# International Economics

**Lecture Notes (currently under revision)**



March 28, 2024

# Table of contents

# List of figures

# List of tables

# 1. Preface

## About the notes

- These notes aims to support my lecture at the HS Fresenius but are incomplete and no substitute for taking actively part in class.
- A pdf version of these notes is available here
- I appreciate you reading it, and I appreciate any comments.
- This is work in progress so please check for updates regularly.
- Do not distribute without permission.
- For making an appointment, you can use the online tool that you find on my private homepage: https://hubchev.github.io/

## About the author

Figure 1.1.: Prof. Dr. Stephan Huber

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.

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 on my work, please visit my private homepage at hubchev.github.io.

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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.

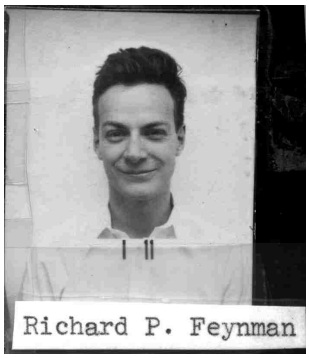
Unfortunately, students sometimes feel overwhelmed by these models because of their reliance on math and rigorous logical reasoning. There is often a perception that there are simpler ways to convey these arguments. While this may occasionally be true, I firmly believe that the formal approach to introducing 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. Nevertheless, they can offer deeper insights into a topic than narratives.
- 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 1.2.: 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 Manhatten Project (see Figure 1.2) 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:

- Study the lecture notes, i.e., try to understand the exercises and solve them yourself.
- Study the exercises, i.e., try to understand the logical rules and solve the problems yourself.
- Test yourself with past exams that you will find online.
- If you have the opportunity to form a group of students to study and prepare for the exam, 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 will do my best to help.

# 2. Monetary international economics

Learning objectives

- Interpret exchange rates and relate their changes to the relative prices of countries' goods.
- Predict the impact of exchange rate changes on 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.

## 2.1. Currencies

**Exercise 2.1.** Our relations are not good

Figure 2.1.: Trump doubles metal tariffs on Turkey by 20%


*Source: Twitter*

Do you understand the logic behind Mr. Trump's action (see Figure 2.1) to double metal tariffs due to a fall of the Turkish Lira? Discuss.

### 2.1.1. Exchange rates

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

Suppose the € is the home currency and 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 2.2.** Exchange currencies (Solution A.1)

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 $1.15\frac{EUR}{USD}$.

### 2.1.2. Relative prices

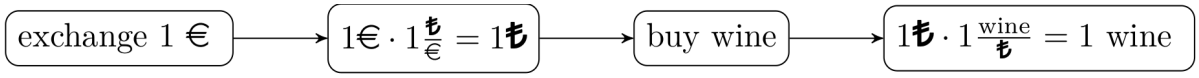
- How much 'value' do I have to give to receive a 'value' from abroad?
- Assume the home country produces beer and the foreign country produces wine. Further assume you want to exchange a beer for wine, then the relative price gives the amount of beer you have to give to receive a unit of wine (in the direct quotation), or the amount of wine you receive for a unit of beer (indirect quotation).
- A relative price of 1, for example, means that you can exchange 1 liter of beer with 1 liter of wine. However, we can also assume that beer is measured in cans of 500ml each and wine in 1 liter bottles. Then, the relative price would be $P^{\frac{beer}{wine}} = \frac{2 \text{ beer}}{1 \text{ wine}}$. That means, you can convert 2 cans of beer for one bottle of wine.
- If the relative prices increase, I must give more beer to receive a wine.
- If the relative prices decrease, I must give less beer to receive a wine.

> **i** Relative Prices and International Trade
>
> 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.

### 2.1.3. Exchange rates and relative prices

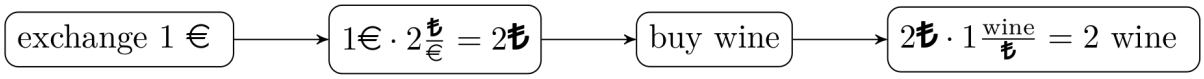
- Relative prices are (directly) determined by exchange rates.
- To prove this statement, assume an exchange rate of 1, $E^{€} = E^{\frac{€}{}} = 1$ and that a liter of beer costs 1 € at home and a wine costs 1 abroad.
- Thus, I can buy both a wine or a beer for 1 €. Due to the fact that I must pay the wine producer with , I must exchange the € beforehand. The process goes like shown in Figure 2.2:

Figure 2.2.: One Wine per Euro




Now, assume that the € appreciates and the exchange rate becomes $E^{\frac{€}{}} = 0.5$ and $E^{€} = 2$, respectively. Then, you receive more than one wine, see Figure 2.3:

Figure 2.3.: Two wine per Euro




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 international trade**

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.

### 2.1.4. Trump and relative prices

Let's return to Trump's Twitter message. Steel producers in the US (and with them Donald Trump) are not happy about a strong dollar (and a weak lira), because it makes their products relatively expensive for Turkish buyers and Turkish steel relatively cheap for US consumers. Trump would have two options to change this situation: He could change the exchange rates or the relative prices of goods in different countries. Since it is difficult for him to influence the exchange rate (the central bank is independent), he decided to increase tariffs and thus the price of foreign steel in the United States. However, this has the disadvantage of making U.S. consumers pay more for these goods (and for goods made from and with steel and aluminum), as David Boaz, executive vice president of the Cato Institute, an American libertarian think tank, notes in his response on Twitter, see Figure 2.1.

In addition, it can be argued that the increased tariffs will make the dollar even stronger because buyers who no longer purchase steel in Turkey due to the increased tariffs will no longer seek to exchange U.S. dollars for Turkish lira. Overall, it can be doubted that raising tariffs is a successful strategy.

Figure 2.4.: *Who wins in the end?*


*Source: Twitter*

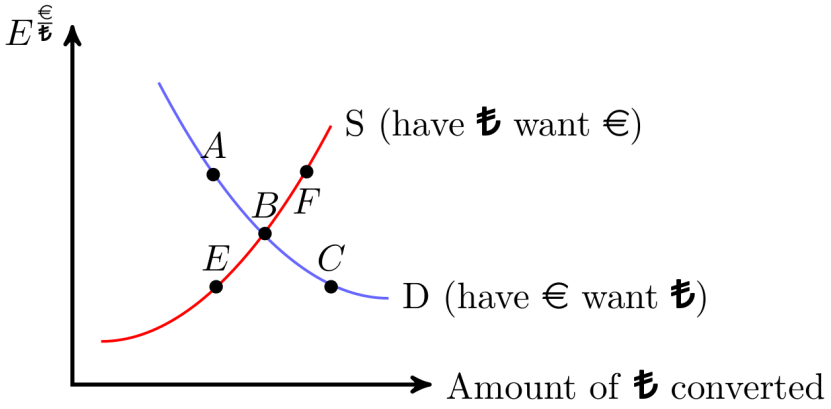
### 2.1.5. The FOREX

#### 2.1.5.1. 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.

- **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).

Figure 2.5.: Example of a foreign exchange market




  - 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 2.1.

Table 2.1.: Daily turnover of global foreign exchange market from 2001 to 2022 (in billion U.S. dollars)

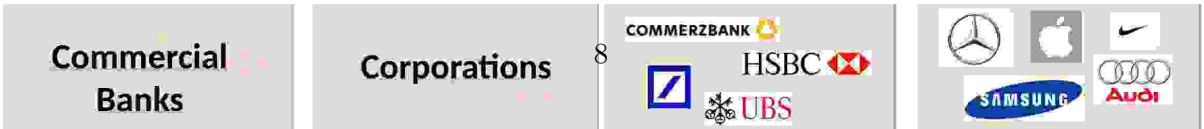
| name | 2001 | 2004 | 2007 | 2010 | 2013 | 2016 | 2019 | 2022 |
|---|---|---|---|---|---|---|---|---|
| Total | 1.239 | 1.934 | 3.324 | 3.973 | 5.357 | 5.066 | 6.581 | 7.506 |
| USD | 1.114 | 1.702 | 2.845 | 3.371 | 4.662 | 4.437 | 5.811 | 6.639 |
| EUR | 470 | 724 | 1.231 | 1.551 | 1.790 | 1.590 | 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).*

#### 2.1.5.2. Actors on the FOREX

Various key actors trade on the FOREY. In particular commercial banks, multinational corporations, and nonbank financial institutions, like investment funds, playing significant roles in trading and speculation. Central banks as play a role. They intervene to stabilize their national currency, influencing the market's direction.

Figure 2.6.: Players on the foreign exchange market

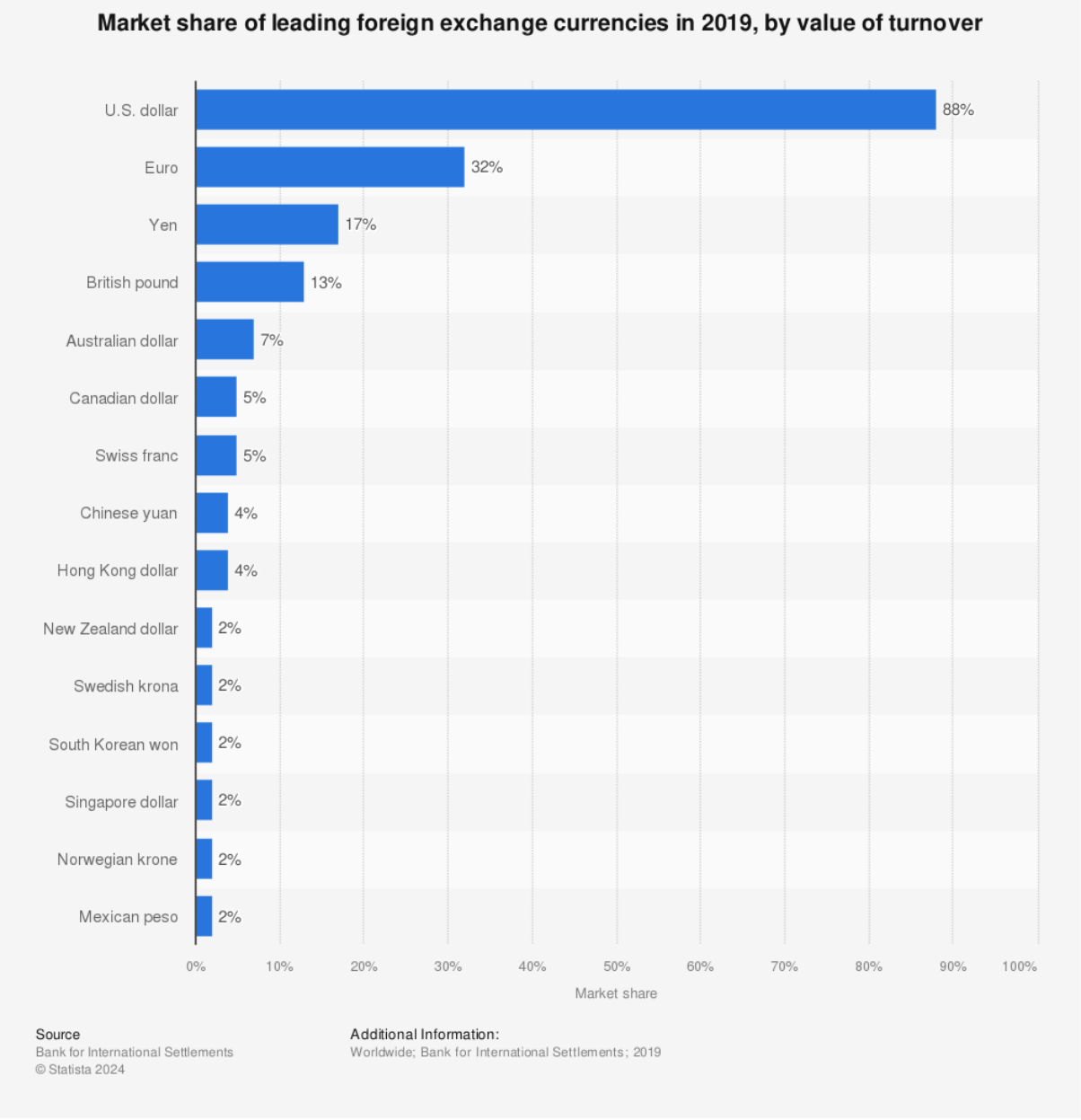


#### 2.1.5.3. The vehicle currency

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 2.7, 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.

Figure 2.7.: Market share of leading foreign exchange currencies in 2019



### 2.1.6. 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 prices differences would exist, profits could 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 2.2 and Exercise 2.8). The assumptions of the PPP do mostly not hold perfectly in reality: some goods and services are not trade-able, firms might have different degrees of market power across countries, and the transaction costs are not zero.

**Exercise 2.3.** Big Mac Index (Solution A.2)
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 2.2 shows countries with on average very expensive (2.2a) and cheap (2.2b) Big Macs.

Table 2.2.: The price of a Big Mac across countries

(a) An Big Mac is relatively expensive here:

| 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) |

(b) An Big Mac is relatively cheap here:

| Country | Price |
|---|---|
| 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*?
c) Using the data of Table 2.2, 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.

**Exercise 2.4.** International arbitrage (Solution A.3)

Table 2.3.: 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 tradable 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 2.3. 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 2.4:

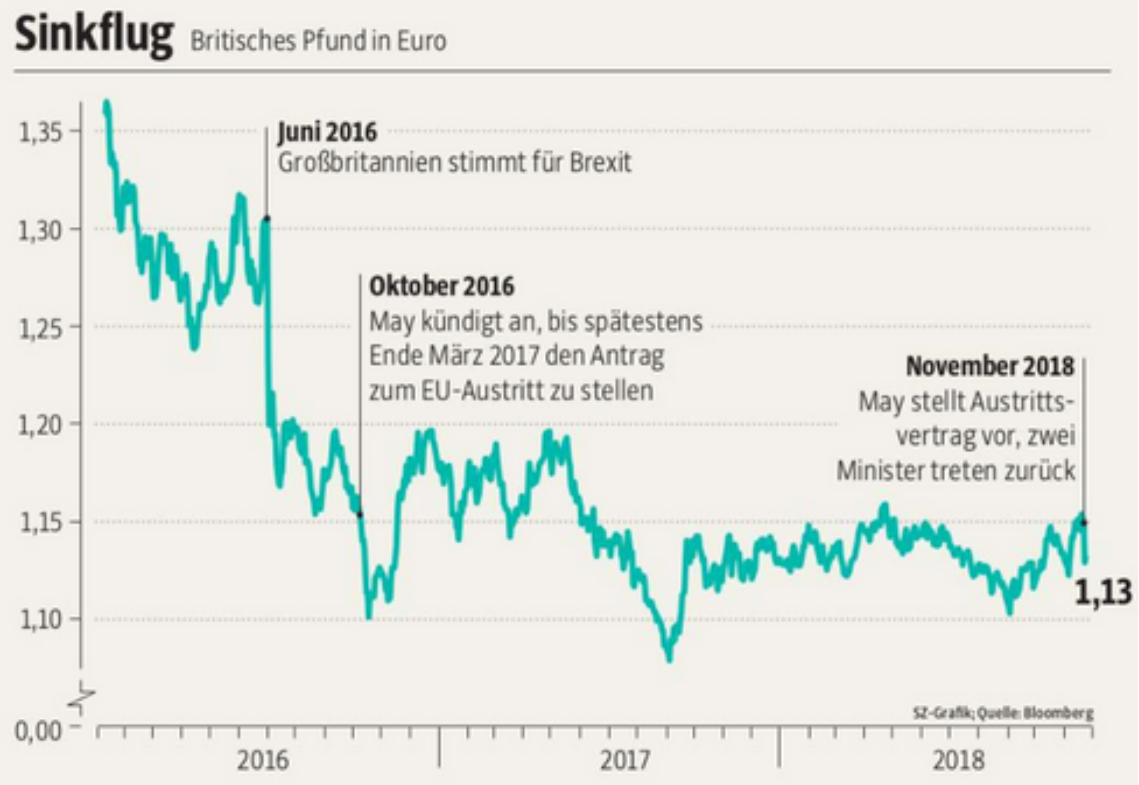
Table 2.4.: Table of prices and currencies across countries post-arbitrage

| 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: - $\frac{\text{USD}}{\text{EUR}}$ - $\frac{\text{EUR}}{\text{USD}}$ - $\frac{\text{USD}}{\text{CHF}}$ - $\frac{\text{CHF}}{\text{USD}}$ - $\frac{\text{CHF}}{\text{EUR}}$ - $\frac{\text{EUR}}{\text{CHF}}$

**Exercise 2.5.** Brexit and the exchange rate
Examine Figure 2.8 and discuss the reasons behind the depreciation of the British pound since June 2016.

Figure 2.8.: 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).*

## 2.2. International investments

Investing or when storing purchasing power by holding a currency is speculative, regardless if the investment takes place at home or abroad. When holding a foreign currency, however, you must consider the fact that this currency can appreciate or depreciate. The value of a currency can fluctuate significantly over time, influenced by economic policy, market sentiment and global events. In the next sections, I present a framework that helps to understand the essential determinant of the rate of return on your investment.

### 2.2.1. 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.

### 2.2.2. 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:

#### 2.2.2.1. 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:

$$\underbrace{I_{t-1}}_{\text{investment in t-1}} \cdot \underbrace{(1+i)}_{\text{1+interest rate}} = \underbrace{I_t}_{\text{payout amount in t}} \tag{2.1}$$

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

#### 2.2.2.2. 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 $t$:

$$I^{€}_{t-1} \cdot E^{\overline{€}}_{t-1} \cdot E^{\underline{€}}_{t} = I^{€}_{t} \tag{2.2}$$

#### 2.2.2.3. 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 $\pi$ 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:

$$I_t = I_{t-1} \cdot (1 + \pi) \tag{2.3}$$

### 2.2.3. 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 2.1, Equation 2.2, and Equation 2.3, we can describe the value of our investment in period $t$ as follows:

$$I_t^{€} = I_{t-1}^{€} \cdot (1 + i^*) \cdot E_{t-1}^{\overline{€}} \cdot E_t^{\underline{€}} \cdot (1 + \pi^*), \tag{2.4}$$

where $I_{t-1}^{€}$ denotes the initial investment, $i^*$ denotes the interest rate abroad and $\pi^*$ the inflation abroad. Dividing by $I_{t-1}^{€}$ and subtracting 1 from both sides of Equation 2.4, 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 $(E_{t-1}^{\overline{€}} \cdot E_t^{\underline{€}})$:

$$\underbrace{\frac{I_t^{€}}{I_{t-1}^{€}}^{*} - 1}_{r} = (1 + i^*) \cdot (1 + \pi^*) \cdot \underbrace{E_{t-1}^{\overline{€}} \cdot E_t^{\underline{€}}}_{\alpha} - 1$$

$$r^* = (1 + i^*) \cdot (1 + \pi^*) \cdot \alpha - 1$$

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

$$\begin{aligned} r^* &= (1 + i^*) \cdot \alpha - 1 \\ \Leftrightarrow r^* &= \alpha + \alpha i^* - 1. \end{aligned} \tag{2.5}$$

Reorganizing Equation 2.5 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 $(\alpha - 1) = w$:

$$\begin{aligned} &\Leftrightarrow r^* = \alpha + \alpha i^* - 1 + i^* - i^* \\ &\Leftrightarrow r^* = \alpha - 1 + i^* + \alpha i^* - i^* \\ &\Leftrightarrow r^* = \underbrace{(\alpha - 1)}_{w} + i^* + i^* \underbrace{(\alpha - 1)}_{w} \\ &\Leftrightarrow r^* = w + i^* + i^* w \end{aligned} \tag{2.6}$$

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 2.6.** Exchange rates and where to invest (Solution A.4)
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?

**Exercise 2.7.** Turkey vs. Germany (Solution A.5)
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.

### 2.2.4. 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 ($*$):

$$r = r^* \tag{2.7}$$
$$i = w + i^* \tag{2.8}$$
$$\tag{2.9}$$
$$\Leftrightarrow w = i - i^* \tag{2.10}$$

The interest parity condition (Equation 2.10) 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.

### 2.2.5. 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.

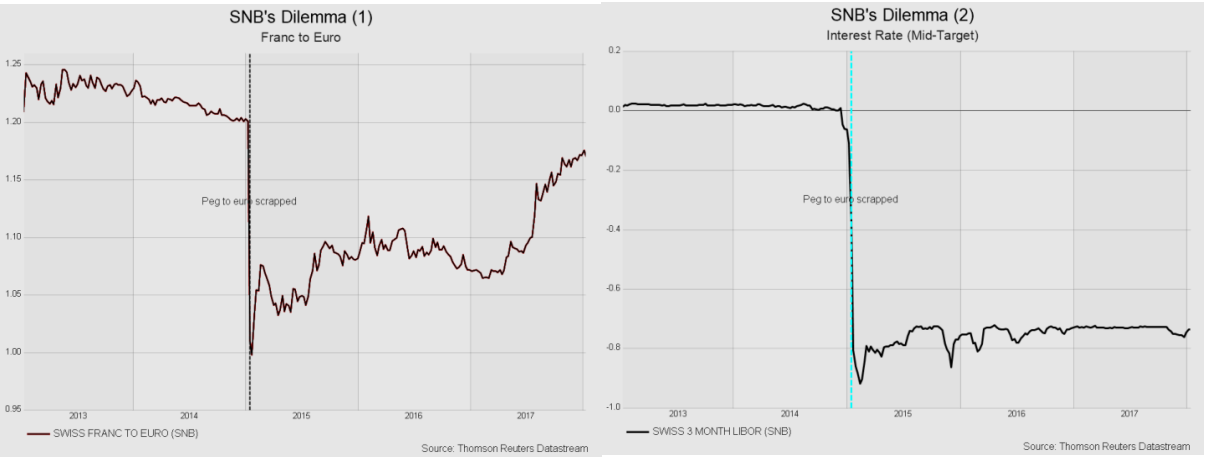
Until early 2015, the Swiss National Bank (SNB) had a policy goal to maintain the franc above the cap of 1.20 Francs per Euro, aiming to protect exporters and combat deflationary pressures. However, in a surprising move, the SNB unpegged the Franc in 2015. This decision was influenced by the appreciation 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 2.9a Almost simultaneously, the interest rate experienced a decline, as depicted in Figure 2.9b. 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 2.10:

$$w = i - i^*$$

Figure 2.9.: The impact of unpegging the Franc on capital markets

(a) The exchange rate: $E^{\frac{CHF}{€}}$ (b) Interest rate for investments in Switzerland




where

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

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.

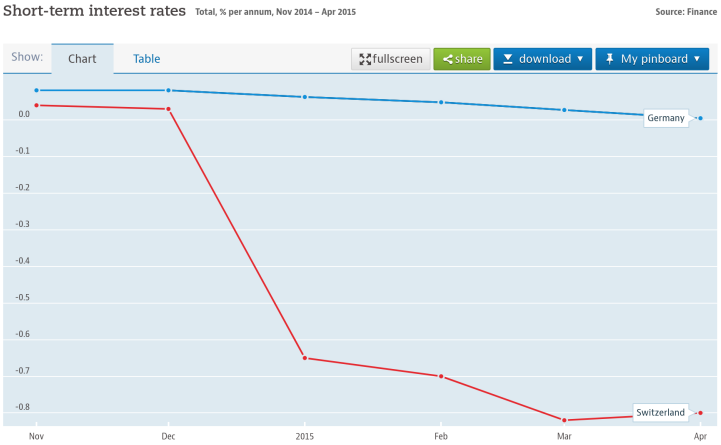
It is important to acknowledge that our theoretical framework simplifies the complex interplay of factors that influence both exchange rates and interest rates. Despite this simplification, the model highlights the key forces driving market dynamics. However, it is important to point out that the actual numbers may not perfectly match our theoretical predictions in quantitative terms, as shown in Figure Figure 2.10.

### 2.2.6. The Fisher effect

The Fisher effect is an economic theory proposed by economist Irving Fisher (1867-1947), which describes the relationship between 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:

$$r = i + \pi.$$

Figure 2.10.: Short-term interest rates across Germany and Switzerland over time




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

We can derive this equation which you see in almost every introductory economics textbook using Equation 2.5 and ignoring international exchanges as the Fisher Effect does not alter with international investments, that means, we assume that the exchange rate is stable over time ($E^{€}_{t-1} = E^{€}_{t}$):

$$I_t = I_{t-1} \cdot (1+\pi) \cdot (1+i) \tag{2.11}$$

$$\Leftrightarrow \frac{I_t}{I_{t-1}} - 1 = (1+\pi)(1+i) - 1 \tag{2.12}$$

$$\Leftrightarrow r = i + \pi + \pi i \tag{2.13}$$

Assuming that the product $\pi i$ is very small, we can say that the rate of return equals approximately the interest rate plus the inflation rate. This approximation is often called the *The Fisher Effect*.

Abstracting from exchange rate movements and interest rate differences, the rate of return is solely determined by the inflation rate and cross-country differences in their rate of return can be described by differences in inflation rates:

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

## 2.3. Balance of payments

**Exercise 2.8.** 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.

### 2.3.1. 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.

### 2.3.2. Two types of international investment

Capital can flow out of a country primarily through two mechanisms:

1. **Foreign Direct Investment (FDI)**: This 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.

Let's consider an example to illustrate how these concepts work in practice. 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 dollars through a financial exchange. For instance, 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.

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).

### 2.3.3. The payments must be balanced!

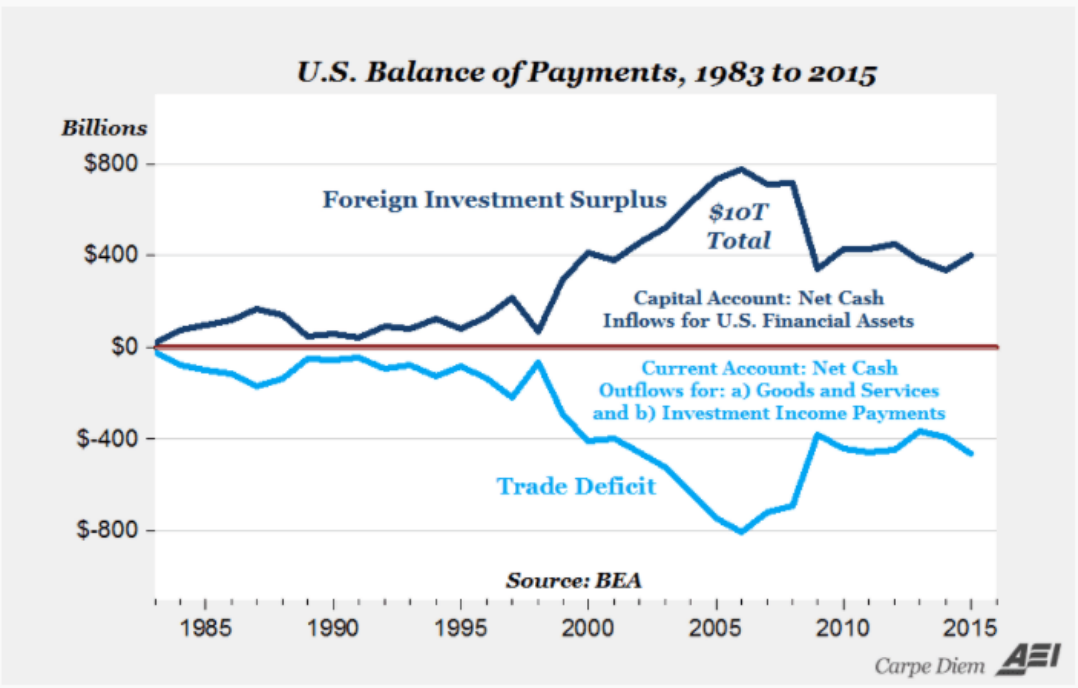
The *Balance of Payments* account consists of some primary components:

1. The **Current account** (Leistungsbilanz) measures a country's trade balance plus the effects of net income and direct payments. It consists of trade, net income, direct transfers of capital, and asset income.

2. The **Capital account** (Kapitalbilanz) reflects the net change in ownership of national assets.

Ignoring statistical effects, these two subaccounts must sum to zero. The U.S. Balance of Payments is an example provided in Figure 2.11.

Figure 2.11.: U.S. Balance of Payments




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.

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.

### 2.3.4. 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.

#### 2.3.4.1. 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.

#### 2.3.4.2. 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.

### 2.3.5. 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.

#### 2.3.5.1. 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.

#### 2.3.5.2. 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:

$$NCO = NEX$$

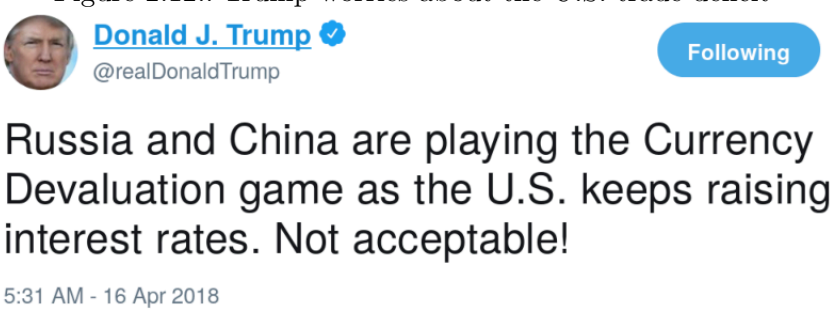
> **i** Net exports must be equal to net capital outflow
> The accounting identities above simply state that there is a *balance of payments*. The Balance of Payment accounts are based on double-entry bookkeeping and hence the annual account has to be balanced. If an economy has a current account trade 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.

### 2.3.6. 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 2.12.

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.

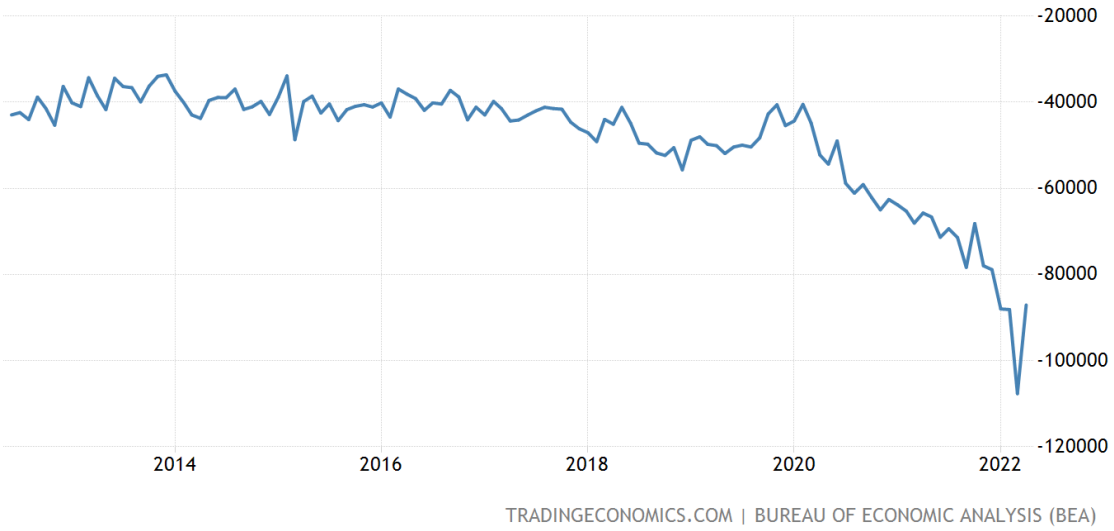
Figure 2.12.: Trump worries about the U.S. trade deficit



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 2.13. 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.

Figure 2.13.: The trade deficit of the United States over time




**Exercise 2.9.** Discuss the pros and cons of Germany's net export surplus. Please watch this video, see Figure 2.14.

Figure 2.14.: Marcel Fratzscher and Clemens Fuest about Germany's trade surplus
Source: YouTube

# 3. 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 3.1 explains Mankiw's principle that trade can make everyone better off.
- Section 3.2 paraphrases the sources of international trade.
- Section 3.3 provides a theoretical framework of trade and shows that under certain circumstances international trade can yield a miserable growth path for a country.
- Section 3.4 explains that more trade does not have to be good for a country's wealth.
- Section 3.5 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 3.6 shows that opening up to free trade generates winners and losers and that countries' endowments with labor and capital determine patterns of trade. :::

## 3.1. Trade can make everyone better off

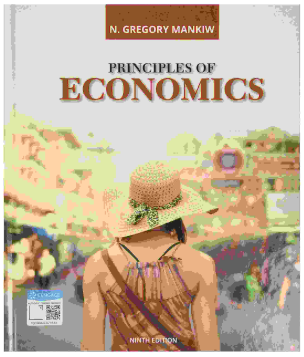
*N. Gregory Mankiw* (*1958) is one of the most influential economists. In his best-selling textbook *Principles of Economics* [Mankiw, 2024, p. 8-9] he claims ten principles of economics of which one is entitled *Trade can make everyone better off* which he explains as follows:

> 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

Figure 3.1.: Mankiw and his textbook

(a) N. Gregory Mankiw

(b) Mankiw's textbook




Source: Harvard.edu and Mankiw [2024].

in the market for automobiles. Compaq and Toshiba compete for the same customers in the market for personal computers.

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.

## 3.2. 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 3.5.

**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 3.3) and the Heckscher-Ohlin Model (see Section 3.6).

**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 **?@sec-policy**.

## 3.3. Exchange economy

> Recommended reading
>
> Suranovic [2012, Chapters 3]

### 3.3.1. 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.

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.

Figure 3.2.: Stylized example of weißwürst and pretzels

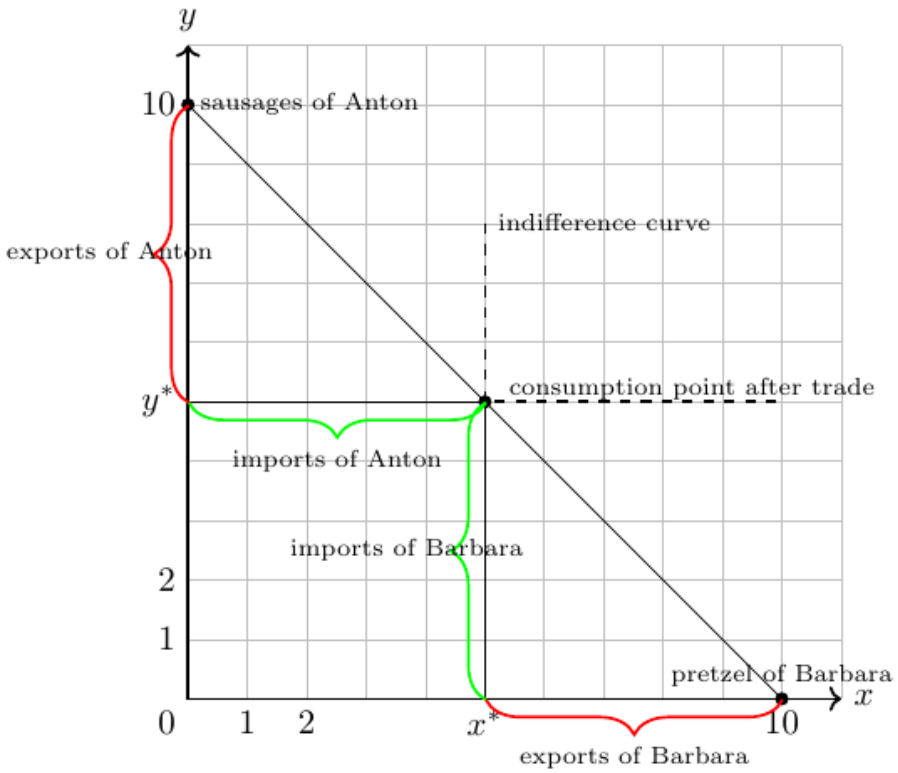
*Source:* *Wikipedia*

**Exercise 3.1.** How Barbara and Anton trade (Solution 3.1)

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.

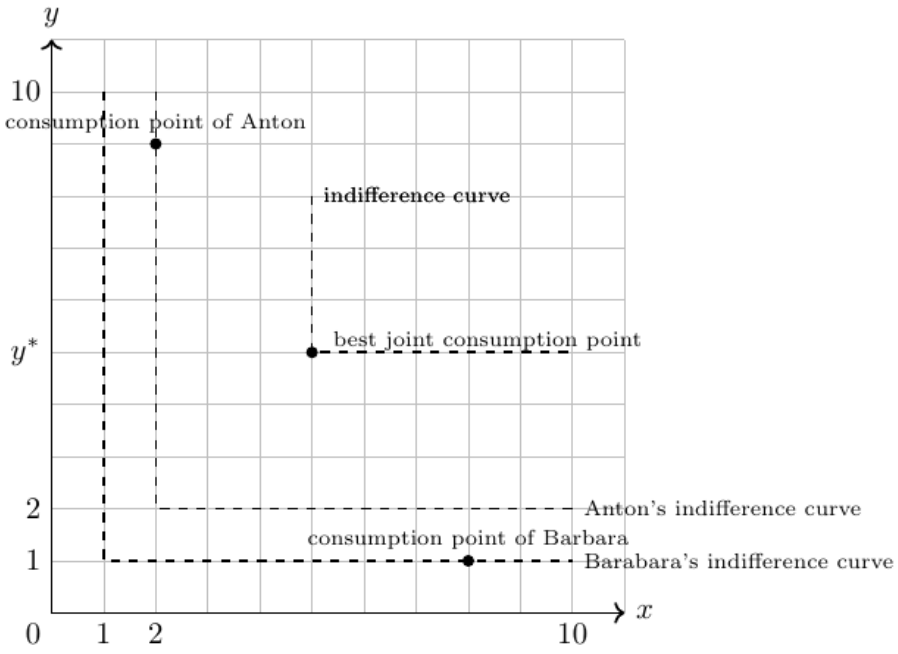
*Solution* 3.1. How Barbara and Anton trade (Exercise 3.1)
Here is a sketch of a solution: a) to c)

Figure 3.3.: The deal of Anton and Barbara




d)

Figure 3.4.: Indifference curves of Anton and Barbara



### 3.3.2. 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.

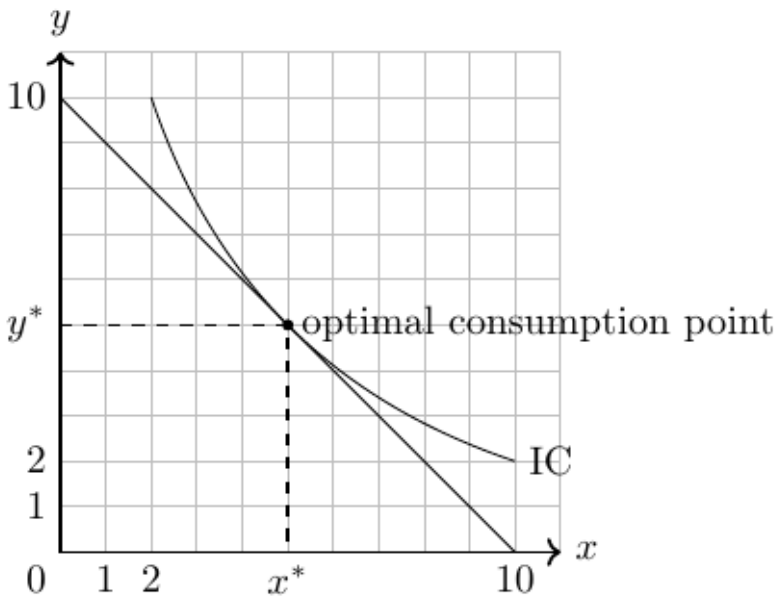
**Quality:** The quality of goods affects the terms of trade. If the pretzels are stale and hard, both might prefer fewer pretzels per sausage.

**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 3.2.** Terms of trade (Solution A.6)

Figure 3.5.: 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, i.e., $p_x = 2$. Draw the new budget line. How will consumption change? What are the new terms of trade?

### 3.3.3. 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 3.6 we will assume that countries are endowed with a certain amount of factors of production that they can use to produce various goods.

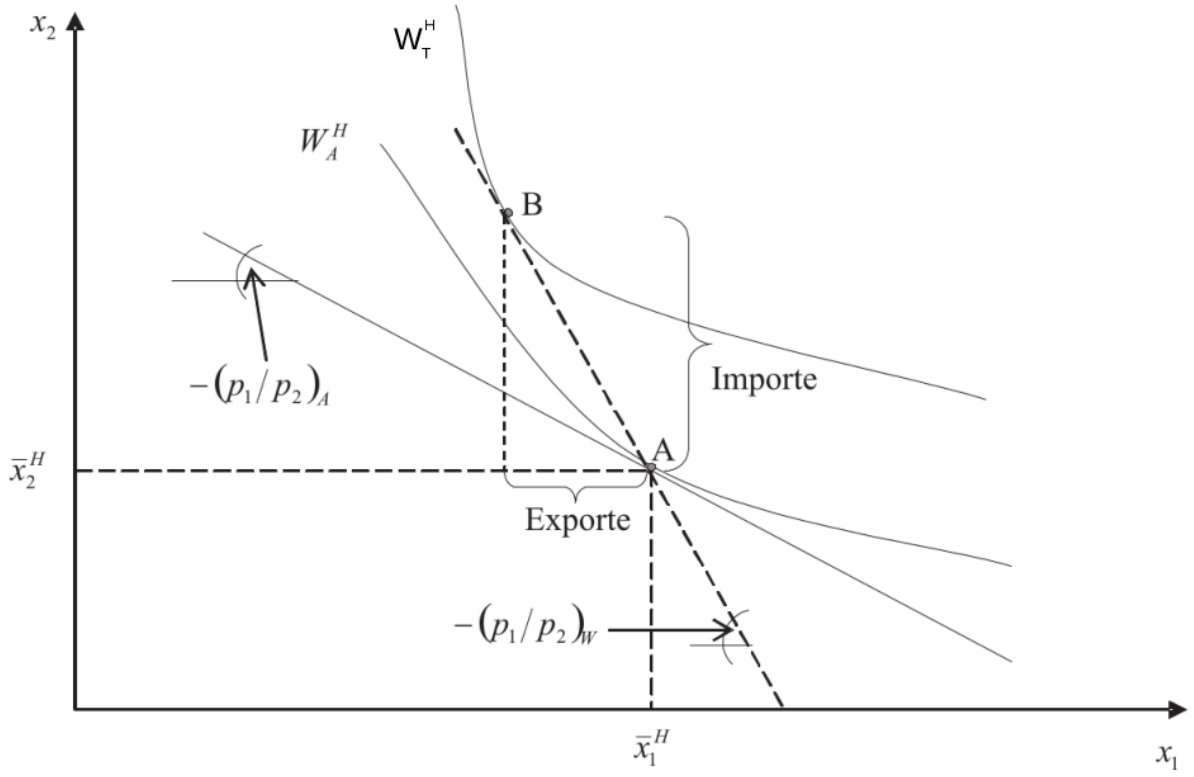
#### 3.3.3.1. Fixed production

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 3.6, 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, $(\frac{p_1}{p_2})_A$:

$$\left(\frac{p_1}{p_2}\right)_W > \left(\frac{p_1}{p_2}\right)_A, \tag{3.1}$$

Figure 3.6.: Optimizing consumption through trade




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.

#### 3.3.3.2. 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 3.7.
- 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 3.3.** Production and consumption

Figure 3.7.: Optimizing consumption by adjusting production and trade

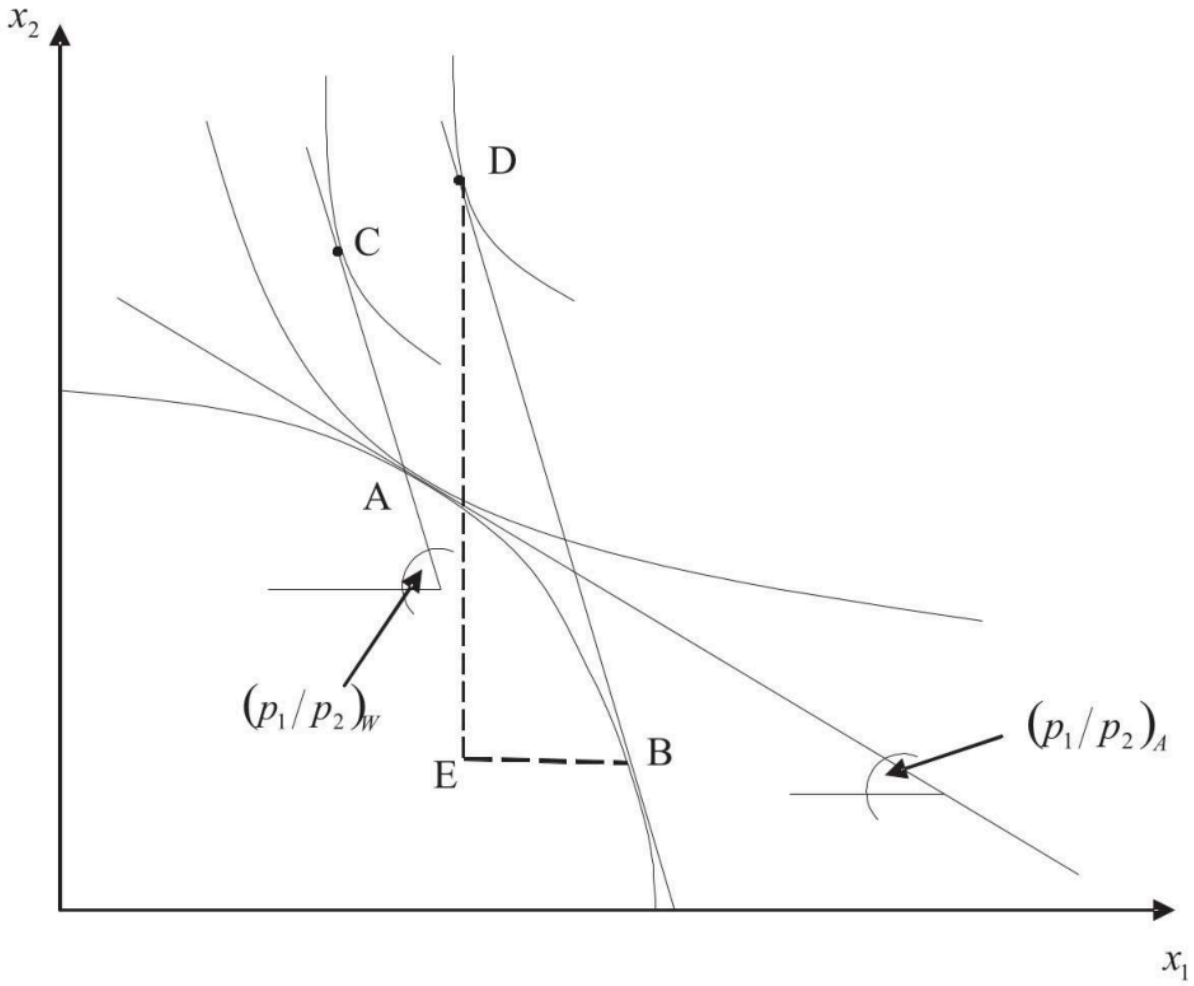
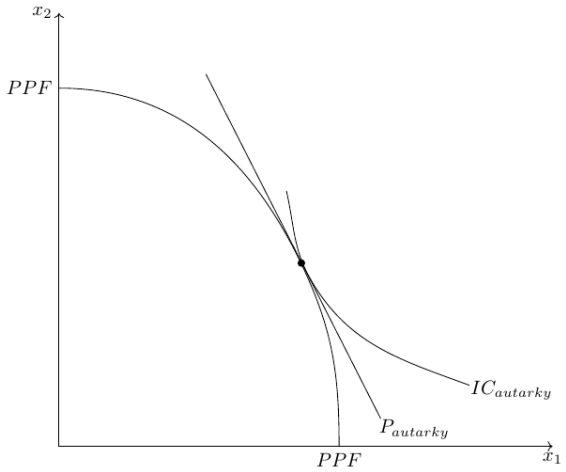


Figure 3.8.: Optimizing consumption by adjusting production and trade




In Figure 3.8 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.

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

$$\left(\frac{p_1}{p_2}\right)_W > \left(\frac{p_1}{p_2}\right)_A, \tag{3.2}$$

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 3.4.** Production and consumption (Solution A.7)
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?

## 3.4. 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 3.9. 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.

## 3.5. 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 3.9.: Immiserizing growth

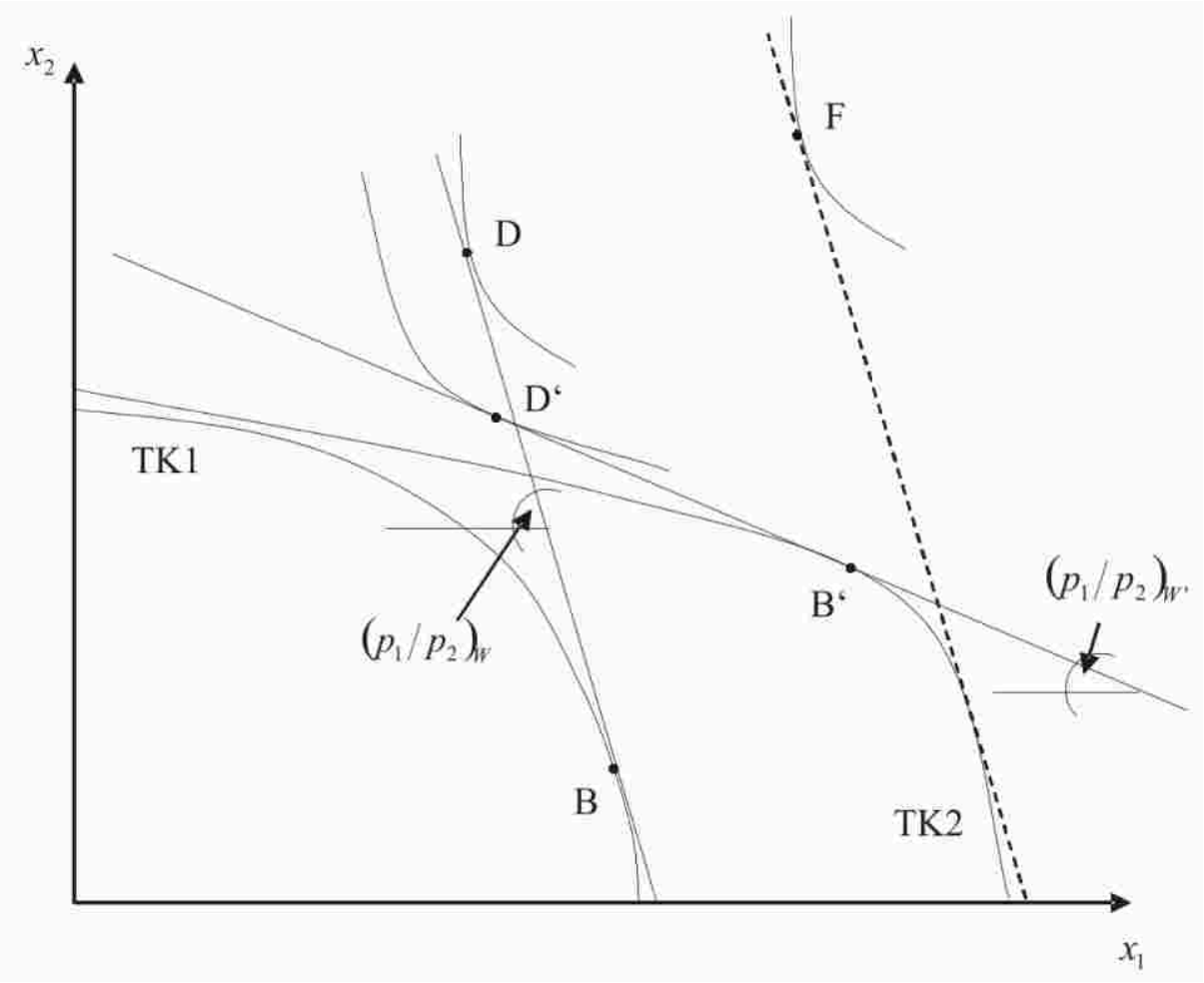



Figure 3.10.: This painting shows Ricardo, aged 49 in 1821.

*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.

### 3.5.1. 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 (e.g., fishing), while the older woman should focus on tasks where her productivity is only slightly lower (e.g., 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,

[1] Actually, strictly speaking, this is not correct, since the original description of the idea can already be found in 1815 in the *Essay on the External Corn Trade* by Robert Torrens. 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].

both the lawyer's and the secretary's performance would increase because it is more difficult to be a lawyer than a secretary.[2]

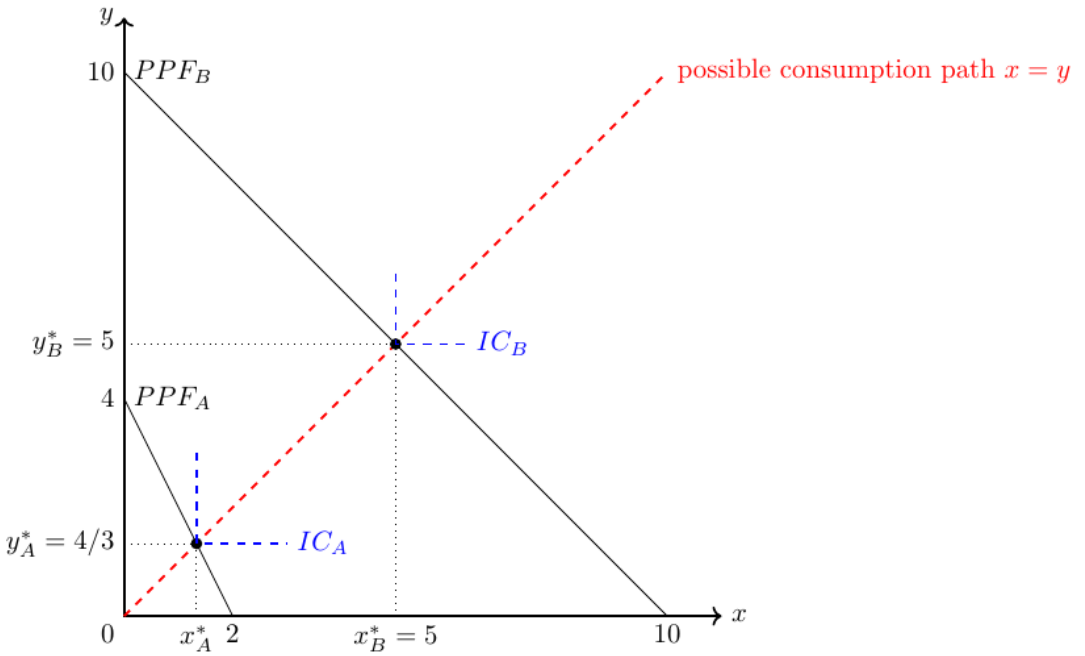
### 3.5.2. Autarky: An example of two different persons

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, i.e., 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 3.11.

Figure 3.11.: The production possibility frontier in autarky




[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 and Cherrier, 2019]. Unfortunately, women are still discriminated against in introductory economics textbooks [see Stevenson and Zlotnik, 2018].

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 3.11.

**Exercise 3.5.** Indifference curves for perfect complementary goods

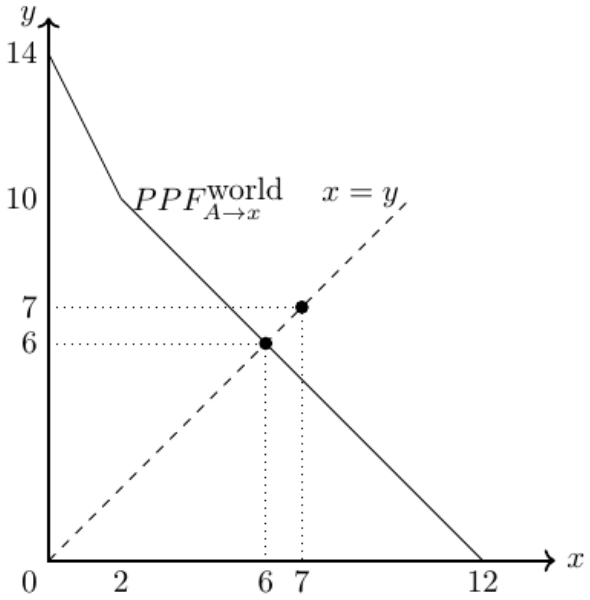
a) Name some real world examples of goods that are perfectly complementary.
b) The blue dashed lines in Figure 3.11 represent the indifference curves of individual A and B. The upward sloping dashed black line is denoted with "possible consumption path''. Explain, why is it not correct–in strict sense–to name it like that?

#### 3.5.2.1. 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 3.12.

Figure 3.12.: World PFF, A specializes in $x$

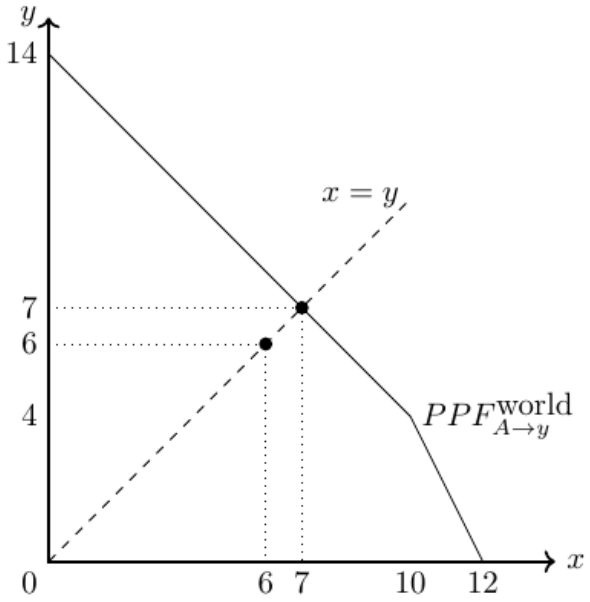



If A produces only good $x$, as shown in Figure 3.12, we see that A and B can consume a total of 6 units of goods $x$ and $y$. This is less in total than in autarky, where A can consume $\frac{4}{3}$ units of each good and person B can consume 5 units of each good, giving a combined consumption of $\frac{19}{3} = 6,\bar{6}$.

2. Person A specializes in good $y$, then the joint production possibilities are presented in Figure 3.13.

If A produces only good $y$, as shown in Figure 3.13, 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

Figure 3.13.: World PFF, A specializes $y$




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 3.14, 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]

#### 3.5.2.2. Optimal production in cooperation

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

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

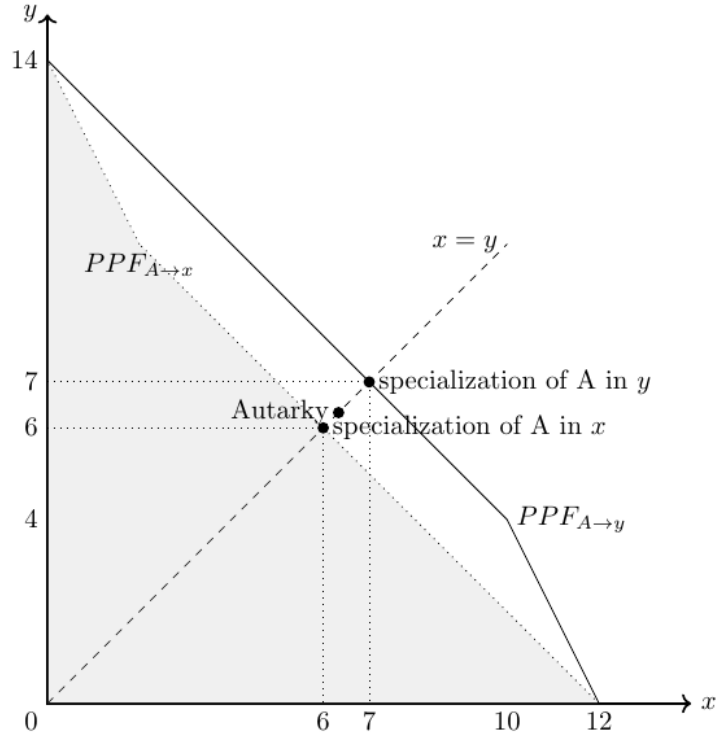
#### 3.5.2.3. Check for absolute advantage

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 $x$ |

[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 3.14.: World PFF in autarky when A specialize in producing good $y$




### 3.5.2.4. 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, i.e., 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) |
| …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 3.14.

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:

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

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

#### 3.5.2.5. 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 3.15):

| | Person | Person |
|---|---|---|
| consumption in cooperation | A | B |
| Good $y$ | 2 | 5 |
| Good $x$ | 2 | 5 |

| | Person | Person |
|---|---|---|
| Trade | A | B |
| inflow/outflow of goods in cooperation | A | B |
| Good $y$ | -2 | 2 |
| Good $x$ | 2 | -2 |

2. All gains from cooperation goes to B:

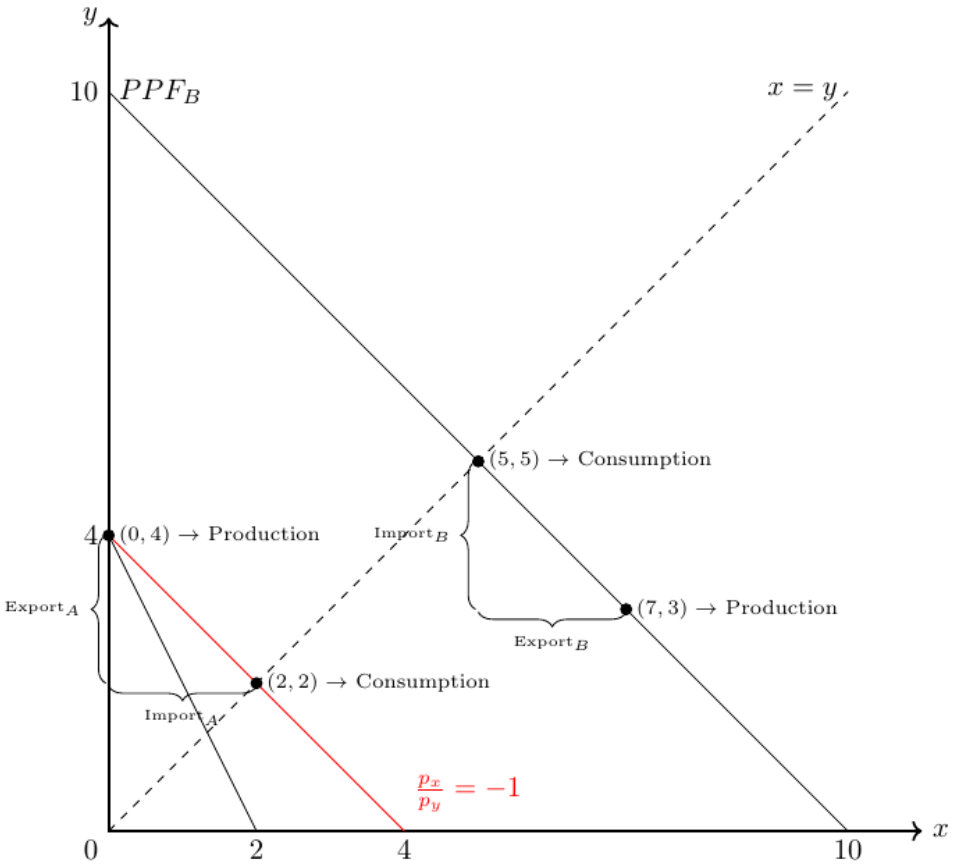
| | Person | Person |
|---|---|---|
| consumption in cooperation | A | B |
| Good $y$ | $\frac{4}{3}$ | $5\frac{2}{3}$ |
| Good $x$ | $\frac{4}{3}$ | $5\frac{2}{3}$ |

| | Person | Person |
|---|---|---|
| Trade | A | B |
| inflow/outflow of goods in cooperation | A | B |
| Good $y$ | $-\frac{2}{3}$ | $\frac{2}{3}$ |
| Good $x$ | $\frac{4}{3}$ | $-\frac{4}{3}$ |

3. The gains from specialization and trade are shared by A and B: Some trade structure between the two shown above.

Each of the three cases yield a pareto-improvement, i.e., 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.

Figure 3.15.: Bilateral trade with one winner




## 3.5.3. 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 [a_y^i Q_y^i+ a_x^i Q_x^{i=L}i, ] where $a_j^i$ denotes the unit of labor requirement for person $i \in \{A, B\}$ in the production of good $j \in \{x, y\}$ and $Q_j^i$ denotes the quantity of good $j$ produced by person $i$, and $Q_j^i$ the quantity of good $j$ produced by person $i$ and $Q_j^i$ the quantity of good $j$ produced by person $i$. (Imagine they both work 4 hours).
- Let $a_j^i$ denote the so-called labor input coefficients, i.e., 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, i.e., $a_y^A > a_y^B$ and $a_x^A > a_x^B$, and that
- a comparative advantage exists, i.e., $\frac{a_y^B}{a_x^B} \neq \frac{a_y^A}{a_x^A}$.

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]

$$\frac{a_y^B}{a_x^B} = \frac{p_y^B}{p_x^B} > \frac{a_y^*}{a_x^*} = \frac{p_y^*}{p_x^*} > \frac{p_y^A}{p_x^A} = \frac{a_y^A}{a_x^A}$$

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

### 3.5.4. 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:

$$\frac{p_W^P}{p_T^P} = \frac{a_W^P}{a_T^P} = \frac{8}{9} < \frac{12}{10} = \frac{a_W^E}{a_T^E} = \frac{p_W^E}{p_T^E}$$

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

[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 $j \in \{x, y\}$, $w_j L_j^i$, must equal the production value, that is, $p_j^i x_j^i$:

$$w_j L_j^i = p_j^i x_j^i.$$

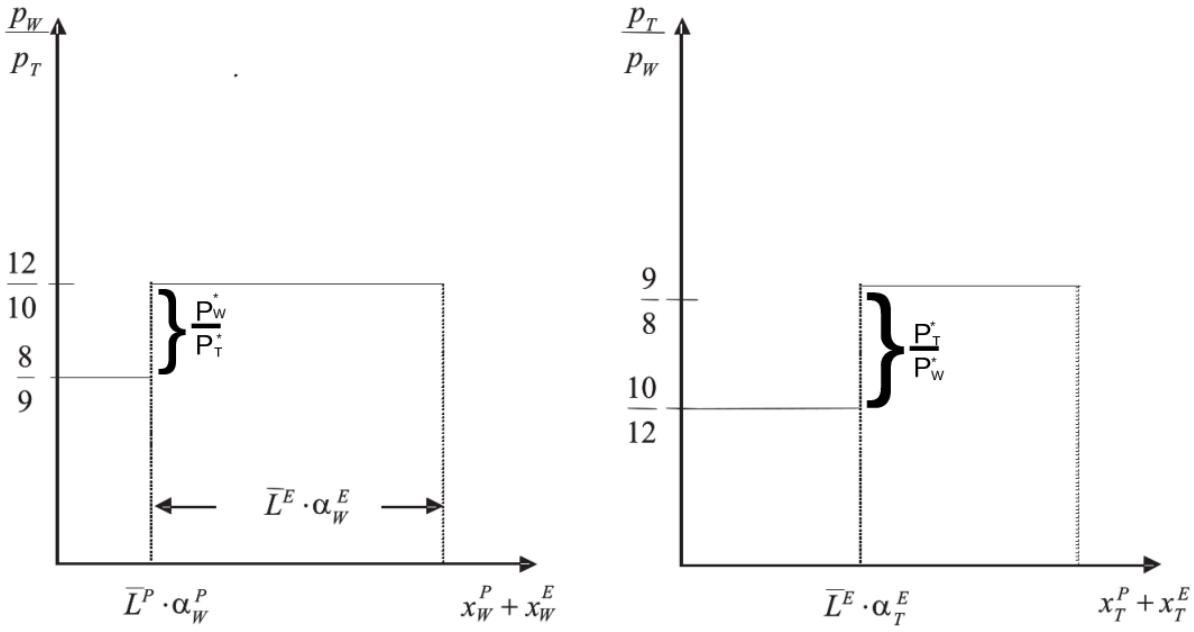
Setting $w_j = 1$ as the numeraire and re-arranging the equation, we get

$$p_j^i = \frac{L_j^i}{x_j^i} = a_j^i.$$

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

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 shown in the left panel of Figure 3.16. Note that $\alpha$ in the figure means $\frac{1}{a}$. Similarly, we can draw in the world supply of clothes, shown in the left panel of Figure 3.16.

Figure 3.16.: 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:

$$\frac{p_T^P}{p_W^P} > \frac{p_T^*}{p_W^*} > \frac{p_T^E}{p_W^E}. \tag{3.3}$$

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

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

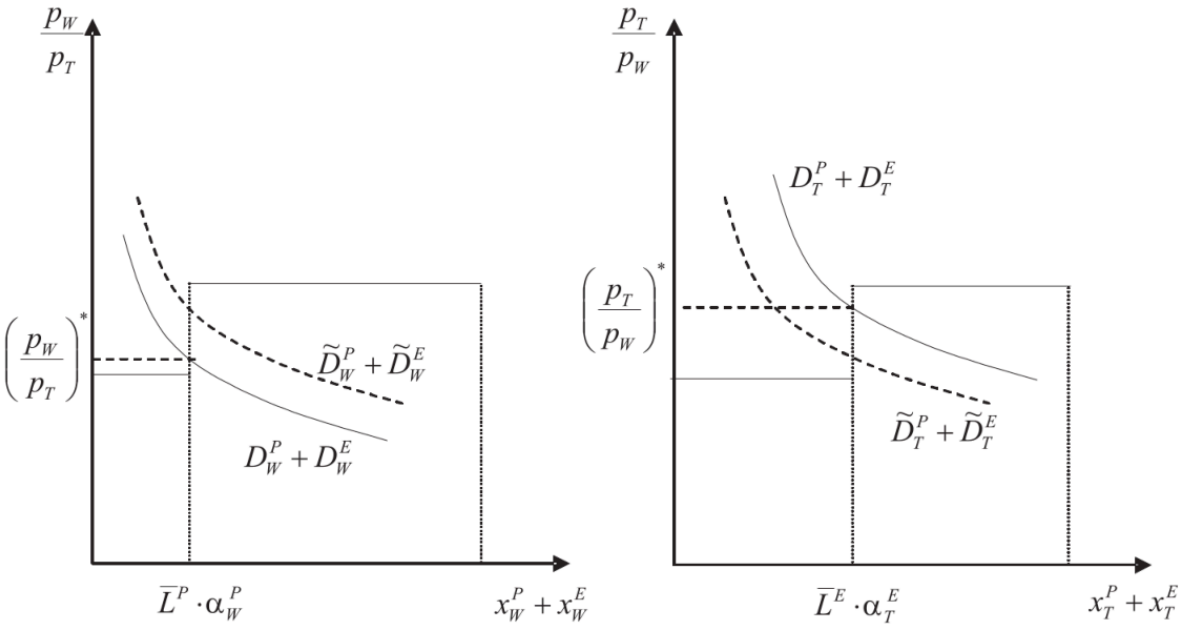
about 57%

$$\left[\frac{\left(1 - \frac{10}{12}\right)}{\left(\frac{9}{8} - \frac{10}{12}\right)} \approx 0.57\right] \tag{3.4}$$

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

In Figure 3.17, 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 3.17.: World's relative supply and demand




**Exercise 3.6.** Comparative advantage and opportunity costs (Solution A.8)
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, i.e., 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 $x$.

**Exercise 3.7.** The best industry is not competitive (Solution A.9)
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, i.e., 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?

**Exercise 3.8.** Comparative advantage and input coefficients (Solution A.10)
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, i.e., 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 $x$.

**Exercise 3.9.** Comparative advantage: Germany and Bangladesh (Solution A.11)
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?
b) What is Germany's and Bangladesh's comparative advantage if we look only at machines and clothes?
c) What is Germany's and Bangladesh's comparative advantage if we look only at ships and clothes?
d) Can you infer from the previous calculations which good Germany will export for sure and which good it will surely not export?

**Exercise 3.10.** Multiple choice: Ricardian model (Solution A.12)
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, i.e., 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.

**Exercise 3.11.** Ricardian Model again (Solution A.13)
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, i.e., the units of labor needed to produce one unit of good $y$ and good $x$, respectively.

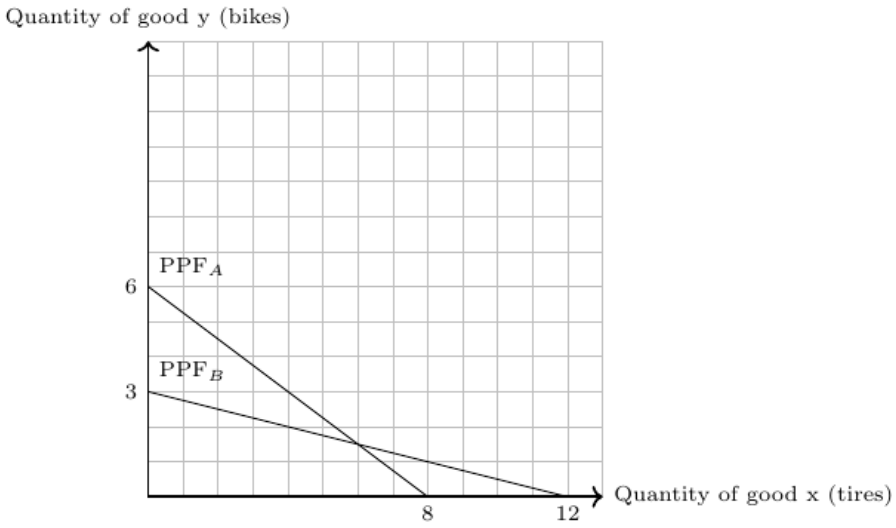
| | Country A | Country B |
|---|---|---|
| Good $y$ | 11 | 22 |
| Good $x$ | 8 | 16 |

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.

**Exercise 3.12.** Bikes and bike tires (Solution A.14)
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 3.18.: Production possibilities of bike and tires in A and B




a) How many **complete bikes**, i.e., 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, $a$, i.e., 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, i.e., 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.

**Exercise 3.13.** Ricardian model MC (Solution A.15)
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, i.e., 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 $y$.

## 3.6. 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, Chapters 5]

### 3.6.1. 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:

::: {.callout-note appearance="minimal"}

*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 3.17, 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 3.17.: 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 |

| RegionCode | Capital stock at current PPPs (in mil. 2011USD) | Population (in millions) | Capital stock per capita |
|---|---|---|---|
| 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*

### 3.6.2. 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 $y$, $L_y$, i.e., 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, i.e., 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.

### 3.6.3. Intuition

- 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.

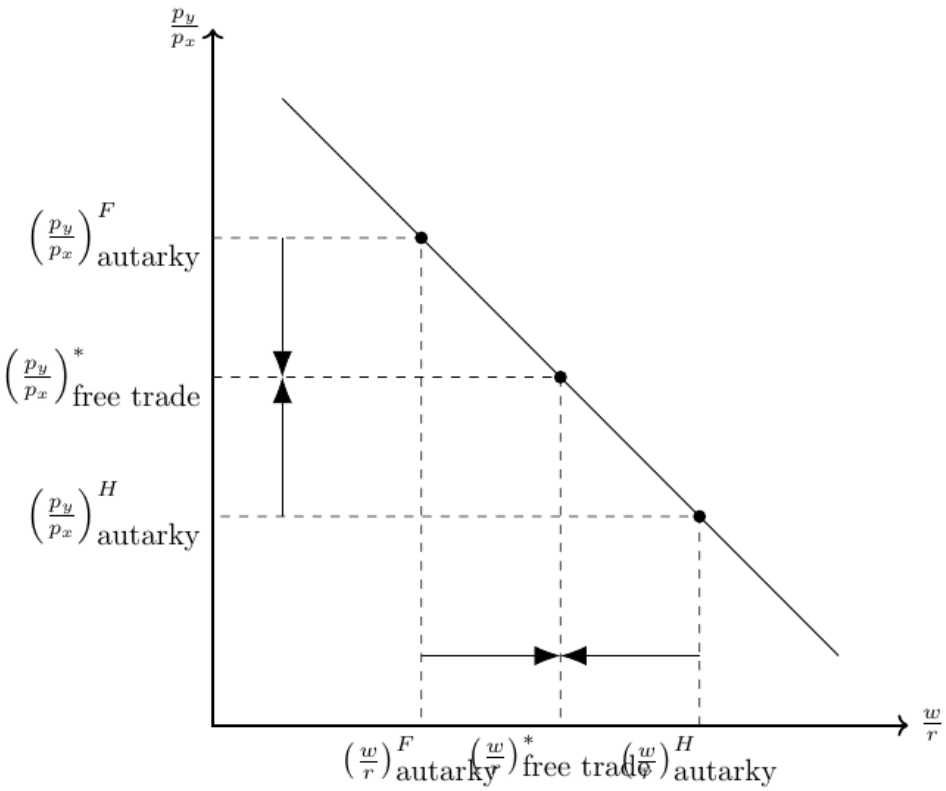
Heckscher-Ohlin Theorem
The capital abundant country exports the capital-intensive good. The labor abundant country exports the labor-intensive good.
In other words:
A country export goods that are intensive in its relatively abundant factor and will import goods that are intensive in its relatively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

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

Figure 3.19.: HO Model and factor prices




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.

#### 3.6.3.1. 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.

#### 3.6.3.2. 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 3.14.** 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, i.e., 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 3.15.** HO-Model in one figure (Solution A.16)
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.

**Exercise 3.16.** Multiple choice: HO-Model (Solution A.17)
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.

## 3.7. The specific factor model

Figure 3.20.: 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 3.20. 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.

#### 3.7.0.1. 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)

#### 3.7.0.2. 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 3.21. 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.

#### 3.7.0.3. Equillibrium in autarky:

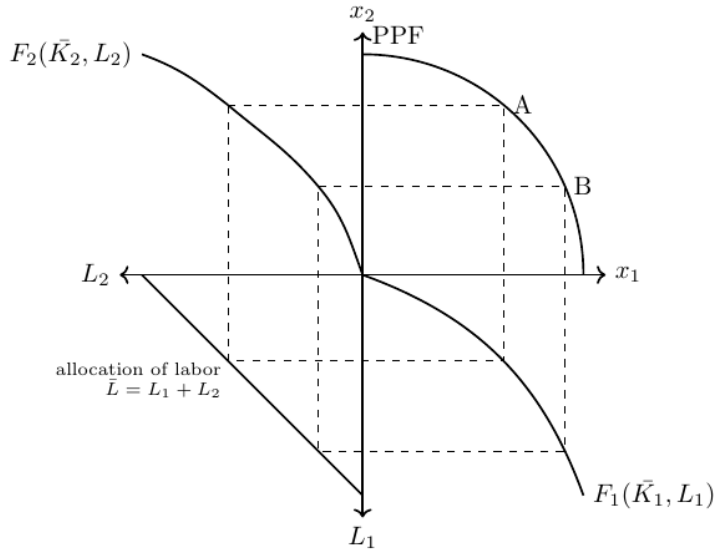
- Depending on a country's demand for good 1 and 2 a production point on the PPF is chosen at which it must hold that the slope of the PPF curve and the price relation (i.e., relation of marginal product of labor in sector 1 and sector 2) must be equal:

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

- What can we say about the rents of the production factors?

[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)

Figure 3.21.: PPF with two factors and positive but declining marginal products




- 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 maximizing of firms

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

- 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:

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

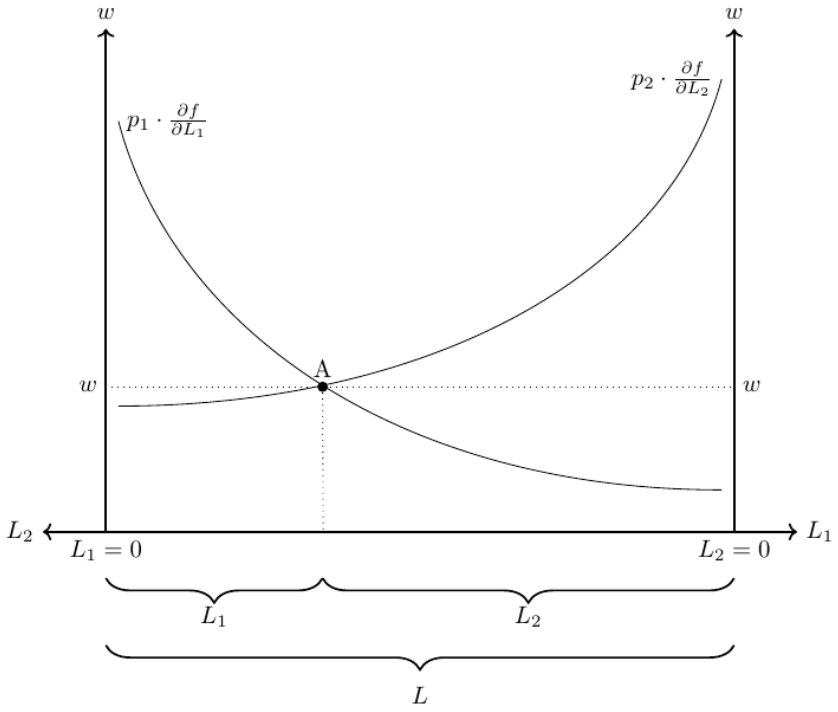
- Figure 3.22 presents the equilibrium wage and the optimal allocation of labor into sector 1 and 2.

#### 3.7.0.4. 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 3.22 this can be shown by shifting both curves upward.

Figure 3.22.: Equilibrium with two sectors




- 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.

#### 3.7.0.5. 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 3.23.
- 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.

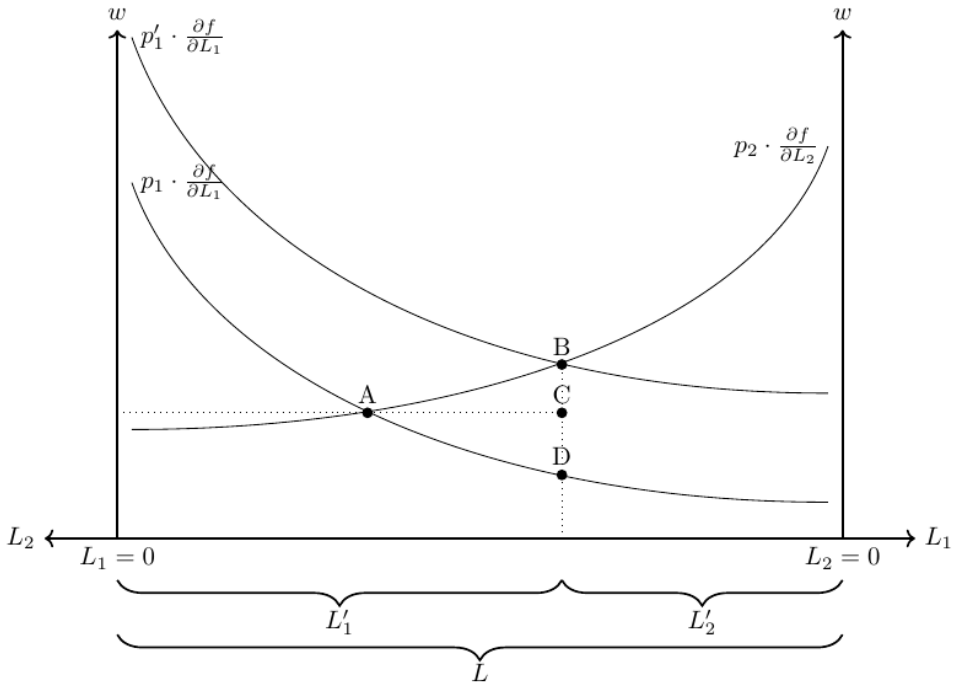
#### 3.7.0.6. Owner of capital-1:

- 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.

#### 3.7.0.7. 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 3.23.: Equilibrium when one price changes



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# A. Solutions to exercises

*Solution* A.1. Exchange currencies (Exercise 2.2)

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:

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

*Solution* A.2. Big Mac Index (Exercise 2.8)

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) To exchange 100 Euro to Swiss Francs, we need to calculate

$$100\ \text{EUR} \cdot 1.0305 \frac{\text{CHF}}{\text{EUR}} \approx 108.1428\ \text{CHF}$$

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.

*Solution* A.3. Big Mac Index (Exercise 2.4)

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**: $\frac{4}{3}\frac{CHF}{USD}$
- **EUR to CHF**: $0.75\frac{EUR}{USD}$

*Solution* A.4. Exchange rates and where to invest (Exercise 2.6)

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.

*Solution* A.5. Turkey vs. Germany (Exercise 2.7)

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:

i) **(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:**

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

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

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

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

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

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

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

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:

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

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

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

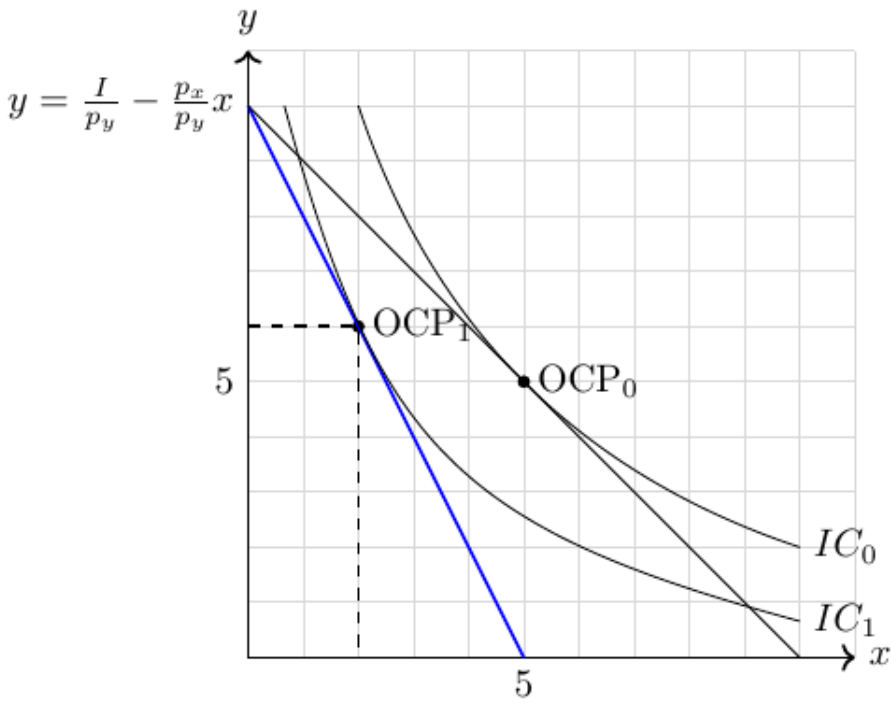
Let us proof our results by re-calculating the rate of return for an investment in Turkey with $E_t^{€/*}$ and $E_t^{€/*'}$:

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

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.

*Solution* A.6. Terms of trade (Exercise 3.2)
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.

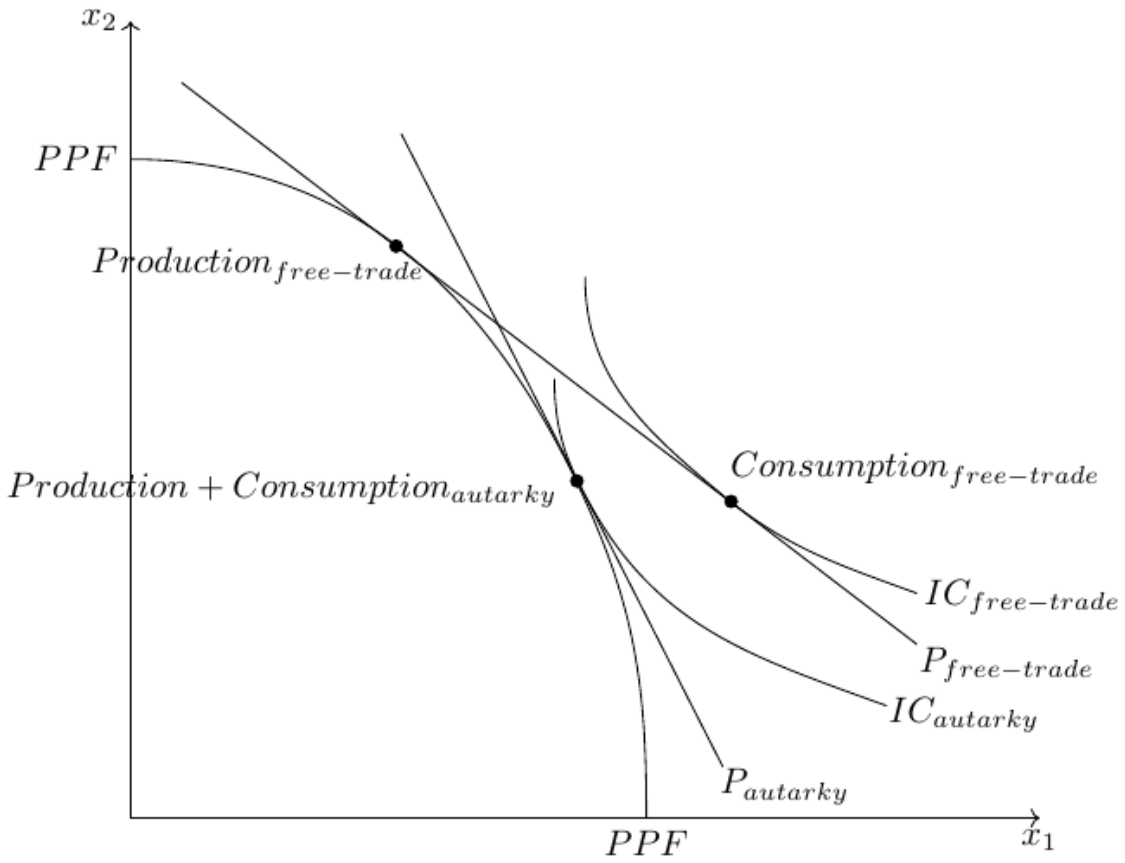
Figure A.1.: Optimal consumption point after price increase




*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 $(x = 4; y = 2)$.*

*Solution* A.7. Gains of small economies (Exercise 3.4)
As visualized in Figure A.2, the indifference curve under free trade lies above the IC under autarky. This reflects the higher utility level under free trade.

Figure A.2.: Gains from trade




*Solution* A.8. Comparative advantage and opportunity costs (Exercise 3.6)

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 top produce one unit more of good $y$ it has to give up $\frac{1}{2}$ units of good $x$.

e) If A wants top produce one unit more of good $x$ it has to give up 2 units of good $y$.

f) If B wants top produce one unit more of good $y$ it has to give up $\frac{3}{4}$ units of good $x$.

g) If A wants top 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 $x$.

*Solution* A.9. The best industry is not competitive (Exercise 3.7)

| opportunity costs of producing… | Person A | Person B |
|---|---|---|
| …1 unit of good y: | a_y$^{A/a_x}$A = 1/2 = 0.5 (good x) | a_y$^{B/a_x}$B = 0.4/0.4 = 1 (good x) |
| …1 unit of good x: | a_x$^{A/a_y}$A = 2/1 = 2 (good y) | a_x$^{B/a_y}$B = 0.4/0.4 = 1 (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 $\frac{a_y^B}{a_x^B} < \frac{10}{12}$

*Solution* A.10. Comparative advantage and input coefficients (Exercise 3.8)

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 $x$.

*Solution* A.11. Comparative advantage: Germany and Bangladesh (Exercise 3.9)

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.

*Solution* A.12. Multiple choice: Ricardian model (Exercise 3.10)
Choices b) and c) are correct.

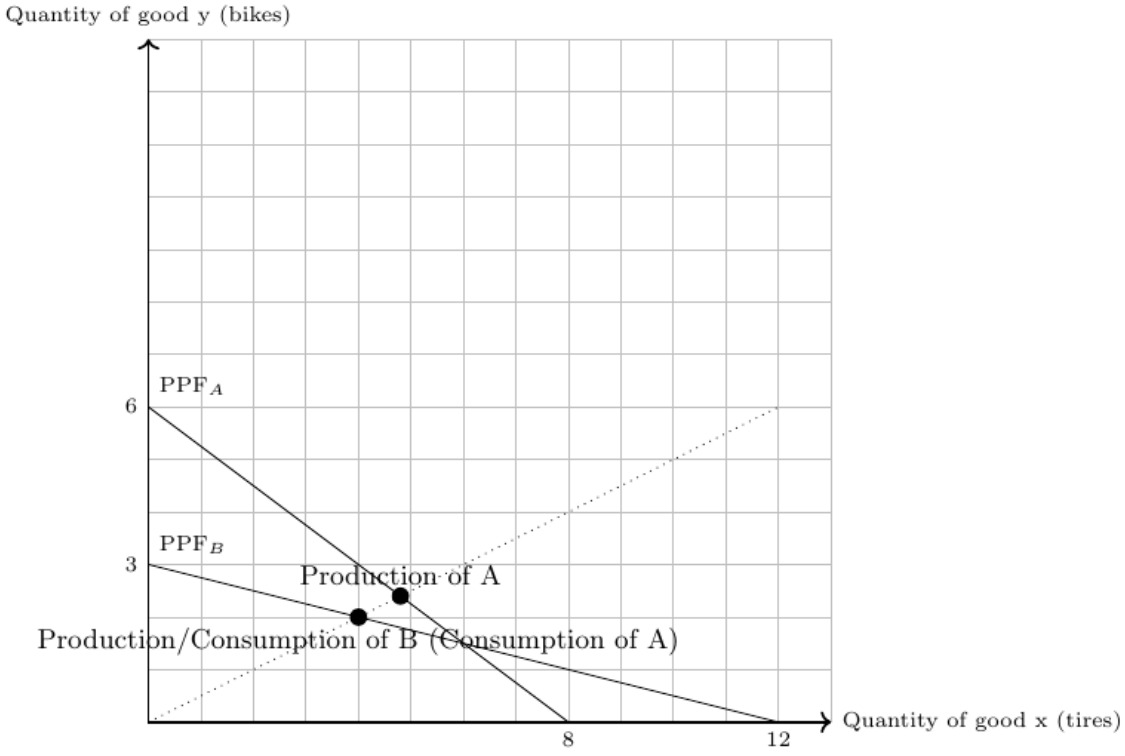
*Solution* A.13. Ricardian Model again (Exercise 3.11)

c) and d) are true.

*Solution* A.14. Bikes and bike tires (Exercise 3.12)

a) Both countries can consume 2 complete bikes, see Figure A.3.

Figure A.3.: 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.

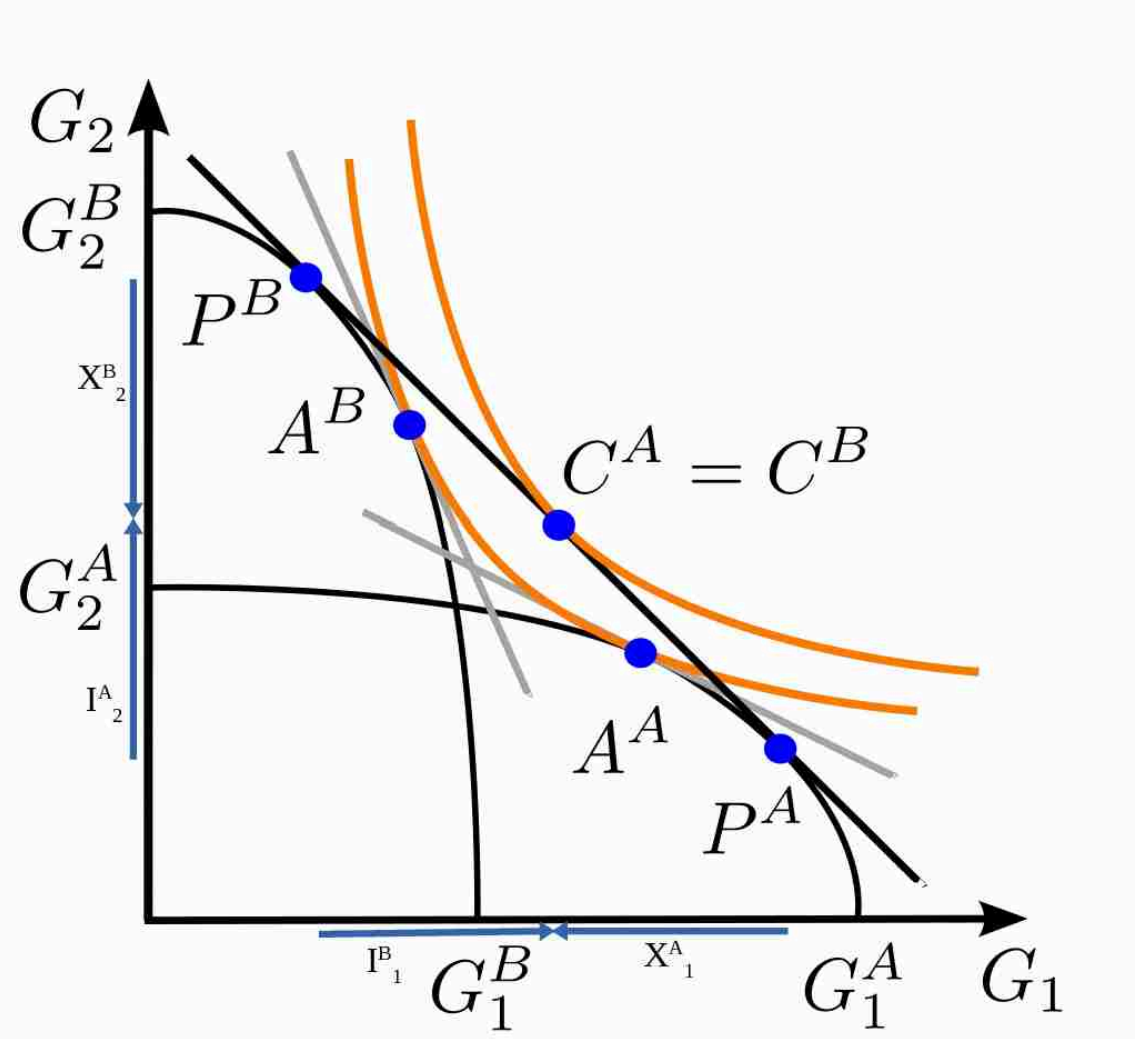
Under free trade

- country A can consume 3 complete bikes and
- country B can consume 3 complete bikes.

*Solution* A.15. Ricardian model MC (Exercise 3.13)
a), b), and e) are correct statements.

*Solution* A.16. HO-Model in one figure (Exercise 3.15)

Figure A.4.: 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 A.4 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 tangent 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.

*Solution* A.17. Multiple choice: HO-Model (Exercise 3.16)
Answer a) is correct.