EC106: Introduction to Economics
– Macroeconomics –

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kansoy

Lecture - 4 -

*University of Warwick

This Week: Outline

1. Globalisation and Financial Integration
2. Covered Interest-Rate Parity
3. Onshore and Offshore Rate
4. Uncovered Interest-Rate Parity
5. Capital Controls
6. The Fama Puzzle

This Lecture

- Covered Interest Parity
- Onshore-Offshore Interest Rate
- Capital Controls
- Uncovered Interest Rate Parity
- The Fama Puzzle

Readings: Chapter 10 and 11 in *International Macroeconomics* by Stephanie Schmitt-Grohe, Martin Uribe and Michael Woodford; Chapter 4 in *International Finance and Open-Economy Macroeconomics* by Giancarlo Gandolfo; Panizza et al (2009); Tomz and Wright (2013)

Globalisation and Financial Integration

Globalisation

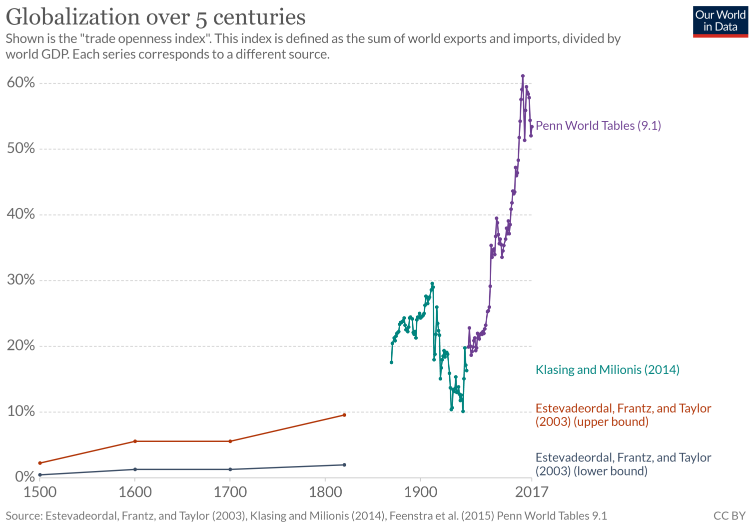
- What is globalisation?
- According to PIIE, globalisation is the word used to describe the growing interdependence of the world's economies, cultures, and populations, brought about by cross-border trade in goods and services, technology, and flows of investment, people, and information.

Let's watch a video:
https://www.piie.com/microsites/globalization/what-is-globalization

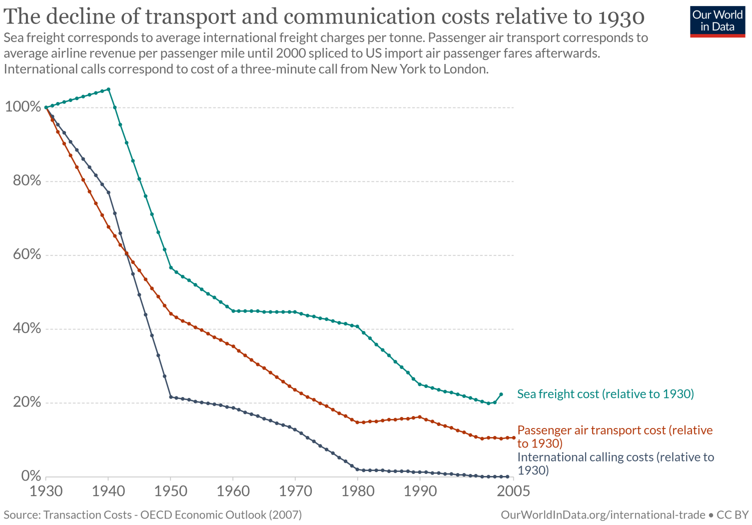
Globalisation

- Over the last five centuries there are two main globalisation waves.
- Until 1800 there was a long period characterised by persistently low international trade.
- This then changed over the course of the 19^{th} century, when technological advances triggered a period of marked growth in world trade – the so-called '**first wave of globalisation**'.
- The first wave of globalisation end with the First World War.

The First Wave



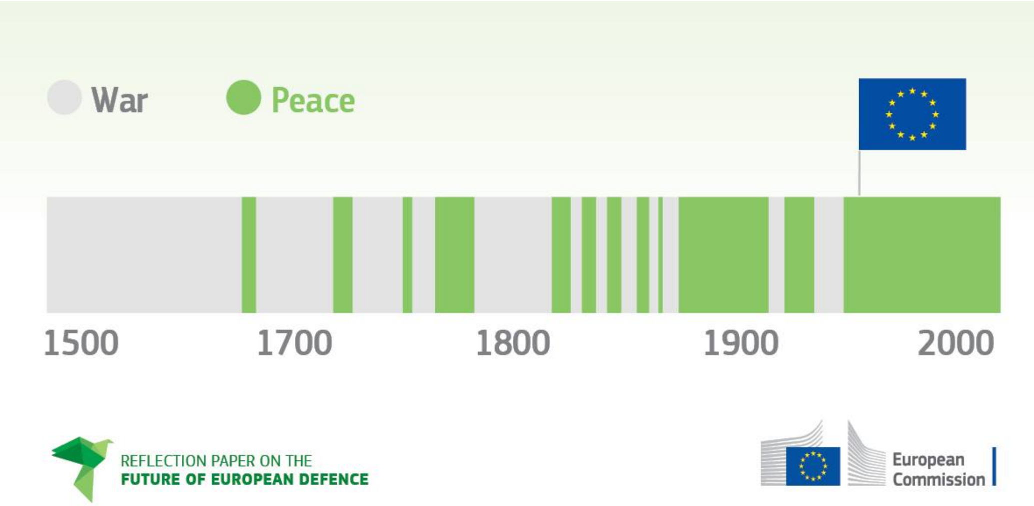
The Second Wave



Globalisation

- The world-wide expansion of trade after the Second World War was largely possible because of reductions in transaction costs
- The reductions in transaction costs had an impact, not only on the volumes of trade, but also on the types of exchanges that were possible and profitable.
- The increasing level of globalisation after the Second World War is known as **the second wave of globalisation**.
- For more visit `https://ourworldindata.org/trade-and-globalization`

Globalisation, Interdependence, and Peace

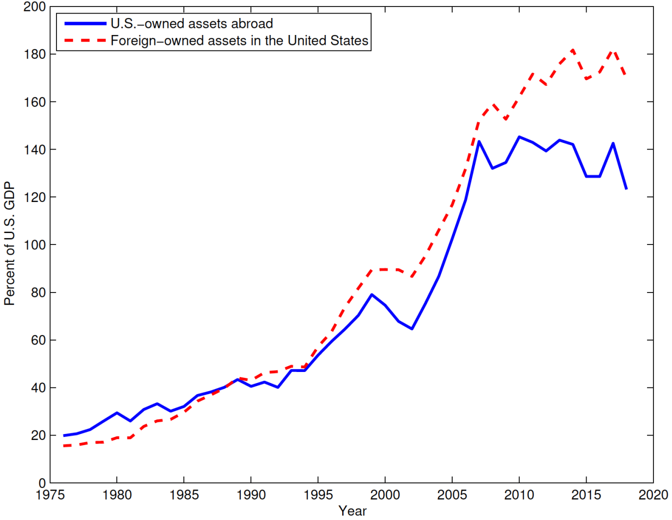


THE LONGEST PEACE PERIOD: Last 75 years is the longest peace period in Europe's troubled history.

International Capital Market

- The relations between interest rates (domestic and foreign) and exchange rates (spot and forward) are very important and frequently used in international finance.
- In this lecture we will look at whether international capital market are integrated and investigate whether under free capital mobility there is a tendency for interest rates to equalise across countries.
- Over the past few decades, the world appears to have become more financially globalised. One manifestation of this phenomenon is the explosion in gross international asset and liability positions.
- The figure below shows that in the mid-1970s U.S. gross international liabilities were only 15 per cent of GDP. By 2018, they had climbed to over 170 per cent of GDP.
- Similarly, the U.S. gross international asset position jumped from 20 per cent of GDP in the mid-1970s to over 130 per cent in 2018.

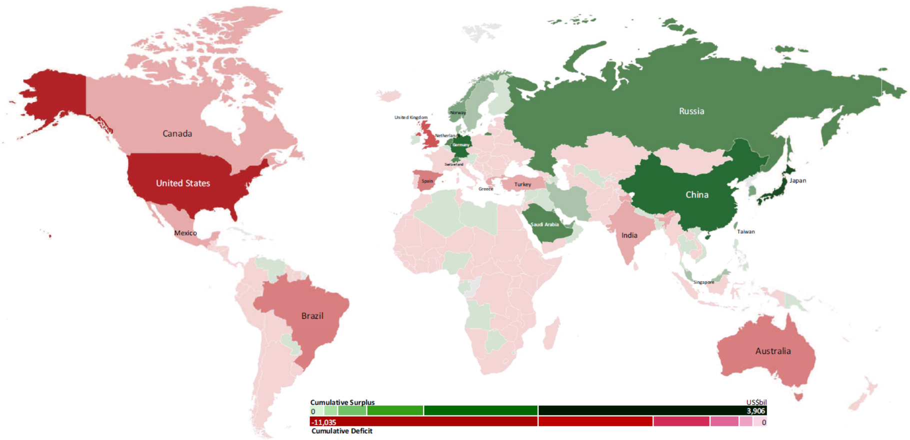
U.S.-Owned Assets Abroad and Foreign-Owned Assets in the U.S.



From *International Macroeconomics* by Stephanie Schmitt-Grohe, Martin Uribe and Michael Woodford

Global Finance: Financial Interdependence

Cumulative Current Account Balances Around the World: 1980-2017



Global Finance & Global Imbalances

- The map shows that the country with the biggest accumulated current account deficit (brightest red) is the United States.
- Its cumulative deficit was $11.0 trillion.
- The countries that have been financing these deficits (deepest green) are Japan ($3.9 trillion), China ($3.3 trillion), Germany ($3.3 trillion), and oil and gas exporting countries (members of OPEC, Russia, and Norway).
- Overall, the picture is one of unbalanced international trade, with some countries running protracted current account deficits and others running protracted surpluses.
- If all countries were in balance, the map would look pastel white.
- Instead, it looks mostly either flaming red or dark green, reflecting large global imbalances.

Covered Interest-Rate Parity

Covered Interest-Rate Parity

- In a world with perfect capital mobility, the rate of return on risk-free financial investments should be equalised across countries. (**Law of one price: LOOP**)
- Otherwise, arbitrage opportunities would arise, inducing capital to flow out of the low-return countries and into the high-return countries.
- This movement of capital across national borders will tend to eliminate differences in interest rates.
- If, on the other hand, one observes that interest rate differentials across countries **persist over time,** it must be the case that **restrictions** on international capital flows are in place in some countries.

Interest Rate Return: China 2021

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QUOTES & COMPANIES

VIEW ALL COMPANIES

China 10 Year Government Bond

AMBMKRM-10Y (Tullett Prebon)

5:00 PM CST 03/02/21

YIELD

3.264%

-0.033 ▼

PRICE

100.05

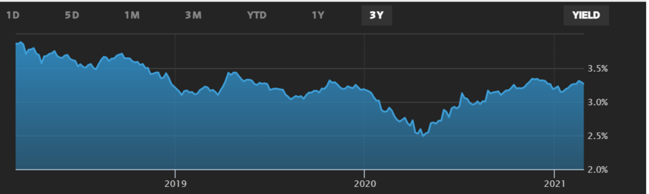
0.274 (0.27%) ▲

1 Day Range
3.256 - 3.297

52 Week Range (Yield)
2.492 - 3.365
(04/24/20 - 11/20/20)

Coupon
3.270%

Maturity
11/19/30



Open 3.297 Prior Close (Yield) 3.297

1 Day Price Chg AMBMKRM-10Y 0.27% ▲ U.S. 10 Year -0.04% ▼ Germany 10 Year -0.12% ▼ Japan 10 Year 0.25% ▲

OVERVIEW HISTORICAL PRICES MONEY RATES TREASURY QUOTES BOND & INDEX BENCHMARKS LIBOR

Interest Rate Return: US 2021

Interest Rate Return: US 2023

Interest Rate Return: China 2023

Interest Rate Return: China 2023

Source: Refinitiv Eikon • Created with Datawrapper

Covered Interest-Rate Parity

- Suppose at date t a U.S. investor has 1 U.S. dollar and is trying to decide whether to invest it domestically or abroad, say in Germany.
- Let i_t denote the U.S. interest rate and i_t^* the foreign (German) interest rate at time t.
- If in period t the investor deposits her money in the U.S, then in period $t+1$ she receives $1+i_t$ dollars.
- **How many dollars would she get, if instead she invested her 1 dollar in Germany?**
- In order to invest in Germany, she must first use her dollar to buy euros.
- Let ϵ_t denote the spot exchange rate at date t, defined as the dollar price of 1 Euro. The investor gets $\frac{1}{\epsilon_t}$ euros for her dollar.
- In period $t+1$, she will receive $\frac{1+i_t^*}{\epsilon_t}$ euros. At this point she converts the euros back into dollars. Let ϵ_{t+1} denote the spot exchange rate prevailing in period $t+1$.

Covered Interest-Rate Parity

- Then the $\frac{1+i_t^*}{\epsilon_t}$ euros can be converted into $(1+i_t^*)\frac{\epsilon_{t+1}}{\epsilon_t}$ dollars in $t+1$.
- Therefore, in deciding where to invest, the investor would like to compare the return of investing in the United States, $1+i_t$, to the dollar return of an equivalent investment in Germany, $(1+i_t^*)\frac{\epsilon_{t+1}}{\epsilon_t}$ and If,

$$1+i_t > (1+i_t^*)\frac{\epsilon_{t+1}}{\epsilon_t} \tag{1}$$

  then it is more profitable to invest in the United States. In fact, in this case, the investor could make unbounded profits by borrowing in Germany and investing in the United States.
- **However**, this investment strategy suffers from a fundamental problem. At time t, the investor does not know ϵ_{t+1}, the exchange rate that will prevail at time $t+1$.

Covered Interest-Rate Parity

- Forward exchange markets (*forward contracts*) are designed precisely to allow investors to circumvent the exchange rate risk.
- Let F_t denote the forward rate, that is, the dollar price at time t of 1 euro delivered and paid for at time $t+1$.
- Thus the dollar return of a one-dollar investment in Germany using the forward exchange market is $\boldsymbol{(1+i_t^*)\frac{F_t}{\epsilon_t}}$
- The important point is here that this return is known with certainty at time t making it comparable to the return on the domestic investment, $\boldsymbol{1+i_t}$.
- The difference between the domestic return and the foreign return expressed in domestic currency by use of the forward exchange rate is known as ***the covered interest rate differential***:

$$\textit{Covered Interest Rate Differential} = (1+i_t) - (1+i_t^*)\frac{F_t}{\epsilon_t} \tag{2}$$

Covered Interest-Rate Parity

$$\textit{Covered Interest Rate Differential} = (1 + i_t) - (1 + i_t^*)\frac{F_t}{\epsilon_t} \tag{3}$$

- This interest rate differential is called covered because the use of the forward exchange rate covers the investor against exchange rate risk.
- When the covered interest rate differential is zero, we say that *covered interest rate parity* (CIP) holds which is Eq.-4.

$$(1 + i_t) = (1 + i_t^*)\frac{F_t}{\epsilon_t} \tag{4}$$

Covered Interest-Rate Parity

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$$(1+i_t) \lesseqgtr (1+i_t^*)\frac{F_t}{\epsilon_t}$$

- In the absence of barriers to international capital mobility, this violation of CIP implies that it is possible to make profits by borrowing in Germany, investing in the United States, and buying euros in the forward market to eliminate the exchange rate risk.

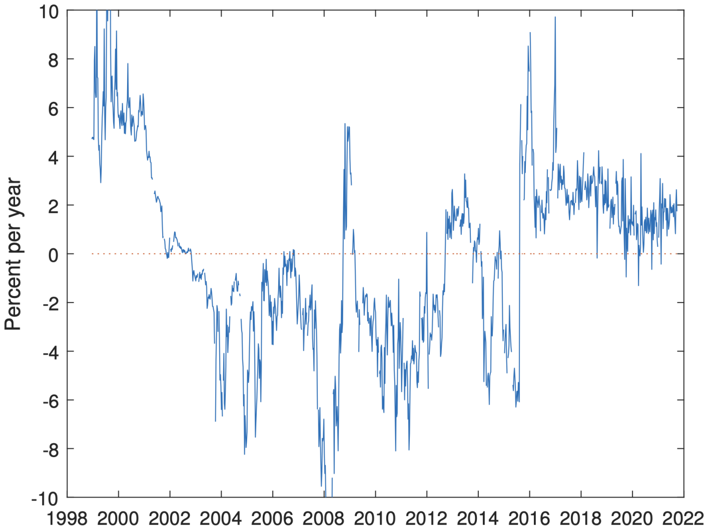
Real World Example: China-US

- In 2001 China became a member of the World Trade Organization. This required lowering barriers to trade in goods and services (tariffs and quotas).
- In this way, China became more integrated with the rest of the world in markets for goods and services.
- **Question:** Did China also become more integrated with world financial markets?
- Let's look at the observed behaviour of the dollar-renminbi-covered interest rate differential

$$(1 + i_t) - (1 + i_t^*)\frac{F_t}{\epsilon_t}$$

- i_t: dollar interest rate in the United States,
- i_t^*: renminbi interest rate in China
- ϵ_t: spot exchange rate (dollars per renminbi), and
- F_t: forward exchange rate (dollars per renminbi).

Dollar-Renminbi Covered Interest Rate Differentials



Martin Uribe : International Macroeconomics: A Modern Approach, 2022

What Does the Figure Show?

- Observed deviations from covered interest rate parity are large 3.1 percentage points on average.
- In the last five years of the sample, the differential fell by about 1 percentage point but remained sizable, 2.1 percentage points on average.
- Large differentials are a sign of impediments to capital flows.
- The sign of the differential flipped twice: Mostly positive prior to October 2002 and after August 2015, and mostly negative in the intervening period.
- A negative differential indicates impediments to capital outflows (Chinese wanting to invest abroad, but not being able to do it).
- A positive differential indicates impediments to capital inflows (inflows to rest of the world: outflows from China) (Chinese wanting to save abroad, but not being able to do it).

Covered Interest-Rate Parity + Extra

$$(1 + i_t) = (1 + i_t^*)\frac{F_t}{\epsilon_t}$$

can be expressed:

$$\frac{1 + i_t}{1 + i_t^*} = \frac{F_t}{\epsilon_t} \tag{5}$$

by subtraction 1 from both sides:

$$\frac{i_t - i_t^*}{1 + i_t^*} = \frac{F_t - \epsilon_t}{\epsilon_t}$$

can be written in alternative specifications, that are often used in the [academic] literature.

From the algebra of logarithms, we recall that

$$ln(1 + x) \approx x \tag{6}$$

for small x.

Covered Interest-Rate Parity + Extra

If we let $x = (y - z)/z$ we also have:

$$ln[y/z] \equiv ln[1 + (y - z)/z] \backsimeq (y - z)/z \tag{7}$$

Now, if we take the logarithms of both members of Eq-(5), we get:

$$ln(1 + i_t) - ln(1 + i_t^*) = ln(F_t/\epsilon_t) \tag{8}$$

hence, using the approximation Eq-(6) and

$$i_t - i_t^* = lnF_t - ln\epsilon_t \tag{9}$$

and, if we also use approximation Eq-(7),

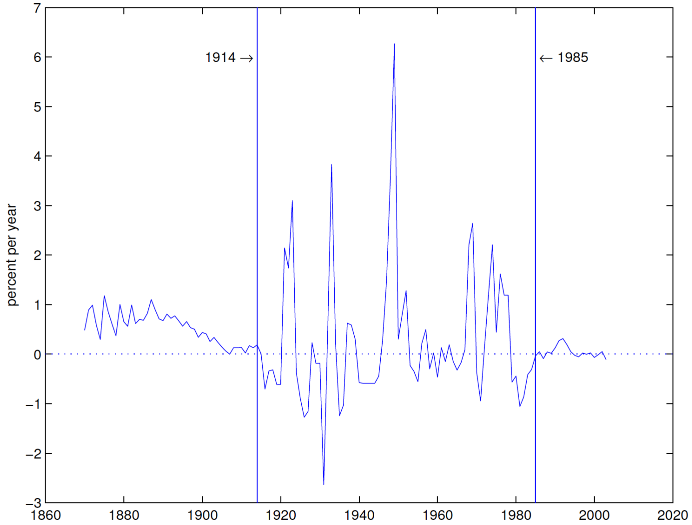
$$i_t - i_t^* = \frac{F_t - \epsilon_t}{\epsilon_t}, \;\; i_t = i_t^* + \frac{F_t - \epsilon_t}{\epsilon_t} \tag{10}$$

The interest differential equals the forward margin, or the domestic interest rate equals the foreign interest rate plus the (positive or negative) forward margin.

Empirical Evidence on Covered Interest-Rate Differentials

- One can use data on interest rates, spot exchange rates, and forward rates to construct empirical measures of covered interest-rate differentials.
- This indicator can provide useful information about the evolution of international capital mobility across time.
- In particular, this type of empirical analysis can be used to address the question of whether the world is more globalised now than in the past, and whether globalisation progresses over time or is non-monotone in nature.
- Covered interest rate differentials were consistently small before World War I and after 1985, suggesting a high degree of international capital-market integration during these two sub-periods.
- What about after the recent crisis & Covid-19 and developing countries? [thesis topic]

Dollar-Pound Covered Interest Rate Differentials: 1870-2003



Dollar-Pound: Long Term Cover Interest Rate Differentials

- **What is plotted?**:

$$(1+i_t^{us}) - (1+i_t^{uk})\frac{F_t^{\$/£}}{\epsilon_t^{\$/£}}$$

  for the period 1870 to 2003.

- **What does the figure reveal?** Small covered interest rate differentials before World War I and after 1985, suggesting a high degree of international capital-market integration in those two sub-periods. High-covered interest rate differentials after World War I until about 1985, suggesting a low degree of international capital market integration in that period.

- **Takeaway:** free capital mobility is not a modern phenomenon: financial capital flowed in a more or less unfettered fashion before World War I and after 1985.

Onshore and Offshore Rate

On Offshore: The Laundromat

Empirical Evidence on Offshore-Onshore Interest Rate Differentials

- An alternative way to construct exchange-risk free interest-rate differentials is to use interest rates on instruments denominated in the same currency. For example, one can compare the interest rate on dollar time deposits in banks located in New York and London.
- The interest rate on the domestic instrument is called the **onshore rate**, and the interest rate on the foreign instrument is called the **offshore rate**.
- **Eurocurrency** deposits are foreign currency deposits in a market other than the home market of the currency. For example, a Eurodollar deposit is a dollar deposit outside the United States. The interest rate on such deposits is called the Eurodollar rate.
- **Example:** A yen deposit at a bank in Singapore is called a Euro yen deposit and the associated interest rate is called the Euro yen rate.
- The biggest market for Eurocurrency deposits in London.

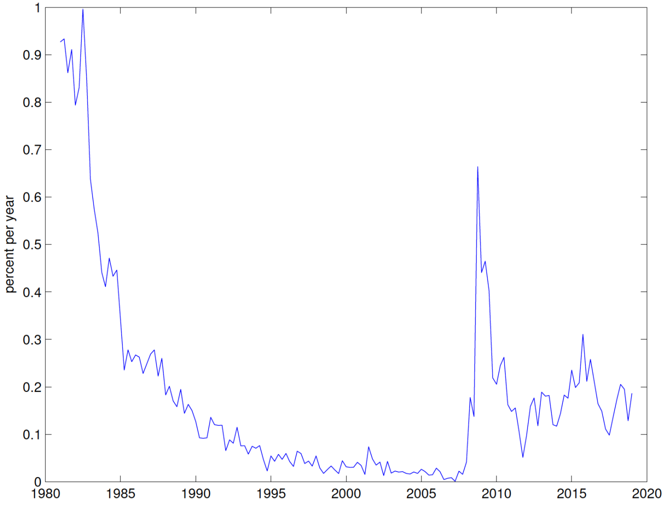
Empirical Evidence on Offshore-Onshore Interest Rate Differentials

- Letting i_t be the interest rate in period t on a dollar deposit in the US and i_t^* the interest rate on a dollar deposit in the foreign country, the offshore-onshore interest rate differential is

$$offshore - onshore\ differential = i_t^* - i_t \tag{11}$$

- The fact that both interest rates are on dollar deposits eliminates the exchange rate risk, thereby making them directly comparable.
- If both deposits are default-risk free, then, under free capital mobility, the offshore-onshore differential should be zero.
- Any difference between i_t and i_t^* would create a pure arbitrage opportunity that investors could exploit to make unbounded profits.
- This means that in the absence of default risk, nonzero offshore-onshore interest-rate differentials are an indication of lack of free capital mobility.

Offshore-Onshore Interest Rate Differential of the U.S. Dollar



From *International Macroeconomics* by Stephanie Schmitt-Grohe, Martin Uribe and Michael Woodford

On Figure

- **What is plotted?:** $i_t^* - i_t$ for 1981Q1-2019Q
- **What does the figure reveal?** Dollar interest rates are higher in the UK than in the US prior to 1985 and after 2008. Near zero offshore-onshore differentials between 1990 and 2008.
- **Takeaway:** free capital mobility between 1990 and 2008, but impediments to free capital mobility in the 1980s (consistent with evidence from CIRD), and to some extent post-2018. The latter is attributed to regulations put into place post-financial crisis that prevent financial institutions to exploit the arbitrage opportunities presented by non-zero offshore-onshore interest rate differentials.

Empirical Evidence on Offshore-Onshore Interest Rate Differentials

- Figure plots the three-month U.K.-U.S. offshore-onshore interest rate differential of the US dollar over the period 1981Q1 to 2019Q1.
- Until the mid 1980s, both the US and the UK had regulations in place that hindered free international capital mobility.
- This is reflected in high offshore-onshore differentials during this period.
- The fact that during this period dollar rates are higher in the UK than in the US indicates that investors wanted to borrow in the latter and lend in the former but could not do it to the extent they wished.
- Offshore-onshore differentials fall to practically zero (below 10 basis points) by 1990 and remain at that low level until the onset of the Global Financial Crisis in 2008.
- In 2008, the interest-rate differential spikes briefly at about 60 basis points and then stabilises at a lower level but higher than the one that prevailed prior to the crisis.
- The lack of convergence to pre-crisis levels can be ascribed to the adoption of prudential regulations in the US and the UK that prevent banks from fully arbitraging these differentials away.

Uncovered Interest-Rate Parity

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- Suppose at date t a U.S. investor has 1 U.S. dollar and is trying to decide whether to invest it domestically or abroad, say in Germany.
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- Then the $\frac{1+i_t^*}{\epsilon_t}$ euros can be converted into $(1+i_t^*)\frac{\epsilon_{t+1}}{\epsilon_t}$ dollars in $t+1$.

Uncovered Interest-Rate Parity

- Therefore, in deciding where to invest, the investor would like to compare the return of investing in the United States, $1 + i_t$, to the dollar return of an equivalent investment in Germany, $(1 + i_t^*)\frac{\epsilon_{t+1}}{\epsilon_t}$ and If,

$$1 + i_t > (1 + i_t^*)\frac{\epsilon_{t+1}}{\epsilon_t} \tag{12}$$

  then it is more profitable to invest in the United States. In fact, in this case, the investor could make unbounded profits by borrowing in Germany and investing in the United States.

- **However**, this investment strategy suffers from a fundamental problem. At time t, the investor does not know ϵ_{t+1}, the exchange rate that will prevail at time $t + 1$.

Uncovered Interest-Rate Parity

- Letting $\mathbb{E}_t$ denote the expectations operator conditional on information available in period t, we would then have that.

$$\mathbb{E}_t[\epsilon_{t+1}] = e_t$$

$$1 + i_t = (1 + i_t^*)\left(\frac{e_t}{\epsilon_t}\right) \tag{13}$$

- This condition is known as uncovered interest rate parity. The difference between the left-hand side and the right-hand side of this equation is known as the *uncovered interest rate differential*,

$$Uncovered\ Interest\ Rate\ Differential = (1 + i_t) - (1 + i_t^*)\left(\frac{e_t}{\epsilon_t}\right)$$

Uncovered Interest-Rate Parity

If we follow the same step in equation 5-10 we will end up

$$i_t - i_t^* = \frac{e_t - \epsilon_t}{\epsilon_t}, \quad i_t = i_t^* + \frac{e_t - \epsilon_t}{\epsilon_t} \tag{14}$$

This condition, according to which the interest differential is equal to the expected variation in the spot exchange rate or, equivalently, the domestic interest rate equals the foreign interest rate plus the expected variation in the exchange rate, is called the **uncovered interest parity (UIP)** condition.

Example - 1 -

Suppose that the treasurer of **IBM** has an extra cash reserve of $ 100,000,000 to invest for **six months.**

The six-month interest rate is **8 percent *per annum*** in the United States and **7 percent** per annum in Germany.

Currently, the spot exchange rate is **1.01 euro** per dollar and the six-month forward exchange rate is **0.99 euro per dollar**.

The treasurer of IBM does not wish to bear any exchange risk. Where should he/she invest to maximize the return?

Example - 1 -

The market conditions can be summarised

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Interest Rates on \$ in the US	$I_{\$} = 4\%$
Interest Rates on € in Germany	$I_{€} = 3.5\%$
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$$\$104,000,000 = \$100,000,000(1 + .04)$$

Example - 1 -

Alternatively, \$100,000,000 can be converted into euros and invested at the German interest rate, with the euro maturity value sold forward. In this case the dollar maturity value will be:

- Converted into euros

$$\$105,590,909 = (\$100,000,000 \times 1.01)(1 + .035)(1/0.99)$$

- Invested at the German interest rate
- The euro maturity value sold forward

Clearly, it is better to invest \$100,000,000 in Germany with exchange risk hedging.

Example - 2 -

While you were visiting London, you purchased a Jaguar for $35,000$ pounds, payable in three months.

You have enough cash at your bank in New York City, which pays 0.35%interest per month, compounding monthly, to pay for the car.

Currently, the spot exchange rate is $\$1.45$ per pound and the three-month forward exchange rate is $\$1.40$ per pound.

In London, the money market interest rate is 2.0% for a three-month investment. There are two alternative ways of paying for your Jaguar.

2a Keep the funds at your bank in the U.S. and buy$35,000$ pounds forward.

2b Buy a certain pound amount spot today and invest the amount in the U.K. for three months so that the maturity value becomes equal to$35,000$ pounds

Example - 2 -

The problem situation can be summarised as follows:

- We have to pay £35,000 in three months for Jaguar.
- Bank in NY pays $i_{NY} = 0.35\%$/ month, compounding monthly
- Market in London pays $i_{LD} = 2.0\%$ for three months
- Spot exchange rate $S = \$1.45/\pounds$;
- Forward exchange rate $F = \$1.40/\pounds$.

Example - 2 -

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- Using the forward market and investing in New York,
- Using the spot market and investing in London.

Example - 2 -

We have two options.

- Using the forward market and investing in New York,
- Using the spot market and investing in London.

- Then, we will compare the present values in each case hence we will able to decide which option is the best.

Example - 2 -

- Option A $ Buying £35K from the forward market.

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- In this option, we will need $\$49,000 = \pounds 35,000 \times 1.4$ in three months to fulfil the forward contract.

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- What is the **the present value** of $49,000 on today ?

Example - 2 -

- Option A \$ Buying £35K from the forward market.
- In this option, we will need $\$49,000 = £35,000 \times 1.4$ in three months to fulfil the forward contract.
- What is the **the present value** of \$49,000 on today ?
- What is the present value(PV)?

Present Value

- Present value (PV) is the current value of a future sum of money or stream of cash flows given a specified rate of return.

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$$PV = \frac{FV}{(1+r)^n}$$

where

FV: Future Value

r: Rate of return

n: Number of period

Therefore,

Example - 2 -

The present value of \$49K is computed as follows:

$$\$48,489 = \$49,000/(1.0035)^3$$

- Thus, the cost of Jaguar as of today is **\$48,489** for option **A**
- Option B £ Similarly, the present value of £35,000 is

$$£34,314 = £35,000/(1.02)^1$$

To buy £34,314 today, we can buy from the spot market and it will cost

$$\$49,755 = £34,314 \times 1.45$$

- Thus the cost of Jaguar as of today is \$49,755 for the option **B**

Example - 2 -

- The cost of Jaguar as of today is **$48,489** for option **A**
- The cost of Jaguar as of today is $49,755 for the option **B**

  We should definitely choose to use option (A), and save $1,266, which is the difference between $49,755 and $48,489.

Capital Controls

Capital Control

- Capital controls are restrictions imposed by governments on the flow of financial capital into or out of a country.
- The imposition of capital controls gives rise to interest rate differentials that cannot be arbitraged away.
- Suppose that a country initially has free capital mobility.
- Let i_t be the domestic interest rate on dollar loans (the onshore rate) and i_t^* the foreign interest rate on dollar loans (the offshore rate).
- As we have shown before under free capital mobility the onshore interest rate must equal the offshore interest rate,

$$i_t = i_t^*$$

Capital Controls

- Suppose now that the government imposes a tax τ per dollar borrowed internationally. The tax raises the cost of borrowing one dollar internationally to $i_t^* + \tau$.
- For agents to be indifferent between offshore and onshore borrowing, the domestic interest rate must equal the sum of the foreign interest rate and the capital control tax rate,

$$i_t = i_t^* + \tau$$

- The resulting onshore-offshore interest rate differential $i_t - i_t^*$ equals the capital control tax rate, τ
- The larger the capital control tax rate is, the larger the interest rate differential will be.

Capital Controls

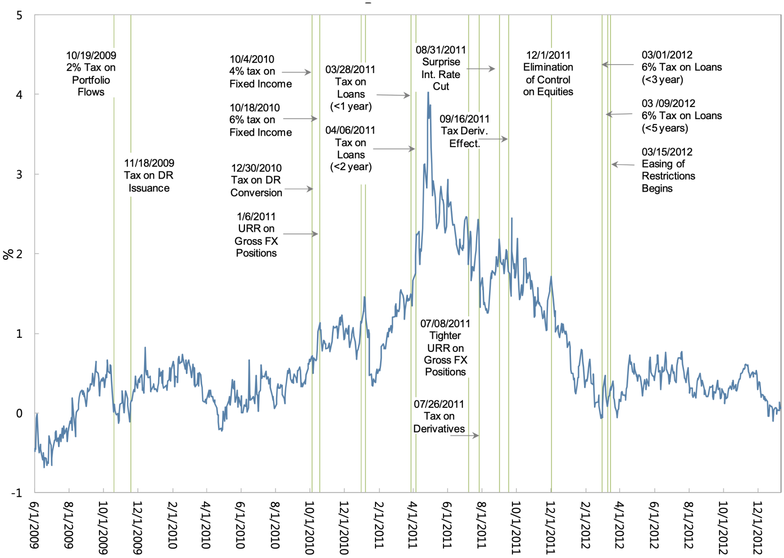
- Between October 2009 and March 2012 Brazil imposed a number of capital control taxes to reduce capital inflows into Brazil.
- After March 2012 those restrictions were removed. The cupom cambial, i_t^{cupom}, is the 360-day interest rate of U.S. dollar deposits inside Brazil.
- It is defined as

$$1 + i_t^{cupom} = (1 + i_t^{\$}) \frac{\epsilon_t}{F_t}$$

  where ϵ_t is the spot exchange rate (that is, the reais price of one U.S. dollar), F_t is the 360-day forward exchange rate of U.S. dollars, and it the 360-day nominal reais interest rate in Brazil.
- Let $i_t^{\$}$ denote the 360-day U.S. dollar LIBOR rate and define the spread as

$$spread_t = i_t^{cupom} - i_t^{\$}.$$

Capital Controls



Capital Controls

- In the absence of capital controls, the onshore dollar rate (i.e. the cupom cambial) would be equal to its offshore counterpart (i.e. the LIBOR) because currency-risk-free speculation would erode any differential.
- With limits to arbitrage, instead, a wedge would exist between these two interest rates that cannot be arbitraged away.
- In particular, if capital controls are imposed to prevent capital inflows it must be the case that Brazil is a relatively more attractive destination for investments, so we should observe a positive differential: $i_t^{cupom} > i_t^{\$}$.
- Therefore, our empirical strategy to test the effectiveness of Brazil's policy measures against capital inflows should be based on testing whether or not the variable spread_t is positive.

Capital Controls

- The picture offers evidence that Brazil was successful at managing capital inflows. The presence of a positive wedge between onshore and offshore dollar rates between October 2009 and March 2012 suggests that Brazil was indeed isolated from the global financial market when capital control measures were in place.
- The spread hovered below 1% after the introduction of taxes on portfolio flows in October 2009; it started to rise after restrictions were imposed on fixed income instruments in October 2010, and it reached a peak of 4% soon after taxes on foreign loans were introduced in March and April 2011. This is evidence that although there was little effect in the aftermath of the first measures, subsequent rounds of capital controls were increasingly effective at driving a wedge between external and internal dollar liquidity.
- After the spike, the spread started to decline: the controls became less effective over time as Brazilian financial institutions found ways to bypass them and progressively restored dollar liquidity in the domestic financial market. In 2012 the restrictions were removed by the Brazilian government and the interest rate differential zero again.

Capital Controls

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Capital controls in Brazil: Effective?

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ABSTRACT

A large theoretical literature emerged in recent years analyzing the positive and normative effects of capital controls, begging for empirical studies to validate it. No emerging market experimented as actively with controls on capital inflows as Brazil did since late 2009. This paper analyzes the impact of those measures. These policies had some success in segmenting the Brazilian from global financial markets, as measured by the spread between onshore and offshore dollar interest rates, as well as ADR premia relative to the underlying local stocks. The measures adopted from late 2009 to mid-2011 did not translate into significant changes in the exchange rate, suggesting limited success in mitigating exchange rate appreciation. However, the exchange rate strongly depreciates after a tax on the notional amount of derivatives is adopted in mid-2011. The last of the three restrictions studied may have depreciated the Brazilian real in the range from 4 to 10 percent. That strong response may have been driven by complementarities with the previous measures, as well as an unexpected easing in monetary policy.

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The Fama Puzzle

The Fama Puzzle

If the CIP and the UIP hold, we can express both condition as

the CIP:

$$i_t - i_t^* = \frac{F_t - \epsilon_t}{\epsilon_t}$$

the UIP:

$$i_t - i_t^* = \frac{e_t - \epsilon_t}{\epsilon_t}$$

Thus, the UIP can be express:

$$\frac{e_t - \epsilon_t}{\epsilon_t} = \frac{F_t - \epsilon_t}{\epsilon_t}$$

$$e_t - \epsilon_t = F_t - \epsilon_t$$

The Fama Puzzle

- We can test the UIP by estimating the following regression

$$\Delta e_t = \alpha + \beta(F_t - \epsilon_t) + \mu_t. \tag{15}$$

- If UIP holds, $\alpha = 0$, $\beta = 1$. A depreciation moves one-to-one with a forward premium. Or, in terms of CIP, a currency depreciation relates to an interest rate differential for the local currency.

- This is the Fama regression (Fama 1984).

- But tests of (15) found: $\alpha \neq 0$, $\beta \approx -1$, for different samples of currencies, time periods, etc. Systematic failure of UIP.

- This is the *Fama Puzzle* or *Forward Bias Puzzle*.

- This result implies that high interest rate currencies tend to appreciate (instead of depreciate).

The UIP Deviations and Excess Returns

- UIP deviations implies excess returns.

$$1 + i_t = (1 + i_t^*) \left(\frac{e_t}{\epsilon_t} \right) \tag{16}$$

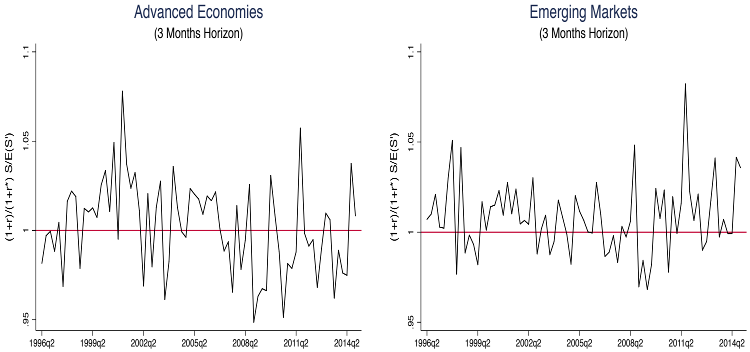
$$e_t(1 + i_t^*) = \epsilon_t(1 + i_t) \tag{17}$$

$$\theta_t = \frac{\epsilon_t}{e_t} \frac{1 + i_t}{1 + i_t^*}$$

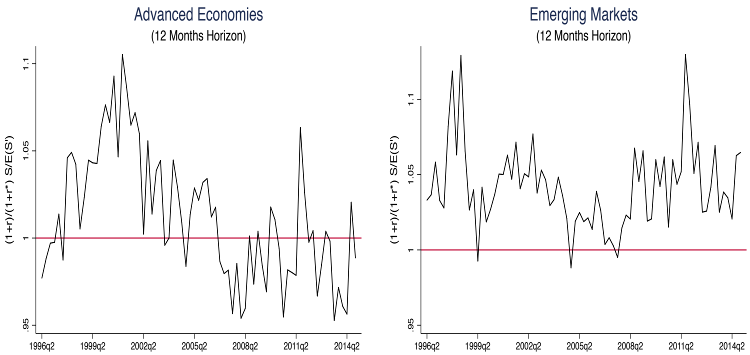
where θ_t is the deviation from the UIP.

- If $\theta_t > 1$, the domestic risk-free interest rate is higher than the foreign risk-free rate even after controlling for expected exchange rate movements.
- International investors can earn high expected returns by borrowing in low-interest-rate currencies and lending in high-interest-rate currencies (carry trade).
- In advanced economies θ_t is on average around 1, but in Emerging markets it is above 1 (approx 1.04). There is excess return when investing in EMs.

The UIP Deviations



The UIP Deviations



The UIP Deviations

Why do we observe persistent UIP deviations?

- Lustig and Verdlhan (2007), consumption risk: excess returns compensate the US investor for taking on more US consumption growth risk.
  - Higher interest rate currencies depreciate when US consumption growth is low, while low foreign interest rate currencies do not.
  - These UIP deviations suggest that higher interest rate currencies predict higher excess returns for US investors in foreign currency.
  - Same logic than any other asset: if an asset offers low returns when the investor's consumption is low, it is risky and the investor wants to be compensated through a positive excess return.

The UIP Deviations

Why do we observe persistent UIP deviations?

- Hassan (2013), differences in country size: bonds issued in currencies of larger economies are a better hedge against consumption risk. Then, these economies have permanently low interest rate.
  - Currencies of larger countries tend to appreciate when world consumption is low. Hence, the interest rates of these currencies are lower.
- Maggiori (2017), financial development: In good times, more financially developed country consumes more, runs a trade deficit and invest in risky investment. In bad times, it suffer credit losses and its currency appreciates. This provides a hedge, which leads to lower interest rates.
  - Four stylized facts: 1) US external position is characterized by risky assets and safe liabilities. 2) The US has a persistent trade deficit. 3) During the crisis, the US has transferred substantial amount of wealth to the the RoW. 4) US dollar as a safe currency (safety premium for the US dollars).

The UIP Deviations

Why do we observe persistent UIP deviations?

- Farhi and Gabaix (2016), disaster risk: the possibility of rare but extreme disasters is an important determinant of risk premia in asset markets.
  - Disasters correspond to bad times. Countries differ by their riskiness: how much their exchange rate would depreciate if a world disaster were to occur. Then, relatively riskier countries have more depreciated exchange rates.

Covered Interest Rate Parity Violations after the Financial Crisis

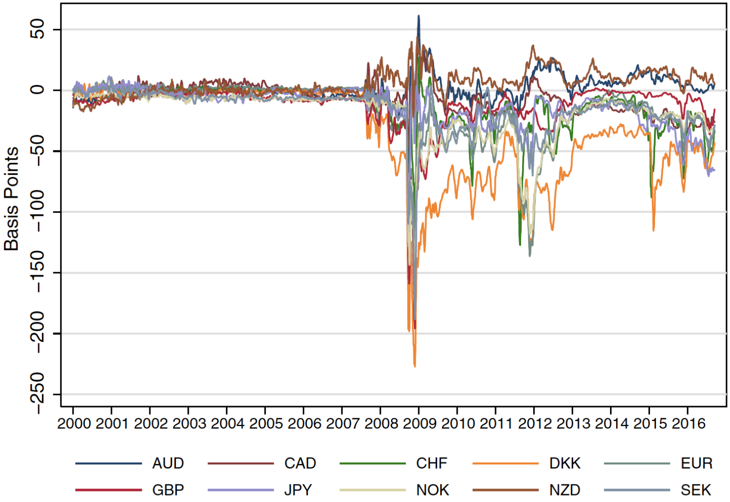
- Recall the CIP condition:

$$i_t - i_t^* = \frac{F_t - \epsilon_t}{\epsilon_t}, \quad i_t = i_t^* + \frac{F_t - \epsilon_t}{\epsilon_t} \tag{18}$$

- Example: an investor with USD may deposit USD for one month, earning the USD deposit rate. Or, she exchange the USD for GBP, deposit the GBP, and earn the GBP deposit rate. She gets a forward contract, which would convert the GBP earned at the end of the month into USD $\rightarrow$ no exchange rate risk.

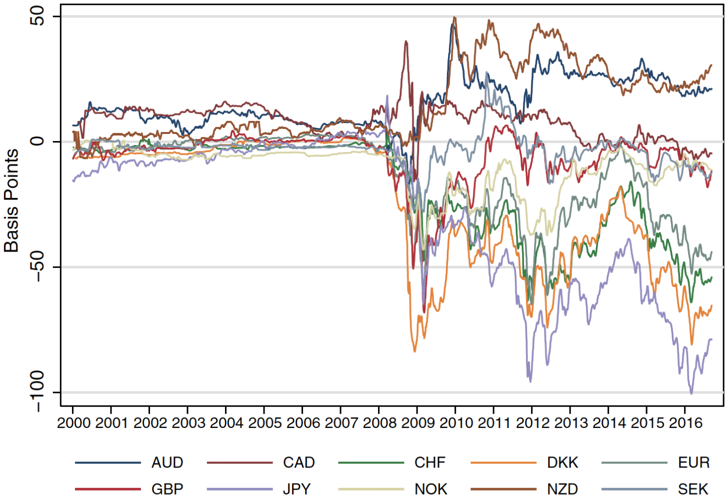
- Du, Tepper and Verdelhan (2018) find persistent and systematic deviations from the CIP since the global financial crisis in G10.
    - This allows large arbitrage opportunities.
    - Postcrisis regulatory reforms and global imbalances can lead to CIP violations and allow arbitrage opportunities.

CIP Violations after the Financial Crisis- Short-term Libor-based



Source: Du, Tepper and Verdelhan (2018) Journal of Finance

CIP Violations after the Financial Crisis - Long-term Libor-based



Source: Du, Tepper and Verdelhan (2018) Journal of Finance