International Economics II

International Capital Market Integration

Tomás Rodríguez Martínez

Universitat Pompeu Fabra

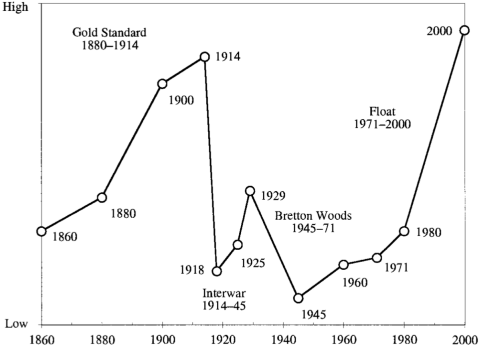
Outline

1. Covered Interest-Rate Parity
2. Uncovered Interest Rate Parity
3. Real Interest Rate Differentials
4. Saving-Investment Correlations

Motivation

- We have investigated whether world goods markets are integrated.
- If yes, there is a tendency for the prices of goods and services to equalize across countries. $\Rightarrow$ Law of One Price.
- What happens if world capital markets are integrated?
- We argued (and used as an assumption in SOE model) that interest rates equalize across countries.
- Let's investigate whether under free capital mobility this is true.
- But first let's see how mobile was capital through history.

A Stylized View of Capital Mobility in Modern History



source: Obstfeld and Taylor (2003)

Gold Standard Era (1880–1914)

- Between 1870-90 a growing share of countries adopted the gold standard.
- England was at the center of the standard, and as such a global capital market centered on London.
- The fixed exchange rate system was a stable and credible regime for many countries, and worked well.
- Given a more stable world exchange rate system, capital flows surged across countries, and interest rates tended to converge.
- Over time, many peripheral countries in Europe and countries in the New World took part in the system, resulting in the first era of economic globalization: capital market, but also goods and labor markets.

Interwar Era (1914-45)

- Two world wars and a Great Depression.
- Rise in nationalism and increasingly noncooperative economic policymaking.
- Gold-standard credibility broken by World War I.
- Monetary policy subject to domestic political goals and to finance wartime deficits.
- Currency devaluations used to try and gain competitive edge.
- Eventually, capital controls became widespread to avoid crises.
- World economy went from globalized to almost autarkic within a few decades. Capital flows minimal; prices and interest rates no longer syncrhonized.

Bretton Woods Era (1945-71)

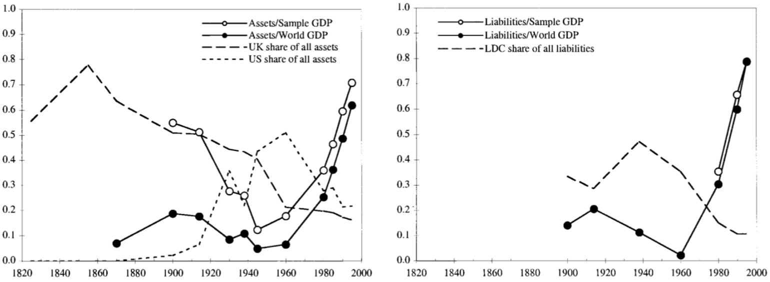
- An attempt to rebuild the global economy took shape. Some form of a gold standard took hold - system of fixed exchange rates based on U.S. dollar.
- Trade flows began to expand rapidly, and a era of most rapid spurt of economic growth worldwide.
- But, concerns on capital flows still remained given previous crises.
- IMF therefore initially sanctioned capital controls to help prevent crisis and given governments more power for activist monetary policy.
- By late 1960s, global capital could not be controlled so easily, and the fixed exchange rate system eventually broke.

Floating Era (1971-present)

- Capital mobility increasing from the 1970s onwards.
- Major industrial and other countries switch to floating rates, and generally no longer need capital controls.
- In peripheral countries, economic reforms reduced transaction cots and risks of foreign investment, so capital flows grew there.
- Episodes of crises in 1980s and 1990s, but over time emerging markets gave up fixed exchange regimes, which also led to smaller role of capital controls.
- Deregulation of domestic capital markets and technological change spurred out further capital market integration across borders, as did new institution arrangements such as the Euro in 1999.

Foreign Capital Stocks over History

- Collecting foreign asset and liability data over time is difficult, but following figure shows some resemblance of the U-shape that Obstfeld and Taylor conjectured:



source: Obstfeld and Taylor (2003)

How to Measure Capital Market Integration?

- Given this historical backdrop, we will explore different methodologies for measuring capital market integration.
- There are two core ways of doing so:
  1. A "price approach" $\Rightarrow$ looks at the "price of capital", the interest rates.
  2. A "quantity approach" $\Rightarrow$ looks at the "quantities of capital", savings and investment.

Outline

1. Covered Interest-Rate Parity
2. Uncovered Interest Rate Parity
3. Real Interest Rate Differentials
4. Saving-Investment Correlations

Interest Rate Differentials

- We will examine interest rate differentials across countries to study capital mobility.
- We first must understand why these differentials are informative about capital mobility.
- **Basic intuition**: capital will flow across countries so that expected returns in countries are equalized.
- Then, we can study empirical evidence on the size of interest rate differentials, and what this implies about capital market integration.

Asset Pricing Across Countries

- Two important concepts that will be the basis of our tests for capital market integration:
  - CIP: covered interest rate parity.
  - UIP: uncovered interest rate parity.
- We will begin by providing an intuitive derivation of CIP before linking CIP and UIP.
- The key mechanism underlying the CIP condition is that, *ceteris paribus*, any arbitrage opportunities across countries will be eliminated if there is perfect capital mobility.

Asset Returns and Exchange Rates

- The assets an investor can hold are either a domestic or foreign risk-free bond, where:
  - i: the domestic, nominally risk free, interest rate on domestic bonds held from period 1 to period 2.
  - i^*: the foreign, nominally risk-free, interest rate on foreign currency bonds held from period 1 to period 2.
  - $\mathcal{E}$: the domestic currency price of one unit of foreign currency in period period 1. In other words, the nominal exchange rate.
  - RECALL: $\mathcal{E} \uparrow$ means a depreciation of the domestic currency.

Investing Across Countries

- Let i_t denote the U.S. interest rate, i_t^* the German interest rate, $\mathcal{E}_t$ the beginning-of-period spot dollar/euro exchange rate, and $\mathcal{E}_{t+1}$ the end-of-period spot rate.
- Investor has one U.S. dollar and has two choices:
  1. Deposits money in U.S.:
     - receives $1 + i_t$ dollars at end of period.
  2. Deposits money in Germany:
     - Invests $1/\mathcal{E}_t$ euros at beginning of period.
     - Receives $(1 + i_t^*)/\mathcal{E}_t$ euros at end of period.
     - Converts back to dollars and has $(1 + i_t^*)\mathcal{E}_{t+1}/\mathcal{E}_t$ dollars at end of period.

Which Deposit Offers the Highest Return?

- What option should investor choose? Amounts to asking whether:

$$1 + i_t \lesseqgtr (1 + i_t^*)\mathcal{E}_{t+1}/\mathcal{E}_t? \tag{1}$$

- Three possible scenarios:
  - $>$ return to investing in U.S. greater than in Germany.
  - $<$ return to investing in U.S. small than in Germany.
  - $=$ return to investing in U.S. equal to in Germany.
- But, does the investor know what $\mathcal{E}_{t+1}$ equals when making deposit decision?
- No, so it is impossible to make direct comparison because return in Germany is uncertain.

Role of Forward Contract

- The forward exchange rate market are designed to eliminate uncertainty of future exchange rates.

- The investor who deposits in Germany can eliminate exchange rate uncertainty by arranging at the beginning of the investment period, the purchase of the necessary amount of U.S. dollars to be delivered at the end of period at a price determined at the beginning of period.

$\Rightarrow$ Called a forward contract.

- Define F_t as the forward rate:
  - the dollar price at the beginning of period of 1 euro to be delivered and paid at the end of the investment period.

- Also, the percentage difference between the forward and spot rates, $fd \equiv \ln F - \ln \mathcal{E}$, is called the forward discount (or premium if it is positive).

Covered Interest Rate Differential

- Given the existence of the foreign exchange rate market, the U.S. dollar return from investing in Germany can now be calculated as

$$(1 + i_t^*)\frac{F_t}{\mathcal{E}_t} \tag{2}$$

- The potential differential between the U.S. dollar domestic and foreign return is called the covered interest rate differential (CID):

$$CID = (1 + i_t) - (1 + i_t^*)\frac{F_t}{\mathcal{E}_t} \tag{3}$$

- Called "covered" because exchange rate uncertainty is eliminated.
- Note we could take a logs and write the equation as:

$$CID \approx i_t - i_t^* - (\ln F_t - \ln \mathcal{E}_t) = i_t - i_t^* - fd_t \tag{4}$$

Arbitrage Example

- Consider the following set of rates faced by an investor:
  - i: 3-month T-bill rate, equal to 1%
  - i^*: 3-month Euribor rate, equal to 0.5%
  - $\mathcal{E}$: dollar/euro spot exchange rate, equal to 0.9
  - F: dollar/euro 3-month forward exchange rate, equal to 1
- Is there a way for the investor to make risk-free money given these rates? If so, how?
- Calculate $CID = (1 + i_t) - (1 + i_t^*)F_t/\mathcal{E}_t$

$$CID = 1.01 - (1.005) \times 1/0.9 = -0.107 \neq 0 \tag{5}$$

- A covered interest rate differential exists, so there is an arbitrage opportunity. Domestic rate is "too low," so the investor will want to go short domestic currency and long foreign currency.

Arbitrage Example: Trading Strategy

- Today:
  - Borrow \$1 million (arbitrary number) from U.S. bank at i.
  - Convert to euros at $\mathcal{E}$ and deposit in a German bank paying i^*.
  - Agree to buy dollars ("buy forward") at F in three months.
- In three months:
  - Receive (\$1 million/$\mathcal{E}$)$(1+i^*)$ from German bank.
  - Convert proceeds to U.S. dollars at F.
  - Repay $(\$1\text{million})(1+i)$ to the U.S. bank.
- Risk-free profits:

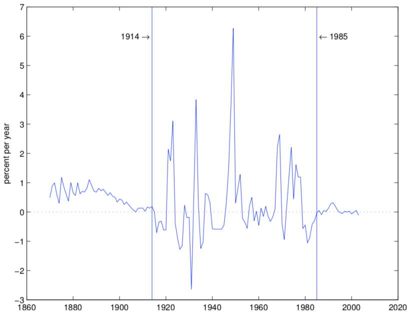
$$\begin{aligned}\text{Profits} &= \$1\text{million} \times (1+i^*)F/\mathcal{E} - \$1\text{million} \times (1+i) \\ &= (\$1\text{million}) \times (1.005(1/.9) - 1.01) \approx \$107,000.\end{aligned}$$

- Note that this example assumes zero transactions costs, so not cost to enter into a forward contracts, etc.

Covered Interest Rate Parity

- Hence, in the absence of transaction costs, if a covered interest rate differential exists, the international investor can make unbounded profits.
- When the covered interest rate differential is zero, we say that covered interest rate parity (CIP) holds.
- A violation of CIP implies the existence of arbitrage opportunities $\Rightarrow$ use covered interest rate differential as a test for capital mobility.
- Let's see a couple of real-world examples to check whether CIP holds in reality.

1. Dollar-Pound Covered Interest Rate Differentials: 1870-2003



- Between 1914 - 1985 the CID was large and different than zero reflecting the low capital mobility at that time.
- A series of deregulation of financial markets undertaken by the Thatcher and Reagan administrations brought the CID down.

2. Onshore-Offshore 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, the U.S. dollar, issued in financial centers located in different countries.
- For example, a US dollar denominated deposit in a Singapore bank.
- This was relatively common in European financial centers in the 80s.
- Hence, it was called Euro-dollar market (nothing to do with the actual currency Euro).
- Nowadays, the term Eurocurrency is given to any currency held on deposit outside its home market, i.e., held in banks located outside of the country which issues the currency.
  - Eurodollar, Euroeuro, Europound, Euroyen...

2. Onshore-Offshore Differentials

- We can define the onshore-offshore differential as the differential between the interest paid at home (onshore) and at the foreign market (offshore):

$$\text{onshore-offshore differential } = i_t^* - i_t. \tag{6}$$

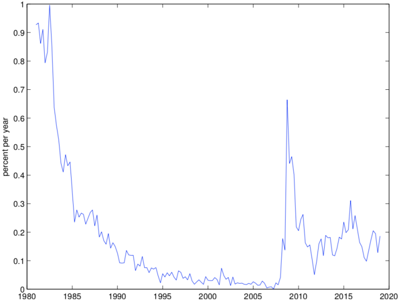
- Since the interest is paid in the same currency, if there is free capital mobility we expect $i_t^* - i_t = 0$.

- For example, compare the interest rate on a French franc deposit in France to the interest rate on a French franc deposit outside France, say in London.

- Since both deposits are in French francs the exchange rate plays no role in comparing the two interest rates.

2. Onshore-Offshore Differentials

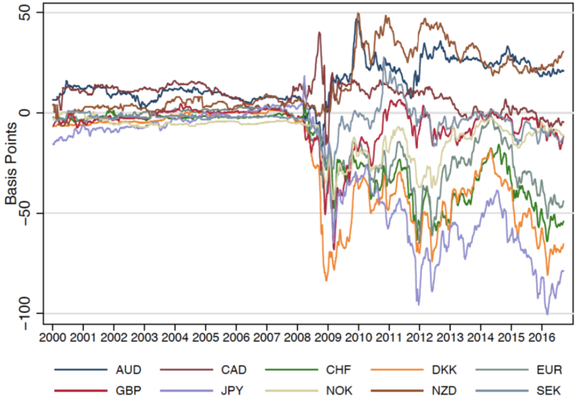
Figure: Three-month U.K.-U.S. offshore-onshore interest rate differential of the U.S. dollar.



- Until the mid 1980s, both the United States and the United Kingdom had regulations in place that hindered free international capital mobility.
- Exploded during the great recession.

3. Deviations of CIP after the Great Recession

Figure: Long-Term Libor-Based Deviations of CIP Post-2008.



Notes: This figure plots the 10-day moving averages of the five-year Libor cross-currency basis, measured in basis points, for G10 currencies. The covered interest rate parity implies that the basis should be zero. One-hundred basis points equal one percent. Source Du et al. (2018).

3. Deviations of CIP after the Great Recession

- Large deviations from CIP since the crisis. $\Rightarrow$ Arbitrage opportunities exist.
- Indication of lack of capital mobility?
- One alternative hypothesis: banks engaged in Libor trade have different levels of creditworthiness, thus generating credit risk and spreads in trade.
- Du et al. (2018) offer (and test for) other explanations since crisis:
  - Financial intermediaries are constrained, agents cannot borrow to enjoy differential rates $\Rightarrow$ Kills zero-profit arbitrage condition.
  - Persistent international imbalances in investment demand and funding supply across currencies $\Rightarrow$ generate liquidity imbalances $\Rightarrow$ but currency-hedging is costly and financial intermediaries are already constrained.

Outline

1. Covered Interest-Rate Parity
2. Uncovered Interest Rate Parity
3. Real Interest Rate Differentials
4. Saving-Investment Correlations

From Covered to Uncovered Interest Rate Parity

- We have thus far showed that a failure of covered interest rate parity (CIP) can only occur when international capital markets are not perfectly integrated.
- We will next introduce the concept of uncovered interest rate parity (UIP) and describe some tests for it in the data.
- It is in fact possible to derive both CIP and UIP using our two-period SOE model, where we allow for uncertainty and households to hold both domestic and foreign currency bonds. This model is described in the SGUW textbook.
- We will not go through this derivation, but the key conclusion from the model is even if CIP hold, UIP need not hold. We will also show this below, but without a full-blown model.

Uncovered Interest Rate Parity

- Recall the CIP: $1 + i_t = (1 + i_t^*) F_t / \mathcal{E}_t$.
- Now suppose there is no forward exchange rate market. How you will decide where to invest?
- Depends on the expectation of the future exchange rate. We will say that UIP holds if

$$1 + i_t = (1 + i_t^*) \frac{E_t[\mathcal{E}_{t+1}]}{\mathcal{E}_t} \tag{7}$$

  where $E_t[.]$ is the expectations operator based on all information available at period t.
- Equivalently, the uncovered interest rate differential is given by the left hand side minus the right hand side of (7).

Uncovered Interest Rate Parity

- If UIP holds, we can re-arrange (7) as:

$$\frac{1+i_t}{1+i_t^*} = \frac{E_t[\mathcal{E}_{t+1}]}{\mathcal{E}_t} \tag{8}$$

- which says that if $i_t > i_t^*$ the domestic currency is expected to depreciate. Why?

- Because if investors did not expect a depreciation they would continue to invest in the domestic currency to make unlimited profit.

- Based on expectations and prevailing interest rates, the exchange rate adjusts at t to ensure that the UIP condition holds.

Market Expectations

- The only difference between CIP and UIP is that one equation relies on an existing exchange rate (i.e., the forward rate), while the other is based on expectations of the future rate.
- A natural question to ask in international finance is then whether the forward rate is equal to the expected value of the future spot rate:

$$F_t = E_t[\mathcal{E}_{t+1}]? \tag{9}$$

- It would seem quite natural to expect this condition to hold.
- If not, agents would have the possibility of earning arbitrage profits by speculating in the forward foreign exchange.

Market Efficiency and UIP in FX Markets

- If foreign exchange markets are efficient, then an investor should not be able to earn an excess return without some premium.
- As a first approximation, this implies that returns are not predictable in the sense that you should not be able to implement a trading strategy and earn money without much risk.
- Failure of UIP in the data may be showing that markets are not efficient.
- Fama (1984) is a famous paper to set out tests for this.

Forward Premium Regression

- Recall the difference between the forward and spot rates (in %), the forward exchange rate premium/discount: $\ln F_t - \ln \mathcal{E}_t = \ln(F_t/\mathcal{E}_t)$ and let future exchange rate changes (in %), $\ln \mathcal{E}_{t+1} - \ln \mathcal{E}_t = \ln(\mathcal{E}_{t+1}/\mathcal{E}_t)$.
- Fama's empirical strategy is to examine whether the forward exchange rate premium has any prediction power of future exchange rate changes:

$$\ln(\mathcal{E}_{t+1}/\mathcal{E}_t) = \alpha + \beta \ln(F_t/\mathcal{E}_t) + \varepsilon_{t+1} \tag{10}$$

- where a typical forward-market "efficiency" tests ask whether one can reject the null hypothesis that $\alpha = 0$ and $\beta = 1$.
- That is, under UIP, the estimation should yield $\alpha = 0$ and $\beta = 1$.

Forward Premium Regression

- We can also use the UIP condition to derive a further regression specification. In particular, we can apply UIP to substitute the forward premium with the interest differentials: $\ln(F_t/\mathcal{E}_t) = \ln((1+i_t)/(1+i_t^*)) \approx i_t - i_t^*$

$$\ln(\mathcal{E}_{t+1}/\mathcal{E}_t) = \alpha + \beta(i_t - i_t^*) + \varepsilon_{t+1} \tag{11}$$

- If markets are efficient and UIP holds, we should expect that today's interest rate differential can predict future exchange rate changes.

- In particular, if $\beta = 1$ then we should expect that with low interest rate, $i_t < i_t^*$, the domestic currency will appreciate.

Forward Premium Regression

- The estimated α and β look very different than what theory would predict if efficient markets held.
- For example, Burnside (2018) estimates this regression for the U.S. dollar against the G10 currencies and found country average estimates of α and β of 0.00055 and -0.75, respectively.
- Numerous studies not only reject joint-null hypothesis that $\alpha = 0$ and $\beta = 1$, but find that $\beta < 0$ and significant!
- These findings have led researchers to posit that there exists a forward premium puzzle.
- In particular, via the the lens of interest rate parity a $\beta < 0$ implies the currency with the higher interest rate appreciates not depreciates.

Carry Trade

- This forward premium appears to exist for long periods of time, which has led to a particular type of investment strategy known as carry trade.
- Borrow in the low interest rate currency (the "funding" currency), invest in the high interest rate currency (the "target" currency), and do not hedge the exchange rate risk.
- Exploits the forward premium of one currency relative to another. This version combines two transactions:
  - Selling currencies that are at a forward premium.
  - Buying currencies that are at a forward discount.
- Burnside et al (2006) document returns to carry trade for the pound sterling against 10 currencies between 1976-2005.
- The average payoffs from carry trade are positive but low, 0.0029 for one pound invested for one month.

U.S. dollar and Japanese yen

- Carry trade is a risky investment (estimated to be similar to S&P 500 index), and is subject to crash risk.
- Example: large surprise appreciation of the Japanese Yen against the U.S. dollar on October 6-8, 1998. The Yen appreciated by 14 percent (or equivalently the U.S. dollar depreciated by 14 percent).

Source: Brunnermeier, Nagel, and Pedersen (2009).

Outline

1. Covered Interest-Rate Parity
2. Uncovered Interest Rate Parity
3. Real Interest Rate Differentials
4. Saving-Investment Correlations

Real Interest Rate Differentials

- Thus far we have focused on nominal interest rates in measuring capital mobility.
- But, our model economies have focused on real interest rates.
- A natural question then arises: can real interest rate differentials be used to test for capital mobility?
- In other words, should we expect that $r - r^*$ tells us something about capital mobility?

Real Interest Rate Differentials

- To answer this question, we will link real and nominal interest rate differentials. To begin, note that each country we have the Fischerian equations:

$$r = i - \pi^e \tag{12}$$

$$r^* = i^* - \pi^{*e} \tag{13}$$

- The real interest rate differential can be expressed as:

$$r - r^* = (i - i^*) - (\pi^e - \pi^{*e}) \tag{14}$$

- We will look at the components of this equation to understand why real interest differentials need not be good indicators of capital mobility.

Decomposing RIRD

- Let's add and subtract the expected change of the nominal exchange rate in % (denote $E_t[\mathcal{E}_{t+1}] = \mathcal{E}^e_{t+1}$)

$$r - r^* = (i - i^* - \ln(\mathcal{E}^e_{t+1}/\mathcal{E}_t)) - (\pi^e - \pi^{*e} - \ln(\mathcal{E}^e_{t+1}/\mathcal{E}_t))$$

  - The first term is the uncovered interest rate differential (e.g. log version of equation (7)).
  - The second term is the expected change in real exchange rate!

- To see that recall: $e_t = \mathcal{E}_t P^*_t / P_t$. Taking the log difference with respect to $t + 1$:

$$\begin{aligned} e^e_{t+1} - e_t &= \ln(\mathcal{E}^e_{t+1}) - \ln(\mathcal{E}_t) + \ln(P^*_{t+1}) - \ln(P^*_t) - (\ln(P_{t+1}) - \ln(P_t)) \\ &= \ln(\mathcal{E}^e_{t+1}/\mathcal{E}_t) + \pi^{*e} - \pi^e = \Delta e_t \end{aligned}$$

Decomposing RIRD

- We saw already that the uncovered interest rate differential usually does not hold, arguably because agents are risk averse.
- Also, in the previous lecture, we saw that the relative PPP, $e^e_{t+1} - e_t$, also does not hold in the short run.
- But does that implies that capital mobility is low? What if $r - r^*$ is not a good measure of capital mobility? Let's go one step further:
- Add and subtract the forward rate (in logs), $\ln F_t$ in:

$$\begin{aligned} r - r^* &= (i - i^* - \ln(\mathcal{E}^e_{t+1}/\mathcal{E}_t)) + \ln F_t - \ln F_t + \Delta e_t \\ &= (i - i^* - \ln(F_t/\mathcal{E}_t)) + \ln(F_t/\mathcal{E}^e_{t+1}) + \Delta e_t \\ &= (i - i^* - fd) + \ln(F_t/\mathcal{E}^e_{t+1}) + \Delta e_t \end{aligned}$$

Decomposing RIRD

- Now the real interest rate differential can be decomposed:

$$r - r^* = \underbrace{(i - i^* - fd)}_{CID} + \underbrace{\ln(F_t/\mathcal{E}^e_{t+1})}_{\text{exchange risk premium}} + \underbrace{\Delta e_t}_{\text{real exchange rate depreciation}}$$

- The covered interest differential (CID) is the gold standard to measure capital mobility.
- We can see that RIRD does not need to be equal to CID.
- In particular, this is the case if:
  - agents are risk averse and ask for a premium to sell future contracts $(\ln(F_t/\mathcal{E}^e_{t+1}) > 0$;
  - agents expect a real depreciation $\Delta e_t > 0$ (consumption basket of the foreign country becomes relatively more expensive).

Outline

1. Covered Interest-Rate Parity
2. Uncovered Interest Rate Parity
3. Real Interest Rate Differentials
4. Saving-Investment Correlations

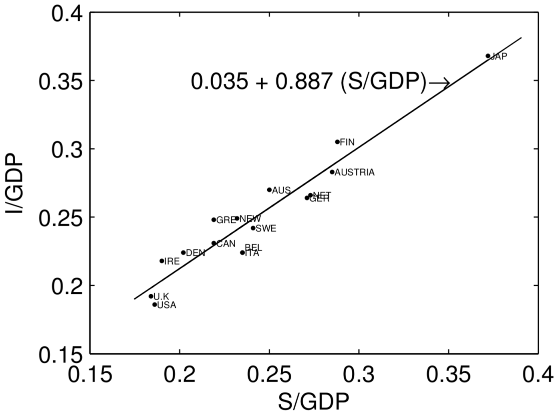
The "Quantity Approach"

- **Idea:** can we infer the degree of international capital market integration from savings-investment correlations?
- **Motivation:** Recall that $CA = S(r) - I(r)$.
  - Since $CA = 0$, S moves together with I, in a closed economy those correlations must be 1.
  - In a small open economy r^* is exogenously given, hence, if the saving and investment schedules are affected by independent factors, we should observe low correlation.
- High correlation of S and $I \Rightarrow$ low capital mobility.
- **Question**: suppose we find a near perfect correlation between S and I. Does this necessarily mean that there is no capital mobility?

Savings and Investment Relationship

- We can analyze this along different dimension:
  - On average across many countries, where the we can also cut the time period in different sub-samples to take the average.
  - Overtime within a given country.
- The first approach was taken in a classic study by Feldstein and Horioka (1980); the so-called "Feldstein-Horioka regression."

S and I for 16 Industrialized Countries



Notes: 1960-1974 averages. Source: Feldstein and Horioka (1980).

Feldstein and Horioka's Original Regression

- Feldstein and Horioka estimated the following equation:

$$\left(\frac{I}{Q}\right)_i = 0.035 + 0.887\left(\frac{S}{Q}\right)_i + \varepsilon_i; \qquad R^2 = 0.91, \tag{15}$$

- where $(I/Q)_i$ and $(S/Q)_i$ are, respectively, the average investment-to-GDP and savings-to-GDP ratios in country i over the period 1960-74. They have 16 observations.

- The coefficient on $(S/Q)_i$ is 0.887 with a standard error of 0.07, making it highly unlikely that the true coefficient is zero.

Feldstein and Horioka's Recent Regression

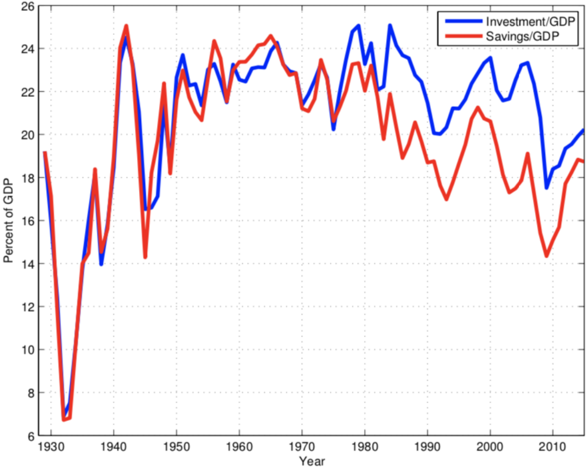
- More recent evidence from Bai and Zhang (Econometrica, 2010) using a sample of 64 countries with data from 1960 to 2003 finds:

$$\left(\frac{I}{Q}\right)_i = \text{constant } + 0.562\left(\frac{S}{Q}\right)_i + \varepsilon_i, \tag{16}$$

- where $(I/Q)_i$ and $(S/Q)_i$ are, respectively, the average investment-to-GDP and savings-to-GDP ratios in country i over the period 1960-2003.

- Slope coefficient has dropped significantly, though still statistically different from zero (standard error is 0.06).

U.S. National Saving and Investment, 1928-2015



corr(S/Q,I/Q) = 0.98 pre 1972 and 0.76 post 1972. Source: Bureau of Economic Analysis (NIPA tables).

Does a Bilateral Correlation tell the Whole Story?

- But do findings of high savings-investment correlations either across countries or across time, necessarily imply imperfect capital mobility?

- No. Even under perfect capital market integration one could observe a high S-I correlation.

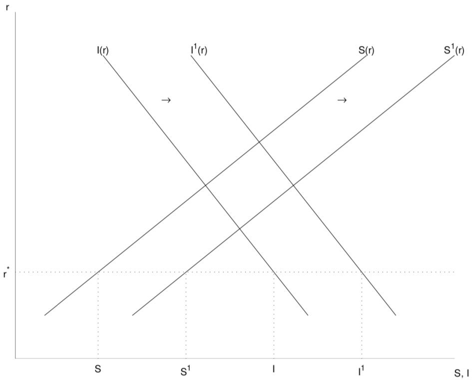
- For example, in a SOE, suppose a persistent positive productivity shock, so A_1 and A_2 increase, but with A_1 increasing more. What is impact on S_1 and I_1?

  - $\uparrow A_1$: (i) Households are richer today and will save more to smooth consumption ($S_1 \uparrow$). (ii) Since investment is predetermined the change in A_1 will not affect investment.

  - $\uparrow A_2$: (i) higher future productivity will make firms invest more today ($I_1 \uparrow$). (ii) This implies higher income tomorrow, which in turn will make households save less today ($S_1 \downarrow$).

  - Since we suppose that A_1 increased by more, the overall effect on savings is positive. Positive correlation between S and I.

Savings and Investment co-movement: SOE

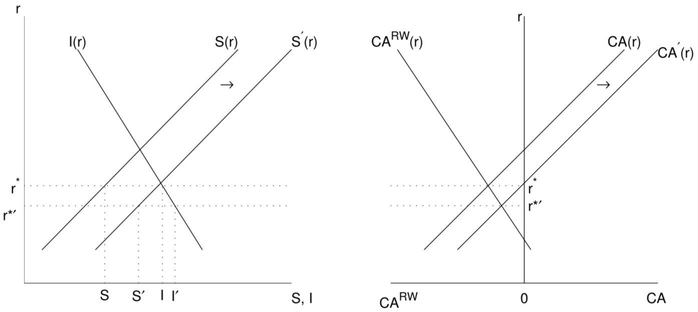


A persistent productivity shock in a SOE can increase both I and S at the same time.

Does a Bilateral Correlation tell the Whole Story?

- In a LOE, a change in savings only will also impact r, which feeds through to investment.
- Suppose a large temporary increase in A_1:
  - Households increase savings to smooth consumption ($S_1 \uparrow$).
  - The extra savings will decrease the world interest rate r^*.
  - Since r^* is lower, firms increase investment ($I_1 \uparrow$).
- Positive correlation between S and I with perfect capital mobility.
- Therefore, we conclude that high $S - I$ correlations need not be evidence of low capital mobility.
- Empirically this can be viewed as a *simultaneity* problem, or else known as an *endogeneity* problem.

Savings and Investment co-movement: LOE



A temporary productivity shock in a LOE can increase both I and S at the same time.

Taking Stock

- Over the time the world experienced phases of high and low capital mobility.
- The covered interest rate differential is a good measure to study capital mobility, since it uses forward contracts to eliminate exchange rate uncertainty.
- The uncovered interest rate differential, however, is not a good measure. The expected value of the exchange rate is not equal to the forward rate.
- Real interest rate differential does not need to be the same of covered interest rate differential, specially if agents expect real depreciation.
- Savings-Investment correlations are not a good way to study capital mobility because it is plagued with simultaneity problems.