Chapter 5

International Capital Market Integration

In the past two decades, a number of events around the world have made the assumption of free capital mobility increasingly realistic. Among the developments that have contributed to increased capital mobility are:

- The breakdown of the Bretton-Woods System of fixed exchange rates in 1972 allowed, as a byproduct, the removal of capital controls in some European countries, particularly in Germany in the mid 1970s.

- The high inflation rates observed in the 1970s together with the Federal Reserve's regulation Q which placed a ceiling on the interest rate that US banks could pay on time deposits, led to fast growth of eurocurrency markets.[1]

- Technological advances in information processing made it easier to watch several markets at once and to arbitrage instantly between markets.

- In the past years there has been a general trend for deregulation of markets of all kinds. For example, financial markets were deregulated in 1979 in Great Britain under the Thatcher administration and in the 1980s in the U.S. under the Reagan administration.

[1] A eurocurrency deposit is a foreign currency deposit. For example, a Eurodollar deposit is a dollar deposit outside the United States (e.g., a dollar deposit in London). A yen deposit at a bank in Singapore is called a Euro yen deposit and the interest rate on such deposit is called the Euro yen rate (i.e., the interest rate on yen deposits outside Japan). The biggest market place for Eurocurrency deposits is London.

- In the past twenty years, Europe underwent a process of economic and monetary unification. Specifically, capital controls were abolished in 1986, the single market became reality in 1992, and in 1999 Europe achieved a monetary union with the emergence of the Euro.

5.1 Measuring the degree of capital mobility: (I) Saving-Investment correlations

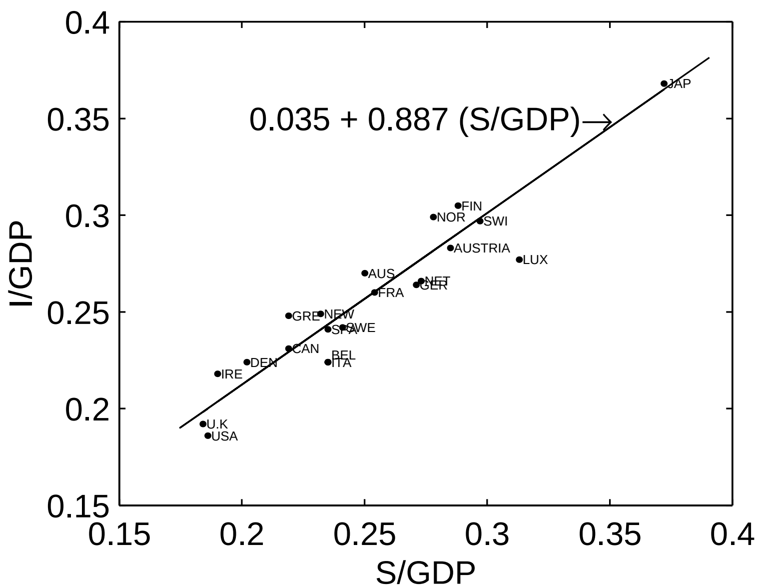
In 1980 Feldstein and Horioka wrote a very provoking paper in which they showed that changes in countries' rates of national savings had a very large effect on their rates of investment.[2] Feldstein and Horioka examined data on average investment-to-GDP and saving-to-GDP ratios from 16 industrial countries over the period 1960-74. The data used in their study is plotted in figure 5.1.

Feldstein and Horioka argued that if capital was highly mobile across countries, then the correlation between savings and investment should be close to zero, and therefore interpreted their findings as evidence of low capital mobility. The reason why Feldstein and Horioka arrived at this conclusion can be seen by considering the identity, $CA = S - I$. In a closed economy—i.e., an economy without capital mobility—the current account is always zero, so that $S = I$ and changes in national savings are perfectly correlated with changes in investment. On the other hand, in a small open economy with perfect capital mobility, the interest rate is exogenously given by the world interest rate, so that if the savings and investment schedules are affected by *independent* factors, then the correlation between savings and investment should be zero. For instance, events that change only the savings schedule will result in changes in the equilibrium level of savings but will not affect the equilibrium level of investment (figure 5.2a). Similarly, events that affect only the investment schedule will result in changes in the equilibrium level of investment but will not affect the equilibrium level of national savings (figure 5.2b).

Feldstein and Horioka fit the following line through the cloud of points

[2] M. Feldstein and C. Horioka, "Domestic Saving and International Capital Flows," *Economic Journal* 90, June 1980, 314-29.

Figure 5.1: Saving and Investment Rates for 16 Industrialized Countries, 1960-1974 Averages



Source: M. Feldstein and C. Horioka, "Domestic Saving and International Capital Flows," *Economic Journal* 90, June 1980, 314-29.

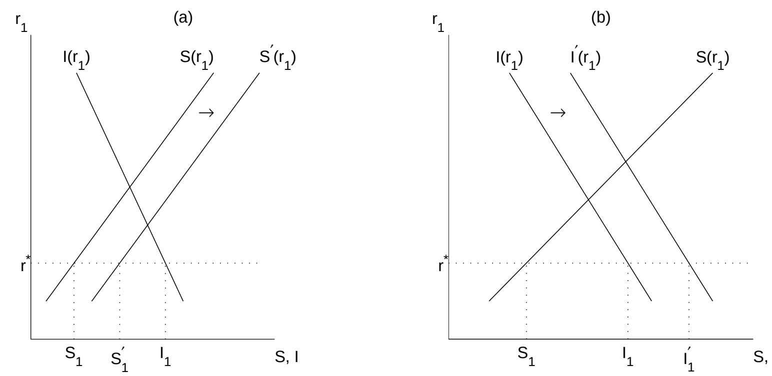
shown in figure 5.1:[3]

$$\left(\frac{I}{Y}\right)_i = 0.035 + 0.887\left(\frac{S}{Y}\right)_i + \nu_i; \qquad R^2 = 0.91$$

where $(I/Y)_i$ and $(S/Y)_i$ are, respectively, the average investment-to-GDP and savings-to-GDP ratios in country i over the period 1960-74. Figure 5.1 shows the fitted relationship as a solid line. Feldstein and Horioka used data on 16 OECD countries, so that their regression was based on 16 observations. The high value of the coefficient on S/Y of 0.887 means that there is almost a one-to-one positive association between savings and investment rates. The reported R^2 statistic of 0.91 means that the estimated equation fits the data

[3]The slope and intercept of this line are found by minimizing the sum of the squared distances between the line and each data point. This way of fitting a line through a cloud of points is called Ordinary Least Square estimation or simply OLS estimation.

Figure 5.2: Response of S and I to independent shifts in (a) the savings schedule and (b) the investment schedule

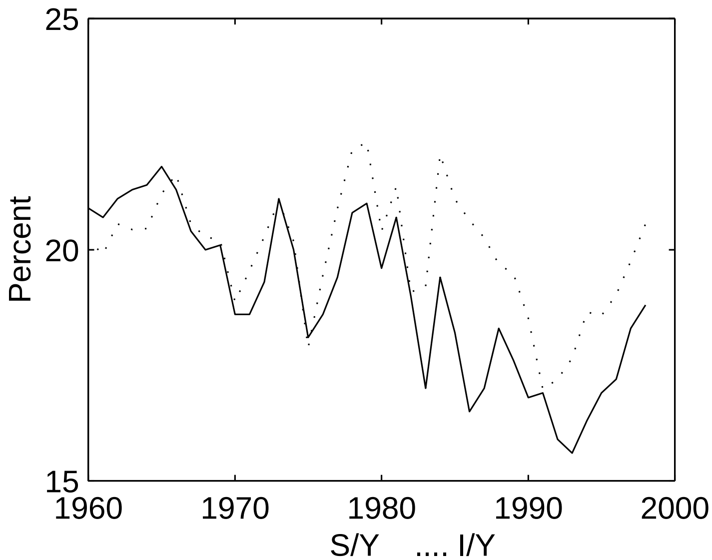


quite well, as 91 percent of the variation in I/Y is explained by variations in S/Y.

The Feldstein-Horioka regression uses cross-country data. A positive relationship between savings and investment rates is also observed within countries over time (i.e., in time series data). Specifically, for OECD countries, the average correlation between savings and investment rates over the period 1974-90 is 0.495. The savings-investment correlation has been weakening overtime. Figure 5.3 shows the U.S. savings and investment rates from 1955 to 1987. Until the late 1970s savings and investment were moving closely together whereas after 1980 they drifted apart. As we saw earlier (see table 4.2), in the first half of the 1980s the U.S. economy experienced a large decline in national savings. A number of researchers have attributed the origin of these deficits to large fiscal deficits. Investment rates, on the other hand, remained about unchanged. As a result, the country experienced a string of unprecedented current account deficits. The fading association between savings and investment is reflected in lower values of the coefficient on S/Y in Feldstein-Horioka style regressions. Specifically, Frankel (1993)[4] estimates the relationship between savings and investment rates using time series data from the U.S. economy and finds that for the period 1955-1979 the coefficient on S/Y is 1.05 and statistically indistinguishable from unity. He then extends the sample to include data until 1987, and finds that the coefficient drops to 0.03 and becomes statistically indistinguishable from zero. In the interpretation of Feldstein and Horioka, these regression results show

[4]Jeffrey A. Frankel, "Quantifying International Capital Mobility in the 1980s," in D. Das, *International Finance*, Routledge, 1993.

Figure 5.3: U.S. National Saving, Investment, and the Current Account as a Fraction of GNP, 1960-1998

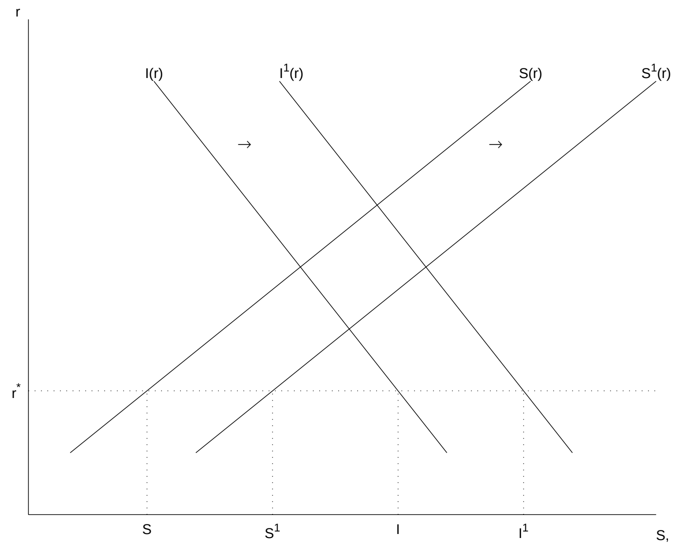


Source: Department of Commerce, Bureau of Economic Analysis, www.bea.doc.gov.

that in the 1980 the U.S. economy moved from a situation of very limited capital mobility to one of near perfect capital mobility.

But do the Feldstein-Horioka findings of high savings-investment correlations really imply imperfect capital mobility? Feldstein and Horioka's interpretation has been criticized on at least two grounds. First, even under perfect capital mobility, a positive association between savings and investment may arise because the same events might shift the savings and investment schedules. For example, suppose that, in a small open economy, the production functions in periods 1 and 2 are given by $Q_1 = A_1F(K_1)$ and $Q_2 = A_2F(K_2)$, respectively. Here Q_1 and Q_2 denote output in periods 1 and 2, K_1 and K_2 denote the stocks of physical capital (such as plant and equipment) in periods 1 and 2, $F(\cdot)$ is an increasing and concave production function stating that the higher is the capital input the higher is output, and A_1 and A_2 are positive parameters reflecting factors such as the state of technology, the effects of weather on the productivity of capital, and so forth. Consider a persistent productivity shock. Specifically, assume that A_1 and A_2 increase and that A_1 increases by more than A_2. This situation is illustrated in figure 5.4, where the initial situation is one in which the

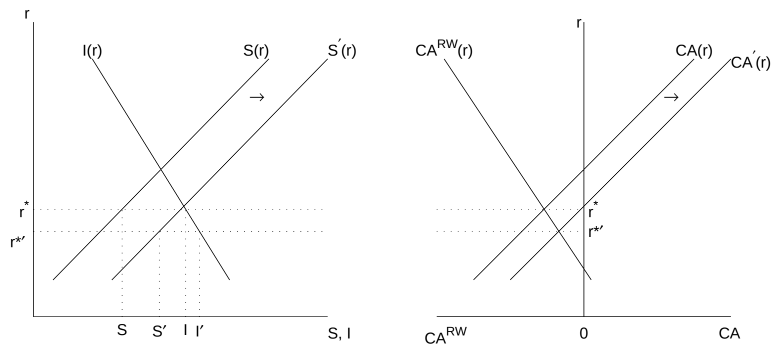
Figure 5.4: Response of S and I to a persistent productivity shock



savings schedule is given by $S(r)$ and the investment schedule by $I(r)$. At the world interest rate r^*, the equilibrium levels of savings and investment are given by S and I. In response to the expected increase in A_2, firms are induced to increase next period's capital stock, K_2, to take advantage of the expected rise in productivity. In order to increase K_2, firms must invest more in period 1. Thus, I_1 goes up for every level of the interest rate. This implies that in response to the increase in A_2, the investment schedule shifts to the right to $I^1(r)$. At the same time, the increase in A_2 produces a positive wealth effect which induces households to increase consumption and reduce savings in period 1. As a result, the increase in A_2 shift the savings schedule to the left. Now consider the effect of the increase in A_1. This should have no effect on desired investment because the capital stock in period 1 is predetermined. However, the increase in A_1 produces an increase in output in period 1 ($\Delta Q_1 > 0$). Consumption-smoothing households will want to save part of the increase in Q_1. Therefore, the effect of an increase in A_1 is a rightward shift in the savings schedule. Because we assumed that A_1 increases by more than A_2, on net the savings schedule is likely to shift to the right. In the figure, the new savings schedule is given by $S^1(r)$. Because the economy is small, the interest rate is unaffected by the changes in A_1 and A_2. Thus, both savings and investment increase to S^1 and I^1, respectively.

A second reason why savings and investment may be positively correlated in spite of perfect capital mobility is the presence of large country effects. Consider, for example, an event that affects only the savings schedule in a large open economy like the one represented in figure 5.5. In response to

Figure 5.5: Large open economy: response of S and I to a shift in the savings schedule



a shock that shifts the savings schedule to the right from $S(r)$ to $S'(r)$ the current account schedule also shifts to the right from $CA(r)$ to $CA'(r)$. As a result, the world interest rate falls from r^* to $r^{*\prime}$. The fall in the interest rate leads to an increase in investment from I to I'. Thus, in a large open economy, a shock that affects only the savings schedule results in positive comovement between savings and investment.

5.2 Measuring capital mobility: (II) Interest rate differentials

A more direct measure of the degree of international capital mobility than the one used by Feldstein and Horioka is given by differences in interest rates across countries. In a world that enjoys perfect capital mobility, the rate of return on financial investments should be equalized across countries. 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 the difference in interest rates. If, on the other hand, one observes that interest rate differential across countries persist over time, it must be the case that some countries have restrictions on international capital flows. It follows that a natural empirical test of the degree of capital market integration is to look at cross-country interest rate differentials. However, such a test is not as straightforward as it might seem. One difficulty in measuring interest rate differentials is that interest rates across countries are not directly comparable if they relate to investments in different currencies. Suppose, for example, that the interest rate on a 1-year deposit in the United States is 6 percent and on a 1-year deposit in Mexico is 30 percent. This interest rate differential will not necessarily induce capital flows to Mexico. The reason is that if the Mexican peso depreciates sharply within the investment period, an investor that deposited his money in Mexico might end up with fewer dollars at the end of the period than an investor that had invested in the United States. Thus, even in the absence of capital controls, differences in interest rates might exist due to expectations of changes in the exchange rate or as a compensation for exchange rate risk. It follows that a meaningful measure of interest rate differentials ought to take the exchange rate factor into account.

5.2.1 Covered interest rate parity

Suppose an investor has 1 US dollar and is trying to decide whether to invest it domestically or abroad, say in Germany. Let i denote the US interest rate and i^* the foreign (German) interest rate. If the investor deposits his money in the US, at the end of the period he receives $1 + i$ dollars. How many dollars will he have if instead he invested his 1 dollar in Germany? In order to invest in Germany, he must first use his dollar to buy German marks. Let S denote the spot exchange rate, defined as the dollar price of 1 German mark. The investor gets $1/S$ German marks for his dollar. At the end of the investment period, he will receive $(1 + i^*)/S$ German marks. At this point he must convert the German marks into dollars. Let S' denote the spot exchange rate prevailing at the end of the investment period. Then the $(1 + i^*)/S$ German marks can be converted into $(1 + i^*)S'/S$ dollars. Therefore, in deciding where to invest, the investor compares the return of investing in the US, $1+i$, to the dollar return of an equivalent investment in Germany, $(1+i^*)S'/S$. If $1+i$ is greater than $(1+i^*)S'/S$, 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 US. Similarly, if $1 + i$ is less than $(1 + i^*)S'/S$, the investor could make infinite profits by borrowing in the US and investing in Germany.

One difficulty in evaluating these two investment strategies is that at the time the investment is made the exchange rate prevailing at the end of the period, S', is unknown. This means that $1+i$ and $(1+i^*)S'/S$ are not directly comparable because the former is known with certainty at the time the investment is made whereas the latter is uncertain at that time.

However, the investor can eliminate the exchange rate uncertainty by buying, at the beginning of the investment period, the necessary amount of U.S. dollars to be delivered at the end of the investment period for a price arranged at the beginning of the period. Such a foreign currency purchase is called a *forward contract*. Let F denote the forward rate, that is, the dollar price at the beginning of the period of 1 German mark delivered next period and to be paid next period. Then, the dollar return of a 1 dollar investment in Germany using the forward exchange market is $(1+i^*)F/S$. This return is known with certainty at the beginning of the investment period, making it comparable to the return on the domestic investment, $1+i$. Thus, under free capital mobility it must be the case that

$$1+i = (1+i^*)\frac{F}{S}$$

Note that if i is small, then the natural logarithm of $1+i$ is approximately equal to i.[5] Similarly, if i^* is small, then the log of $1+i^*$ is well approximated by i^*. Letting s and f denote, respectively, the natural logarithms of S and F, then we can rewrite the above expression as

$$i = i^* + f - s$$

The difference between the logs of the forward and the spot rates, which we will denote by fd, is called the forward discount, that is,

$$fd = f - s \tag{5.1}$$

The forward discount measures the percentage difference between the forward and the spot exchange rates. We can then write above expression as

$$i - i^* - fd = 0 \tag{5.2}$$

The left-hand side of this expression is known as the *covered interest rate differential*, or *country risk premium*. When the country risk premium is zero, we say that *covered interest rate parity* holds. In the absence of barriers to capital mobility, a violation of covered interest rate parity implies the existence of arbitrage opportunities. That is, the possibility of making

[5]For example, if i is 5 percent, then $\ln(1+i) = 0.0488$, or 4.88 percent.

unbounded amounts of profits by borrowing in one country and investing in another without taking on any risk. Consider the following example. Suppose that the annual nominal interest rate in the U.S. is 7% ($i = 0.07$), that the annual nominal interest rate in Germany is 3% ($i^* = 0.03$), that the spot exchange rate is \$0.5 per mark ($S = 0.5$), and that the 1-year forward exchange rate is \$0.51 per mark ($F = 0.51$). In this case, the forward discount is 2%, or $fd = \ln(0.51/0.50) \approx 0.02$. Thus, the covered interest rate differential is $2\% = 7\% - 3\% - 2\%$. In the absence of barriers to international capital mobility, this violation of covered interest parity implies that it is possible to make profits by borrowing in Germany, investing in the U.S., and buying marks in the forward market to eliminate the exchange rate risk. To see how one can exploit this situation consider the following sequence of trades. (1) borrow 1 mark in Germany. (2) exchange your mark in the spot market for \$0.5. (3) Invest the \$0.5 in U.S. assets. (4) buy 1.03 marks in the forward market (you will need this amount of marks to repay your mark loan including interest). Note that buying marks in the forward market involves no payment at this point. (5) After 1 year, your U.S. investment yields $1.07 \times \$0.5 = \$0.535$. (6) Execute your forward contract, that is, purchase 1.03 German marks for $0.51\$/DM \times DM1.03 = \$0.5253$. The difference between what you receive in (5) and what you pay in (6) is $\$0.535 - \$0.5253 = \$0.0097 > 0$. Note that this operation involved no risk (because you used the forward market to eliminate exchange rate risk), needed no initial capital, and yielded a pure profit of \$0.0097. It is clear from this example that the country premium should be zero if there are no barriers to capital flows.

Table 5.1 shows the covered interest rate average differential for four countries over the period 1982-1988. Germany and Switzerland have small country risk premia on average of less than 50 basis points. Thus, they were relatively open to international capital flows. By contrast, Mexico had an enormous negative country risk premium of over 16 percent. The period 1982-1988 corresponds to the post debt crisis period, when the financial sector in Mexico was nationalized. In France barriers to the movement of capital were in place until 1986, which explains the large average deviations from covered interest rate parity vis-a-vis the two other industrialized countries shown in the table. The fact that the country risk premia of France and Mexico are negative indicates that capital controls were preventing capital from flowing out of these countries.

Table 5.2 presents an alternative approach to computing covered interest rate differentials. It uses interest rate differentials between domestic deposit rates and Eurocurrency deposit rates. (See footnote 1 for a definition of Eu-

Table 5.1: Covered interest rate differentials for selected countries September 1982-January 1988

	$i - i^* - fd$	
	Mean	Std. Dev.
Germany	0.35	0.03
Switzerland	0.42	0.03
Mexico	-16.7	1.83
France	-1.74	0.32

The covered interest rate differential is measured by the domestic 3-month interest rate minus the 3-month Euro-dollar interest rate minus the forward discount. Source: J. Frankel, *"Quantifying International Capital Mobility in the 1980s,"* in D. Das, *International Finance*, Routledge, 1993, table 2.6.

rocurrency deposit rates.) For example, it compares 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. The table provides further evidence suggesting that the presence of capital controls leads to deviations from covered interest rate parity. It shows differences between domestic interbank and the corresponding Euro currency interest rate for France, Italy, Germany, and Japan from 1982 to 1993. In general, interest rate differentials are lower after 1987. This is most evident for France, where important capital market deregulation took place in 1986. In Italy, the high differential observed between 1990 and 1992 reflects market fears that capital controls might be imposed to avoid realignment of the lira, as an attempt to insulate the lira from speculative attacks, like the one that took place in August/September 1992. These violent speculative attacks, which affected a number of European economies, particularly, France, Sweden, Italy, and England, led to exchange rate realignments and a temporary suspension of the European Exchange Rate Mechanism (ERM) in September 1992. Once the ERM was reestablished, the lira interest rate differential falls as fears of capital controls vanish. Japan had large onshore/offshore differentials between February 1987 and June 1990, which were the result of the Bank of Japan's heavy use of administrative guidelines to hold interbank rates below offshore rates.

The empirical evidence we have examined thus far shows that countries

Table 5.2: International capital mobility in the 1990s
Domestic Interbank minus Eurocurrency 3-month interest rates: (in percent)

Country	1/1/82-1/31/87	2/1/87-6/30/90	7/1/90-5/31/92	6/1/92-4/30/93
France	-2.27	-.11	.08	-.01
Italy	-.50	.29	.56	.36
Germany	.17	.05	-.05	.07
Japan	-.07	-.60	.09	.17

Source: M. Obstfeld, *"International Capital Mobility in the 1990s,"* in Kenen, *Understanding Interdependence: The Macroeconomics of the Open Economy,* Princeton University Press, 1995, table 6.1.

that have little barriers to capital mobility also tend to have small country premia on assets with short maturities, typically 3 months. However, this finding also holds for assets with longer maturities. For example, the covered interest rate differential on five-year U.S. government bonds versus Japanese bonds averaged only 0.017 percentage points in the period 10/3/1985 to 7/10/1986, and the differential on 7-year bonds averaged only 0.053 percentage points. Over the same period, the mean differentials on 5-year bonds for Germany were 0.284 percentage points and 0.187 percentage points for Switzerland.[6] The magnitude of the covered interest rate differentials at these longer maturities is in line with those reported in table 5.1 for much shorter maturities, supporting the argument that under free capital mobility covered interest rate differentials should vanish.

5.2.2 Real interest rate differentials and capital market integration

In the two-period model developed in class, perfect capital mobility amounts to the domestic real interest rate r_1 being equal to the world interest rate r^*. This suggests that another way of testing for capital mobility could be to look at real interest rate differentials across countries. Table 5.3 shows real interest rate differentials, $r - r^*$, in the 1980s for four countries. The

[6]See, H. Popper, "International Capital Mobility: direct evidence from long-term currency swaps," IFDP # 386, Board of Governors of the Federal Reserve System, September 1990.

average real interest rate differential over the sample period was significantly different from zero and quite volatile, with the highest mean and standard deviation for Mexico, at the time a closed developing country. But there

Table 5.3: Real interest rate differentials for selected countries
September 1982-January 1988

	$r - r^*$	
	Mean	Std. Dev.
Germany	-1.29	.65
Switzerland	-2.72	.81
Mexico	-20.28	9.43
France	-0.48	.72

Note: The real interest rate differential ($r - r^*$) is measured by the local minus the Eurodollar 3-month real expost interest rate (that is, interest differential less realized inflation differential). Source: Jeffrey A. Frankel, "Quantifying International Capital Mobility in the 1980s," in D. Das, *International Finance*, Routledge, 1993, table 2.5.

seems to be a puzzle in the data shown in the table. For example, open developed economies such as Switzerland and Germany had large negative real interest rate differentials, while France had a much smaller real interest rate differential despite the fact that it had significant capital controls in place over most of the sample period. This suggests that real interest rate differentials as a measure of international capital mobility seem to be missing something.

As will become clear soon, in reality, real interest rate differentials are not good indicators of the degree of capital mobility. They represent a good measure of international capital mobility *only if* the relative price of consumption baskets across countries does not change over time and if there is no nominal exchange rate uncertainty or if people don't care about that kind of risk. The first two conditions are met in our simple two-period model. In that model, there is only one good, which is assumed to be freely traded across countries. Thus, the relative price of consumption baskets across countries is constant and equal to one. In addition in that model there is no uncertainty, and in particular no exchange rate risk.

To show that in actual data capital mobility need not imply a zero real interest rate differential, we decompose the real interest rate differential into three components. We begin by noting that the real interest rate is given by the difference between the nominal interest rate and expected inflation, that is,

$$r = i - \pi^e \tag{5.3}$$

where r denotes the real interest rate, i denotes the nominal interest rate, and π^e denotes expected inflation. This relationship is often referred to as the Fisher equation. A similar relation must hold in the foreign country, that is,

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

where starred variables refer to variables in the foreign country. Taking the difference of the domestic and foreign Fisher equations, we obtain,

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

We will manipulate this expression to obtain a decomposition of the real interest rate differential, $r - r^*$, into three terms reflecting: (i) the degree of capital mobility; (ii) nominal exchange rate risk; and (iii) expected changes in relative prices across countries. For illustrative purposes, let the U.S. be the domestic country and Germany the foreign country. As above, let S be the spot nominal exchange rate defined as the price of 1 German mark in terms of U.S. dollars and let S^e be the nominal exchange rate expected to prevail next period. Also, let F denote the forward rate. Let s, s^e, and f denote, respectively, the logs of S, S^e, and F. Add and subtract $s + s^e + f$ to the right hand side of the above expression and rearrange terms to get

$$r - r^* = (i - i^* - fd) + (f - s^e) + (s^e - s + \pi^{*e} - \pi^e), \tag{5.4}$$

where we use the fact that $f - s$ equals the forward discount fd. The first term on the right-hand side of this expression is the covered interest rate differential. This term is zero if the country enjoys free capital mobility. However, the above expression shows that the real interest rate differential may not be equal to the covered interest rate differential if the sum of the second and third terms on the right-hand side is different from zero. To the extent that the sum of these two terms deviates significantly from zero, the real interest rate differential will be a poor indictor of the degree of capital market integration. This point is illustrated in table 5.4, which shows the decomposition of the real interest rate differential for Germany, Switzerland, France, and Mexico.

Table 5.4: Decomposition of the real interest rate differential for selected countries: September 1982 to January 1988

Country	$r - r^*$	$i - i^* - fd$ (1)	$f - s^e$ (2)	$s^e - s + \pi^{*e} - \pi^e$ (3)
Germany	-1.29	.35	4.11	-6.35
Switzerland	-2.72	.42	3.98	-8.35
France	-.48	-1.74	7.47	-6.26
Mexico	-20.28	-16.47	6.04	-3.32

Note: Columns (1), (2), and (3) do not add up to $r - r^*$ because in constructing (2) and (3) s^e, which is not directly observable, was proxied by the actual one-period-ahead spot exchange rate. Source: J. Frankel, *"Quantifying International Capital Mobility in the 1980s,"* in D. Das, *International Finance*, Routledge, 1993, tables 2.5, 2.6, 2.8, and 2.9.

We next discuss in more detail the factors that introduce a wedge between real and covered interest rate differentials. We begin by analyzing the second term on right-hand side of (5.4), $f - s^e$, which we will call *exchange risk premium.* Then we will study the meaning of the third term, $s^e - s + \pi^{*e} - \pi^e$, which is known as the *expected real depreciation.*

5.2.3 Exchange Risk Premium ($f - s^e$)

The exchange risk premium measures the percentage difference between the forward and the expected future spot exchange rates. It depends on the degree of uncertainty about future exchange rates as well as on people's attitudes towards risk. If there is no uncertainty about future exchange rates, then $S^e = F$ and the exchange risk premium is therefore zero. If investors are risk neutral, then all people care about is expected returns. In particular, if S^e is, say, higher than F, then people would find it advantageous to buy marks in the forward market, which yields an expected profit of $S^e - F > 0$. Thus, agents would demand unbounded amounts of forward marks, driving F up until it is equal to S^e. Consequently, under risk neutrality $F = S^e$, or the exchange risk premium is zero. But typically the exchange risk premium is not zero reflecting the fact that neither of the two aforementioned assumptions hold. For example, column (2) of table 5.4 shows an estimate of the average exchange rate risk premium for Germany, Switzerland, France and Mexico over the period September 1982 to January 1988 using monthly data. For all countries the exchange risk premium is positive and high, ranging from 4 percentage points for Switzerland to 7.5 percentage points for France.

5.2.4 Expected Real Depreciation, $s^e - s + \pi^{*e} - \pi^e$

The third term on the right-hand side of (5.4) is related to expected changes in the relative price of consumption baskets in the domestic (US) and the foreign (German) country. The relative price of a German consumption basket in terms of a US consumption basket is known as the real exchange rate. We will denote the real exchange rate by e. Formally, e is given by

$$e = \frac{S \cdot P^*}{P}, \tag{5.5}$$

where P^* is the mark price of a German consumption basket and P is the dollar price of a US consumption basket. An increase in e means that Germany becomes more expensive relative to the U.S.. In this case, we say that the U.S. dollar experiences a *real depreciation* because one needs more U.S. consumption baskets to purchase one German basket. Similarly, a decline in e is referred to as a *real appreciation* of the U.S. dollar. Letting p and p^* denote the logs of P and P^*, we have

$$\ln e = s + p^* - p$$

The expectation of the log of the real exchange rate next period is similarly given by

$$\ln e^e = s^e + p^{*e} - p^e,$$

where the superscript ^{e} denotes expected value next period. It follows from the above two expressions that

$$\ln e^e - \ln e = (s^e - s) + (p^{*e} - p^*) - (p^e - p).$$

The left-hand side of this expression is the expected percentage depreciation of the real exchange rate, which we will denote by $\%\Delta e^e$. The first term on the right-hand side is the expected depreciation of the spot (or nominal) exchange rate. The second and third terms represent, respectively, expected consumer price inflation in the foreign (German) and the domestic

(US) economies, π^{*e} and π^e. Thus, we can express the expected percentage increase in e as

$$\%\Delta e^e = s^e - s + \pi^{*e} - \pi^e, \tag{5.6}$$

Using (5.1) and (5.6) we can write the real interest rate differential given in (5.4) as

$$r - r^* = (i - i^* - fd) + (f - s^e) + \%\Delta e^e \tag{5.7}$$

This expression says that the real interest rate differential can be decomposed into the country premium, the exchange risk premium, and the expected depreciation of the real exchange rate. We use the following terminology:

- If $i - i^* - fd > 0$, we say that the country premium is positive.
- If $f - s^e > 0$, we say that the exchange risk premium is positive.
- If $\%\Delta e^e > 0$, we say that the real exchange rate is expected to depreciate.

As we mentioned earlier, the real exchange rate, $e \equiv SP^*/P$, is the relative price of a basket of consumption in the foreign country in terms of a basket of consumption in the domestic country. Suppose that the baskets of consumption in both countries contained only one good, say wheat, and that the good is freely traded between the two countries. Then the price of wheat in the U.S., P, must equal the dollar price of buying wheat in Germany, which is given by P^*, the price of wheat in German marks, times S, the nominal exchange rate; that is, $P = P^*S$. Thus, in this case the real exchange rate, e, is identically equal to 1 in every period. When $e = 1$, we say that ***purchasing power parity*** (PPP) holds. Clearly, if PPP holds, then the expected real depreciation, $\%\Delta e^e$, is equal to zero because the real exchange rate is always expected to be equal to 1. In the 2-period model we have been studying thus far, there is only one good, which is freely traded in world markets. Thus, in our model, PPP holds.

In reality, however, PPP does not hold. Column (3) of table 5.4 shows that the German mark experienced a real appreciation of 6.3% per year vis-a-vis the US dollar over the period September 1982 to January 1988. This means that a basket of consumption in Germany became more expensive than a basket of consumption in the United States over the period considered. A similar pattern emerges for the other countries included in the table. In fact, for Germany and Switzerland, which had free capital mobility in the period covered by the table, the expected real appreciation explains the observed negative real interest rate differential. This is because for these two economies, the country premium is negligible and the exchange risk premium was positive.

But why does PPP not hold? An important reason is that the assumption that all goods are freely traded across countries, which we used to construct the wheat example, is counterfactual. In the real world there is a large number of goods that are not traded internationally, such as haircuts, housing, ground transportation, and so forth. We refer to these goods as *nontradables*. Also, barriers to international trade, such as import tariffs and quotas, introduce a wedge between the domestic and foreign prices of goods and services. We will explore the factors affecting the determination of the real exchange rate in more detail in the next chapter.

We conclude this section by reiterating that the real interest rate differential, $r - r^*$, is in general not a true measure of international capital mobility. Capital mobility is better measured by deviations from covered interest rate parity $(i - i^* - fd)$. In the 2-period model we studied in previous chapters, there is only one good in each period, which is freely traded across countries and there is no exchange rate uncertainty. Thus, in our model both the exchange risk premium and expected real depreciation are equal to zero. This means that our model represents a special case in which real interest rate parity implies free capital mobility.