned}
r'_{TUR} =& 0.1 + \frac{\frac{91}{700}}{\frac{1}{7}} - 1 = \frac{637}{700} - 0.9 = 0.01 \\
I_t^{€*} =& 100€ \cdot 7\frac{₺}{€} \cdot (1+0.1) \cdot \frac{91}{700}\frac{€}{₺} = \frac{70070}{700} = 100.1 \\
\rightarrow r^*_{TUR} =& 0.01
\end{aligned}
$$

c) The ₺ must appreciate in t-1 since it is more profitable to exchange € to store the asset value in Turkey. That means the demand curve in the FOREX shifts upwards till the exchange rate equals the exchange rate that makes both investments equal profitable and hence nobody has an incentive to demand more ₺ for the given exchange rate $E_t^{€/₺*}$ as calculated above.

Exercise 10.10. Suppose you have 50,000 Indian Rupees (INR) this year that you want to invest for one year from t to $t+1$ and then buy something with the Indian Rupees in India. Calculate the return on an investment in India and Germany, given the following conditions:

- The annual interest rate in India is 5% and 2% in Germany.
- 1 INR can be converted to 0.01 Euro (EUR) this year, t.

- You expect the Indian Rupee to depreciate, that is, you expect 1 EUR to cost 1 INR more next year, that is $t+1$.
- Moreover, you expect no inflation in India and Germany.

Solution

The return on investment for the investment in India is 5%.

The return on investment for the investment in Germany can be calculated as follows:

$$50,000 \text{ INR} \cdot \underbrace{\frac{0.01\text{EUR}}{1 \text{ INR}}}_{=\frac{100 \text{ INR}}{1 \text{ EUR}}} \cdot 1.02 \cdot \frac{101 \text{ INR}}{1 \text{ EUR}} = 51,510 \text{ INR}$$

To calculate the rate of return calculate

$$\frac{51,510 - 50,000}{50,000} \cdot 100 = 3.02.$$

Thus, the return on investment for the investment in Germany is 3.02%. One challenge of this exercise is to consider “1 EUR to cost 1 INR more” properly. This does not mean 1 INR is equal to 1 €!

10.2.4 The interest parity condition

Assume the rate of return is lower domestically than it is for investments abroad. Representing the foreign country with an asterisk $(*)$, this situation, where investing money abroad is more profitable, can be expressed as:

$$r < r^*.$$

Given that domestically the rate of return, r, equals the interest rate, i, assuming zero inflation, and that the simple rule for an investment abroad is described by $r^* = w + i^*$, we can rewrite the equation as:

$$i < w + i^*.$$

What would happen if financial market actors became aware of this?

Market participants would likely convert their domestic currency into the foreign currency to invest abroad, increasing demand for the foreign currency. Consequently, the foreign currency would appreciate, becoming relatively more expensive. This implies that w is negative. This appreciation process halts when investing abroad no longer offers a higher return. If the attractiveness of investments is equalized, the FOREX is in equilibrium. The deposits of all currencies offer the same expected rate of return. In other words, in equilibrium the exchange rate, w, assures that the rate of return from the home country, r, is equal to the rate of return in any foreign country, denoted with an asterisk ($*$):

$$r = r^* \tag{10.8}$$

$$i = w + i^* \tag{10.9}$$

$$\tag{10.10}$$

$$\Leftrightarrow w = i - i^* \tag{10.11}$$

The interest parity condition (Equation 10.11) enables us to analyze how variations in interest rates and expected exchange rates affect current exchange rates through comparative static analysis of the equation:

$$\frac{\partial w}{\partial i} > 0; \quad \frac{\partial w}{\partial i^*} < 0.$$

This means:

- An increase in the domestic interest rate results in a positive change in the depreciation rate, leading to the depreciation of the domestic currency.
- An increase in the foreign interest rate causes a negative change in the depreciation rate, resulting in the appreciation of the domestic currency.

10.2.5 The theory in real markets: Unpegging the Swiss Franc

You might now question whether this theory of the interest parity condition truly holds in real-world markets. Analyzing international markets and the FOREX empirically is challenging due to the frequent occurrence of both large and small exogenous shocks on a global scale, each impacting market outcomes in various ways. Furthermore, market dynamics are often influenced by emotions and speculation rather than solely measurable facts. However, there are instances where the shocks are so significant that the fundamental forces driving the market become visible, even without a sophisticated empirical identification strategy that controls for confounding effects. The case study of the unexpected unpegging of the Swiss Franc serves as a poignant example. It vividly demonstrates that the principles underpinning the interest parity condition are not merely theoretical constructs but actively influence real market behaviors.

Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation pressure on the Franc, as many investors many investors wanted to store their assets in the Swiss Franc. Following the SNB's announcement, the exchange rate plunged from 1.20 to 1.00 Franc per Euro ($E^{\frac{CHF}{€}}$), as illustrated in Figure 10.12a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 10.12b. These developments align precisely with what the interest parity condition would predict, demonstrating its applicability in real-world financial market dynamics.

To analyze the relationship between changes in exchange rates and interest rates, we need to consider the interest parity assumption of Equation 10.11:

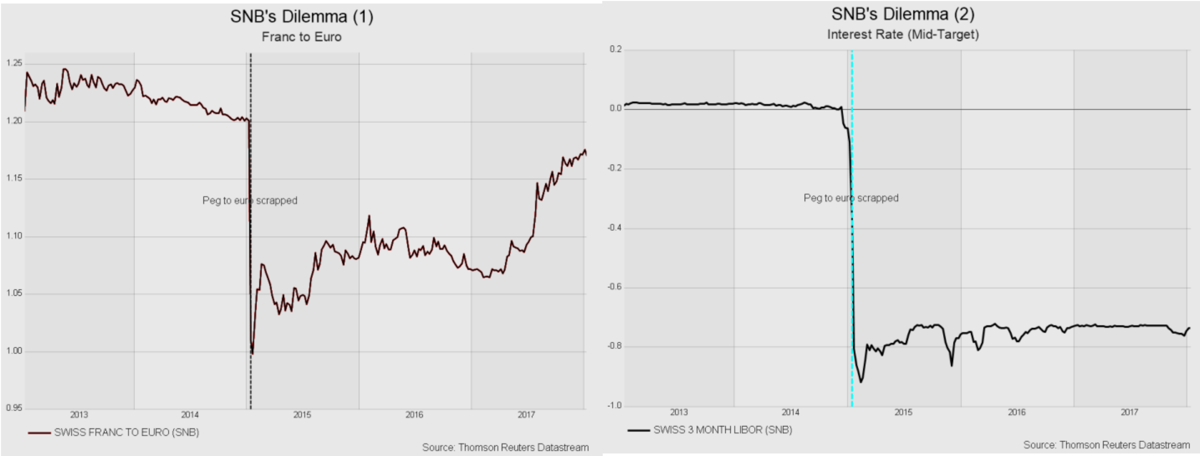
$$w = i - i^*$$

where

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1.$$

Figure 10.12: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland



In January 2015, the exchange rate $E^{\frac{CHF}{€}}$ decreased from 1.20 to 1.00. Alternatively, we can express this change in direct quotation, noting that the exchange rate $E^{\frac{€}{CHF}}$ increased from $E_{t-1}^{\frac{€}{CHF}} \approx \frac{1}{1.20} \approx 0.83$ to $E_t^{\frac{€}{CHF}} \approx 1.00$, resulting in

$$w = \frac{E_t^{\frac{€}{CHF}}}{E_{t-1}^{\frac{€}{CHF}}} - 1 = \frac{1}{0.83} - 1 = 0.20.$$

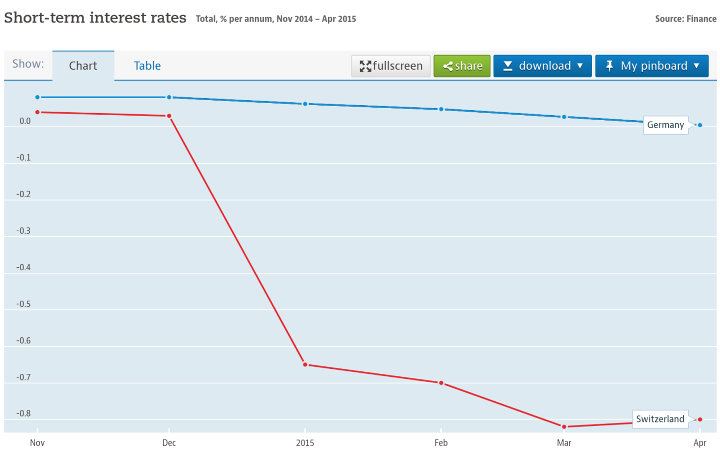
Since $w > 0$, the fraction on the left-hand side of the interest rate parity equation must also be positive, as already mentioned. This implies that

$$i - i^* > 0,$$

which means that an interest rate spread must occur. This condition can occur if the foreign interest rate i^* decreases or the domestic interest rate i increases. In our observations, we can indeed see a pattern that is consistent with our theoretical expectations.

It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 10.13.

Figure 10.13: Short-term interest rates across Germany and Switzerland over time



Source: Data are taken from the OECD and show the total, % per annum.

10.2.6 The Fisher Effect

The *Fisher Effect* is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between (expected) inflation and both nominal and real interest rates.

According to the *Fisher Effect*, the nominal interest rate is equal to the sum of the real interest rate and the (expected) inflation rate. In formula terms, it is often expressed as:

$$r = i + \pi. \tag{10.12}$$

We can derive Equation 10.12 assuming that the exchange rate is stable over time

$$\left(E_{t-1}^{\frac{€}{₺}} = E_t^{\frac{€}{₺}} \Leftrightarrow \frac{E_{t-1}^{\frac{€}{₺}}}{E_t^{\frac{€}{₺}}} = 1 \Leftrightarrow \alpha = 1 \right)$$

and using this in Equation 10.5, we get:

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{\alpha}_{=1} - 1 \tag{10.13}$$

$$\Leftrightarrow r = i + \pi + \pi i \tag{10.14}$$

Assuming that the product πi is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation shown in Equation 10.12 is often called the *Fisher Effect*.

Considering now cross-country differences in their rate of return, we can explain the rate of return spread by the inflation rate and the nominal interest rate spread as follows:

$$r_{GER} - r_{TUR} = \pi_{GER} - \pi_{TUR} + i_{GER} - i_{TUR}. \tag{10.15}$$

We have learned in Section 10.2.4 (the interest parity condition) that the rate of return can differ only in the short run and will be equal across countries in the long run ($r_{GER} - r_{TUR} = 0$). Utilizing this concept in Equation 10.12, we can demonstrate that the nominal interest rates of countries will adjust to accommodate any changes in (expected) inflation, and vice versa:

$$i_{GER} - i_{TUR} = \pi_{GER} - \pi_{TUR}.$$

Recommended reading

Wikipedia (2025): Wikipedia entry to the Fisher Effect.

10.3 Balance of payments

Required reading

Council of Economic Advisers (2004, ch. 14)

10.3.1 Introduction

The *Balance of Payments* is a record of a country's financial transactions with the rest of the world. It tracks the money flowing in and out through various economic activities. If we account for all transactions, the inflow and outflow should theoretically balance. Before I elaborate on this concept, let's clarify some key terms:

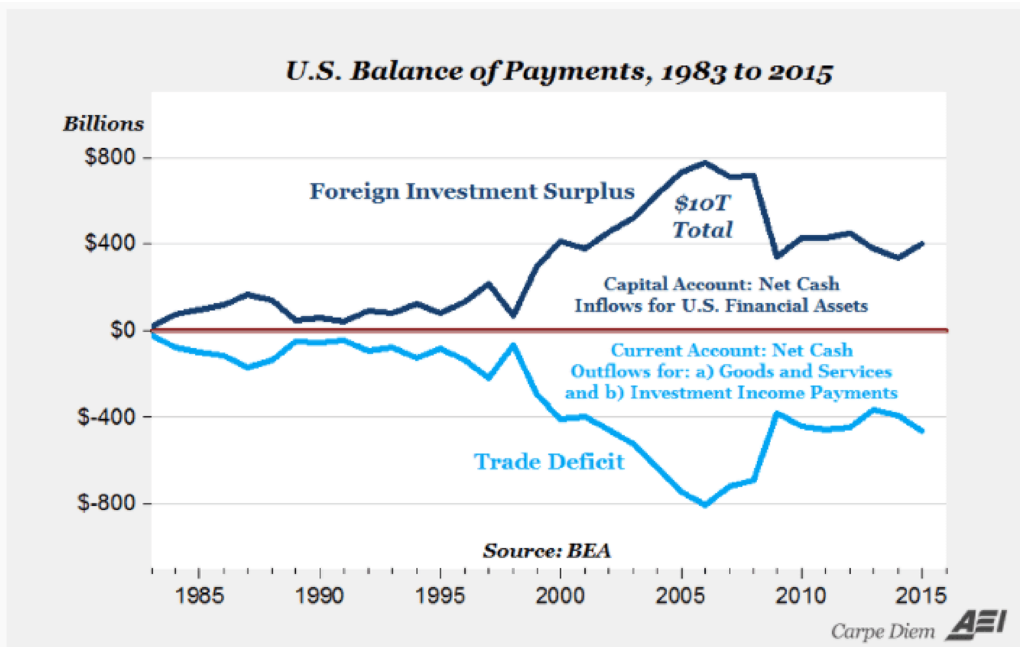
- *Exports*: Goods and services sold to other countries.
- *Imports*: Goods and services bought from other countries.

- *Trade balance*: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as *net exports*.
- *Trade surplus*: When a country sells more than it buys, resulting in a positive trade balance.
- *Trade deficit*: When a country buys more than it sells, leading to a negative trade balance.
- *Balanced trade*: When the value of exports equals imports.
- *Net capital outflow*: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Exercise 10.11. Some facts about foreign trade
Make yourself familiar with the descriptive statistics at destatis.de, the World Trade Organization here and here, the OECD, and World Trade Historical Database by the CEPR.

Exercise 10.12. Figure 10.14 represents the foreign investment surplus and the trade deficit. Discuss why the two lines mirror each other. Could this be a coincidence?

Figure 10.14: U.S. Balance of Payments



10.3.2 The payments must be balanced!

Every international financial transaction is essentially an exchange. When a country sells goods or services, the buying country compensates by transferring assets. Consequently, the total value of goods and services a country sells (its net exports) must be equal to the value of assets it acquires (its net capital outflow).

The *Balance of Payments* account consists of two primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance (goods and services exports minus imports) plus the effects of net income and direct payments. It is positive, if a country is a net lender to the rest of the world and negative, if it is a net borrower from the rest of the world. In other words, an account surplus increases a country's net foreign assets.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets. Capital can flow in the form of following:

    1. **Foreign Direct Investment (FDI)**: It involves investing in foreign companies with the intention of controlling or significantly influencing their operations.

2. **Foreign Portfolio Investment (FPI)**: This type of investment is in foreign financial assets, such as stocks and bonds, where the investor does not seek control over the companies.
3. **Other investments**: This includes capital flows into bank accounts or funds provided as loans. It also encompasses the reserve account, which is managed by the central bank responsible for buying and selling foreign currencies.

Ignoring statistical effects, these two subaccounts must sum to zero.

Example

Imagine Boeing, an American company, sells airplanes to a Japanese airline:

1. Boeing transfers airplanes to the Japanese firm, and in return, the Japanese firm pays Boeing in Yen. This transaction increases exports (boosting net exports) and results in the United States acquiring foreign assets in the form of Yen (increasing net capital outflow).
2. Boeing might then convert its Yen to U.S. Dollars through a financial exchange. For example, if an American mutual fund wants to invest in a Japanese company, Boeing's sale of planes (a net export) is mirrored by the mutual fund's investment in Japan (a net capital outflow).
3. Alternatively, Boeing could exchange its Yen with an American company looking to purchase goods or services from Japan. In this scenario, the value of imports matches the value of exports, leaving net exports unchanged.

While it's true that the overall totals of payments and receipts must inherently balance, certain transaction types can create imbalances, leading to either deficits or surpluses. These imbalances may manifest in various sectors such as trade in goods (commodities), services trade, foreign investment income, unilateral transfers (including foreign aid), private investment, and the flow of gold and currency between central banks and treasuries, among other international dealings. It's crucial to note, though, that the accounting framework ensures these surpluses and deficits ultimately zero out, adhering to the principles of double-entry bookkeeping.

Example

Take, for example, a scenario where Americans purchase cars from Germany without engaging in any other transactions with it. The outcome is that Germans accumulate dollars, which can be maintained as bank deposits in the United States or within other U.S.-based assets. The American payment for German automobiles is counterbalanced by German acquisitions of dollar assets, including investments in U.S. entities and institutions. This exchange means Germany sells cars to the U.S., while the U.S. sells dollars or dollar-backed assets to Germany. Consequently, Germany experiences a trade surplus, indicated by a positive trade balance and a corresponding surplus in its current account, which encompasses the trade balance. Nonetheless, this also implies Germany faces a deficit in its capital account, characterized by a net outflow of money.

Table 10.5

Table 10.5: A hypothetical account

Receipt (credit)		Payments (debits)	
Current Account			
1. Export of goods and services	800	3. Import of goods and services	600
2. Unilateral receipts	300	4. Unilateral payments	390
Total	**1100**	**Total**	**990**
Capital Account			
5. Borrowings	700	7. Lendings	750
6. Sale of gold/assets	100	8. Purchase of gold/assets	150
Total	800	**Total**	900
		Errors and omissions	10
Total	1900	**Total**	1900

10.3.3 A normative discussion of imbalances in the capital and current account

Normatively discussing imbalances in the capital and current accounts of countries involves evaluating these phenomena from a perspective of what ought to be, considering ethical, practical, and policy implications. These imbalances are not merely numerical figures; they reflect underlying economic activities and policy decisions with significant implications for national and global economic health.

10.3.3.1 Current account imbalances

The current account includes trade in goods and services. A surplus in the current account indicates that a country is exporting more goods than it imports.

Surpluses: Normatively, persistent current account surpluses might be viewed as a sign of a country's competitive strength in the global market. However, they can also indicate underconsumption or insufficient domestic investment, suggesting that a country is not fully utilizing its economic resources to improve the living standards of its population. Furthermore, large surpluses can lead to tensions with trading partners and might prompt accusations of unfair trade practices or currency manipulation.

Deficits: On the other hand, persistent deficits could signal domestic economic vitality and an attractive environment for investment, reflecting high consumer demand and robust growth. Yet, they can also indicate structural problems, such as a lack of competitiveness, reliance on foreign borrowing to sustain consumption, or inadequate savings rates. Over time, large deficits may lead to unsustainable debt levels, making the country vulnerable to financial crises.

10.3.3.2 Capital account imbalances

The capital account records the net change in ownership of national assets. It includes the flow of capital into and out of a country, such as investments in real estate, stocks, bonds, and government debt.

Inflows: Capital account inflows can signify strong investor confidence in a country's economic prospects, potentially leading to increased investment and growth. However, excessive short-term speculative inflows can destabilize the economy, leading to asset bubbles and subsequent financial crises when the capital is suddenly withdrawn.

Outflows: Capital outflows might indicate a lack of confidence in the domestic economy or better opportunities abroad. While some level of outflow is normal for diversified investment portfolios, large and rapid outflows can precipitate a financial crisis by depleting foreign reserves and putting downward pressure on the currency.

10.3.4 A formal representation

In the following, I present a streamlined perspective on the global trading system. This overview does not engage with the benefits or drawbacks of maintaining trade surpluses or deficits, a subject that warrants its own discussion. However, it aims to identify the factors influencing current account deficits and surpluses.

10.3.4.1 Closed economy

Within a closed economy, we identify three principal actors: households, firms, and the government. Let's define C as the consumption of goods and services by households, encompassing necessities and luxuries like food, housing, and entertainment. Let G represent government expenditures, which cover infrastructure, social services, military outlays, education, and more. Lastly, I symbolizes the investment by firms in assets such as machinery, buildings, and research and development. Given these components, the total economic output, Y, can be expressed by the *fundamental equation of economics* as:

$$Y = C + I + G.$$

This equation encapsulates the aggregate spending within a closed economy, highlighting the interplay between consumption, investment, and government expenditure in determining overall economic activity.

If we define national savings, S, as the share of output not spent on household consumption or government purchases, then the investments, I, must be equal to the savings in a closed economy:

$$\begin{aligned} Y &= C + I + G \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I \\ \Leftrightarrow S &= I, \end{aligned}$$

This implies that within a closed economy, any portion of the output that is not consumed—either privately by households (C) or by the government (G)—necessarily must be allocated towards investment (I). Thus, the equation underscores a foundational economic principle: the total output of an economy (Y) is either consumed or invested, leaving no surplus output.

10.3.4.2 Open economy

In an open economy, the dynamics of household consumption, government expenditures, and firm investments extend beyond domestic production to include imports from and exports to foreign markets. Thus, an economy can import and export goods. Denoting imports by IM and exports by EX, we can re-write the fundamental equation of economics by adding the concept of net exports (NEX), the difference between a country's exports and imports. A positive net export value ($EX > IM$) indicates a trade surplus, reflecting that the economy exports more than it imports. Conversely, a negative net export value ($EX < IM$) signifies a trade deficit, where imports exceed exports:

$$\begin{aligned} Y &= C + I + G + \underbrace{EX - IM}_{NEX} \\ \Leftrightarrow \underbrace{Y - C - G}_{S} &= I + NEX \\ \Leftrightarrow \underbrace{S - I}_{NCO} &= NEX \end{aligned}$$

In scenarios where investment equals savings ($I = S$), the economy's net exports are zero, reflecting a balance between domestic production not allocated towards household or government consumption and investments. However, when an economy experiences a trade surplus ($NEX > 0$), such as Germany in recent decades, it implies that domestic savings exceed investments. This surplus indicates that the country produces more than it spends on domestic goods and services, channeling excess savings into investments abroad. Thus, savings not utilized domestically ($S - I$) are equivalent to the net capital outflow (NCO), establishing a direct link between a country's trade surplus and its role as a global lender or investor:

$$NCO = NEX$$

> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade deficit (surplus), it is offset one-to-one by a capital account surplus (deficit) to assure a balance of payments. In other words, if an economy wants to import more goods than it produces, it must attract foreign capital to be invested at home.

10.3.5 Case study: U.S. trade deficit

Consider a scenario where the United States is unable to attract sufficient capital flows from abroad to finance its trade deficit. In such a case, American consumers continue purchasing foreign goods with US Dollars, leading to an outflow of US Dollars that surpasses inflow. This imbalance results in an

increased supply of US Dollars relative to its demand, causing the value of the US Dollar to depreciate. A depreciated US Dollar would, in theory, make US exports more competitive (cheaper for foreign buyers) and imports more costly, thereby potentially reducing the current account deficit. However, the trade deficit of the United States has remained relatively stable, and the US Dollar has not experienced significant depreciation. This stability is partly why former President Trump criticized other countries for allegedly *manipulating* their currencies, see Figure 10.15.

Trump's stance on the trade deficit was clear: he perceived it as detrimental to the United States. He advocated for a weaker dollar and lower interest rates to address this issue. A weaker dollar would render American products more affordable internationally, stimulating exports and discouraging imports. Concurrently, lower interest rates in the United States would diminish the country's appeal for foreign capital investments (I would decrease), leading to reduced net capital inflows. This adjustment would, in turn, decrease the **Capital Account** surplus and, by extension, shrink the **Current Account** deficit. Specifically, Trump accused the Chinese government and the European Central Bank of implementing policies that undervalue their currencies (the Renminbi and the Euro), thereby gaining an unfair advantage in trade.

Figure 10.15: Trump worries about the U.S. trade deficit

As Trump thinks a trade deficit is bad for the United States, he would like to have a weak dollar and low interest rates. A weak dollar makes American products cheap for the rest of the world and has positive effects on exports and negative on imports. A low interest rate in the United States would make the country less attractive for foreign capital investments (I would become smaller), meaning the net capital inflows would decrease and so would the **Capital Account**'s surplus (and with it, the **Current Account** deficit would become smaller). In concrete terms, he claims that in particular the Chinese government and the European Central Bank run policies that keep their currencies (Renminbi and Euro) cheap.

Despite significant efforts by President Trump to reduce the U.S. trade deficit, the endeavor did not achieve its intended outcome, as illustrated in Figure 10.16. One likely reason for this shortfall was the reduction of taxes for large corporations, which enhanced the rate of return on investments. This policy made investing in the U.S. more appealing to foreign investors, potentially counteracting efforts to diminish the trade deficit.

Exercise 10.13. Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 10.17.

Figure 10.17: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus

Source: YouTube

Figure 10.16: The trade deficit of the United States over time

Appendix A

Glossary

Autarky: Autarky is the characteristic of self-sufficiency; the term usually applies to political states or their economic systems. Autarky exists whenever an entity survives or continues its activities without external assistance or international trade.

Balance of payments: The balance of payments, also known as balance of international payments and abbreviated B.O.P. or BoP, of a country is the record of all economic transactions between the residents of the country and the rest of the world in a particular period of time (e.g., a quarter of a year). These transactions are made by individuals, firms, and government bodies. Thus, the balance of payments includes all external visible and non-visible transactions of a country. It is an important issue to be studied, especially in the international financial management field.

Balance of trade: The balance of trade, commercial balance, or net exports (sometimes symbolized as NX), is the difference between the monetary value of a nation's exports and imports over a certain time period.

Balanced trade: When the value of exports equals the value of imports.

Budget constraint line: Shows the possible combinations of two goods that are affordable given a consumer's limited income.

Closed economy: If a self-sufficient economy also refuses to conduct any trade with the outside world, then economists may term it a "closed economy."

Complements: Goods that go together; a decrease in the price of one results in an increase in demand for the other, and vice versa.

Competitive market: A market in which there are many buyers and many sellers, ensuring that no single buyer or seller can significantly impact the market price.

Consumer equilibrium: Occurs when the ratio of the prices of goods is equal to the ratio of the marginal utilities, indicating the point at which a consumer achieves maximum satisfaction.

Deadweight loss: The loss in social surplus that occurs when a market produces an inefficient quantity of goods.

Demand: Refers to the willingness and ability of consumers to purchase a quantity of a good or service at a given point in time or over a period.

Demand curve: A graph illustrating how much of a given product a household would be willing to buy at different prices.

Demand schedule: A table that shows the relationship between the price of a good and the quantity demanded.

Diminishing marginal utility: The principle that each additional unit of a good consumed provides less additional satisfaction than the previous unit.

Elasticity: A concept used to quantify the responsiveness of one variable when another variable changes.

Equilibrium: The condition that exists when the quantity supplied equals the quantity demanded, resulting in no tendency for price changes.

Excess demand: The condition where the quantity demanded exceeds the quantity supplied at the current price.

Excess supply: The condition where the quantity supplied exceeds the quantity demanded at the current price.

Export: An export in international trade is a good or service produced in one country that is bought by someone in another country. The seller of such goods and services is an exporter; the foreign buyer is an importer.

Giffen good: A type of good for which an increase in price leads to an increase in quantity demanded, contrary to the basic law of demand.

Import: An import in the receiving country is an export from the sending country. Importation and exportation are the defining financial transactions of international trade.

Indifference curve: In economics, an indifference curve connects points on a graph representing different quantities of two goods, points between which a consumer is indifferent. That is, any combinations of two products indicated by the curve will provide the consumer with equal levels of utility, and the consumer has no preference for one combination or bundle of goods over a different combination on the same curve.

Inferior good: A good for which an increase in income results in a decrease in demand.

International trade: International trade is the exchange of capital, goods, and services across international borders or territories.

Labor demand: Refers to the amount of work that employers are willing to hire at a given wage.

Labor supply: Refers to the amount of time workers are willing to work at a given wage.
Law of demand: The principle that, other things being equal, the quantity demanded of a good falls when the price of the good rises.

Law of supply: The principle that, other things being equal, the quantity supplied of a good rises when the price of the good rises.

Marginal utility: The additional satisfaction gained from consuming one more unit of a good.

Marginal utility per dollar: The additional satisfaction gained from purchasing a good adjusted by the product's price; calculated as MU/Price.

Market: A group of buyers and sellers engaged in the exchange of a particular good or service.

Market-clearing price: An alternative term for market equilibrium; it refers to the fact that the market is cleared of all unsatisfied demand and excess supply at the equilibrium price.

Net capital outflow: The difference between the purchase of foreign assets by domestic residents and the purchase of domestic assets by foreigners. This equals net exports, indicating that a country's savings can fund investments domestically or abroad. We will elaborate on that later on in greater detail.

Normal good: A type of good for which an increase in income or a decrease in price leads to an increase in demand.

Perfectly competitive market: A market characterized by the identical nature of goods offered for sale and a large number of buyers and sellers, ensuring no single entity can influence the market price.

Perfect substitutes: Goods that are identical in nature and can be used in place of one another.

Price ceiling: A legally mandated maximum price that sellers may charge for a good, typically set by the government.

Price control: Government regulations aimed at influencing the prices of goods and services rather than allowing market forces to determine them.

Price floor: A legally mandated minimum price set by the government.

Producer surplus: The extra benefit producers receive from selling a good, calculated as the price received minus the minimum acceptable price.

Production-possibility frontier: A production–possibility frontier (PPF) or production possibility curve (PPC) is a curve that shows various combinations of the amounts of two goods that can be produced within the given resources and technology— a graphical representation showing all the possible options of output for two products that can be produced using all factors of production, where the given resources are fully and efficiently utilized per unit time.

Protectionism: Protectionism is the economic policy of restricting imports from other countries through methods such as tariffs on imported goods, import quotas, and a variety of other government regulations.

Quantity demanded: The total amount of a good that buyers are willing and able to purchase at a given price.

Quantity supplied: The total amount of a particular good that sellers are willing and able to sell at a given price.

Subsidy: An economic incentive given to remove some type of burden in the interest of market welfare; a subsidy drives a wedge, decreasing the price consumers pay.

Substitutes: Goods that can be used in place of one another; when the price of one increases, demand for the other often rises.

Supply: The willingness and ability of producers to create goods and services and bring them to market.

Supply curve: A graph that illustrates the quantity of a good that a firm will supply at various price levels.

Tariff: A tariff is a tax on imports or exports between sovereign states. It is a form of regulation of foreign trade and a policy that taxes foreign products to encourage or safeguard domestic industry. Traditionally, states have used them as a source of income. They are now among the most widely used instruments of protectionism, along with import and export quotas.

Tax: Money collected by a government from buyers or sellers, directly or indirectly, in exchange for services provided to the community.

Total utility: The overall satisfaction derived from consuming a certain quantity of goods or services.

Trade: Trade involves the transfer of goods or services from one person or entity to another, often in exchange for money. Economists refer to a system or network that allows trade as a market.

Trade balance: The difference between the value of goods and services a country sells abroad and those it buys from abroad, also known as net exports.

Trade surplus: When a country sells more than it buys, resulting in a positive trade balance.

Trade deficit: When a country buys more than it sells, leading to a negative trade balance.

Trade barrier: Trade barriers are government-induced restrictions on international trade.

Trade war: A trade war is an economic conflict resulting from extreme protectionism in which states raise or create tariffs or other trade barriers against each other in response to trade barriers created by the other party.

Utility: Within economics, the concept of utility is used to model worth or value. Its usage has evolved significantly over time. The term was introduced initially as a measure of pleasure or satisfaction within the theory of utilitarianism by moral philosophers such as Jeremy Bentham and John Stuart Mill. The term has been adapted and reapplied within neoclassical economics, which dominates modern economic theory, as a utility function that represents a consumer's preference ordering over a choice set. It is devoid of its original interpretation as a measurement of the pleasure or satisfaction obtained by the consumer from that choice.

Appendix B

Mathematical preliminaries

Please feel free to download and study my introduction for mathematics for economics here.

Appendix C

Past exams

> Note
>
> I have taught several courses, which are now summarised in the course *Economics*, including *International Economics*, *Economic Thinking in a Global Context*, *Macroeconomics*, *Microeconomics* and *Managerial Economics*. There are sub-areas from each of these courses that are also covered in the Economics course.
> If you have any questions, please do not hesitate to contact me. However, I do not offer solutions to the exams.

C.1 Macroeconomics

Please feel free to download a collection of past *Macroeconomics* exams here.

C.2 Economic Thinking in a Global Context

Please feel free to download a collection of past *Economic Thinking in a Global Context* exams here.

C.3 International Economics

Please feel free to download a collection of past *International Economics* exams here.

C.4 Managerial Economics

Please feel free to download a collection of past *Managerial Economics* exams here.

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