CHAPTER 5. FOREIGN EXCHANGE AND INTEREST RATES

Traditional Uncovered Interest Rate Parity (UIRP)

In the section, we cover the traditional version of the UIRP condition. The traditional UIRP condition is also sometimes called the ***International Fisher Equation*** or the ***Fisher Open Equation***, after the economist Irving Fisher.

Traditional UIRP Condition: the current spot FX rate should be aligned with interest rates and the expected future spot FX rate.

The **FX Rate Form** of the UIRP theory is shown in equation (5.1) where r^{Sf} and $r^{\$}$ are the annualized interest rate on a zero-coupon eurocurrency instrument between now and time *N*.

Traditional Uncovered Interest Rate Parity (UIRP) Condition (FX Rate Form)

$$E\left(X_N^{Sf/\$}\right) = X_0^{uSf/\$}\left[\frac{(1 + r^{Sf})}{(1 + r^{\$})}\right]^N \qquad \textbf{(5.1)}$$

$E(X_N^{Sf/\$})$: expected future spot FX rate
$X_0^{uSf/\$}$: **current spot FX rate** that *should* prevail if the UIRP condition holds
(instead of the actual spot FX rate found in the CIRP equation).
u : superscript denotes a spot FX rate that would be observed only if the UIRP condition holds.

Equation (5.1) is set up to allow the comparison to the CIRP condition.
The variable we want to solve for is $X_0^{uSf/\$}$ on the right side.
$E(X_1^{Sf/\$})$: take as given.

Example: let $N = 1$, $r^{Sf} = 0.04$, $r^{\$} = 0.06$, and $E(X_1^{Sf/\$}) =$ **1.57 Sf/\$**. Solve for $X_0^{uSf/\$}$.
UIRP condition (eq. 5.1) says that today's spot FX rate should be $X_0^{uSf/\$} = 1.60$ Sf/\$.
Figure 5.1 lays out the details of this example.

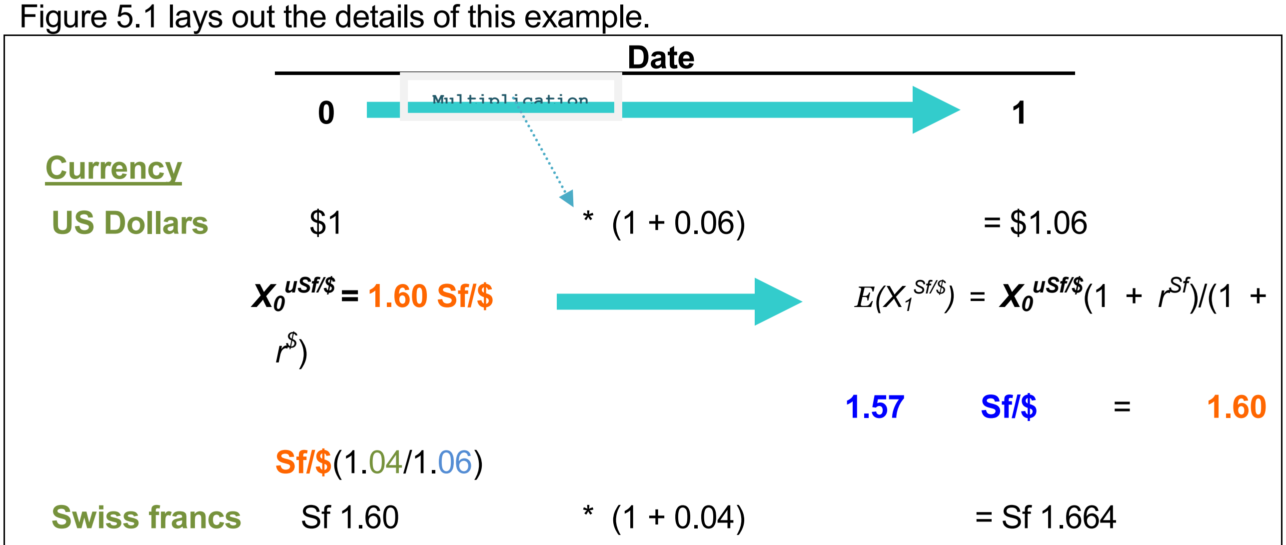

Figure 5.1 The traditional uncovered interest rate parity (UIRP) condition where $N = 1$, $r^{Sf} =$

0.04, $r^{\$} = 0.06$, and $E(X_1^{Sf/\$}) = 1.57$ Sf/\$. The traditional UIRP condition holds if $\boldsymbol{X_0^{uSf/\$}}$ **= 1.60 Sf/\$**, because $E(X_1^{Sf/\$}) = 1.57$ Sf/\$ = **1.60 Sf/\$**(1.04/1.06).

The one-year interest rate in US dollars is 7% and in yen is 2%. The expected spot FX for a year from now is 104 ¥/\$. What should be the spot FX rate now if the traditional UIRP condition holds?

Answer: *You want to find* $X_0^{u¥/\$}$ *such that*

$E(X_1^{¥/\$}) = 104\ ¥/\$ = X_0^{u¥/\$}[(1 + r^{¥})/(1 + r^{\$})] = X_0^{u¥/\$}(1.02/1.07)$.

Thus, $X_0^{u¥/\$} = 109.10\ ¥/\$$.

Asserting that the traditional UIRP condition holds means that **today's actual spot FX rate**, $X_0^{Sf/\$}$, **is equal to the UIRP parity spot FX rate**, $X_0^{uSf/\$}$.

Since we have already argued in Chapter 3 that the CIRP condition is empirically reliable, we'll take the CIRP condition as given. And given the CIRP condition, asserting that **the traditional UIRP condition holds** is mathematically equivalent to asserting that **the forward FX rate,** $F_N^{Sf/\$}$**, is equal to the expected future spot FX rate,** $E(X_N^{Sf/\$})$.

Explain why:

So another way of saying that the traditional UIRP condition holds is that the forward FX rate is equal to the expected spot FX rate, and vice versa.

So another way of saying that the traditional UIRP condition holds is that the forward FX rate is equal to the expected spot FX rate, and vice versa.

The argument made by economists supporting the UIRP theory is that alert traders in the FX market will quickly exploit any speculative profit opportunities that they think are available. If the Swiss franc has a lower forward FX price than expected future spot FX price, the **traders will presumably go long forward on Swiss francs, locking in a low FX price today** for buying Swiss francs in the future, and expecting to profit from the higher realized FX price of Swiss francs at that future time. In this **theory**, **the pressure of the speculative trading will force the forward FX rate to be aligned with the expected spot FX rate**, and thus today's actual spot FX rate to be aligned with the spot FX rate that should hold according to the traditional UIRP condition.

Note that if the traditional UIRP condition holds, the expected change in the spot FX rate is aligned with the interest rate differential.

The currency with the **higher interest rate** is expected to **depreciate**, just as …
The currency with the **higher interest rate** is at a **forward discount** under the CIRP condition.

This result can seem counter-intuitive. Remember, the UIRP theory presumes that the current spot FX rate is ***already in equilibrium***, in the sense that all potential speculative profit opportunities have already been exploited.

If the currency with the higher interest rate were expected to appreciate, meaning the currency with the lower interest rate is expected to depreciate, this would not be an equilibrium situation, because money everywhere would shift from the lower interest rate currency to the higher interest rate currency. Movement like this would cause the spot FX price of the higher interest rate currency to rise until an equilibrium point is reached where money would quit shifting.

Equilibrium: the spot FX price of the high interest rate currency has already been bid up high enough so that the expected future depreciation of the currency leaves investors indifferent between interest-bearing deposits in the two currencies.

The Forward Premium Puzzle

Empirical studies designed to test the **Traditional UIRP Theory** with actual data check whether forward discounts and premiums have been good predictors of actual subsequent spot FX rate movements. **The studies test the implication of the theory that a currency with a higher interest rate tends to depreciate relative to a currency with a lower interest rate**.

The results of these empirical studies, however, are often the *opposite* of what the UIRP relationship would predict. On average …

Currencies at a **forward premium (lower interest rate)** have tended to **subsequently depreciate in FX price**, exactly the opposite of the UIRP prediction.

Currencies at a **forward discount (higher interest rate)** have on average **appreciated**, contrary to the UIRP prediction.

These empirical findings that appear contrary to the UIRP condition are known as the ***Forward Premium Puzzle*** (see figure 5.2).

Example: the euro was at a forward premium (there were lower euro interest rates than US dollar interest rates), and the euro subsequently depreciated in 1999-2000.

	UIRP CONDITION	**EMPIRICAL EVIDENCE**
Higher Interest Rate Currency	↓	↑
Lower Interest Rate Currency	↑	↓

Figure 5.2 Summary of the Forward Premium Puzzle The arrows show the direction of change in spot FX rates. The **UIRP condition implies that**:

The currency with the higher interest rate will tend to **depreciate.**
The currency with the lower interest rate will tend to **appreciate**.
Empirical evidence is that the opposite tends to happen!

The forward premium puzzle mainly occurs for currencies of developed countries and mainly when the US dollar has the higher interest rate.

The UIRP prediction of a drop in the FX price of a currency with the higher interest rate is more reliable when an emerging market country is involved. This is expected since higher interest rates are more likely to reflect higher inflation rates in emerging market countries.

The reported empirical evidence of the forward premium puzzle is consistent with a common speculative strategy called a ***Currency Carry Trade***, or often simply a ***Carry Trade***. In this trade, a speculator will borrow in a low interest rate currency and deposit the exchanged proceeds into a high interest rate currency. The speculator lays out no capital, basically creating a synthetic long forward FX position on the higher interest rate currency.

CARRY TRADE:

- **Borrow Low Interest Rate Currency**
- **Spot FX to the High Interest Rate Currency**
- **Deposit in High Interest Rate Currency**

If the UIRP condition holds, speculators would not expect to profit from carry trades because a higher interest rate currency presumably would tend to decline.

So speculators doing carry trades, and many do, believe that the actual spot FX rate and the interest rates are not (yet) consistent with the UIRP condition.

Of course, the Carry Trade is a synthetic long forward FX position on the higher interest currency.

Perhaps carry trades are popular than actual forward FX positions because carry trades look more like a “respectable” investment strategy.

The traditional **UIRP relationship** is fundamentally very different from the **CIRP condition**.

The **CIRP condition** is a no-arbitrage financial relationship; if it is violated, traders can earn immediate, guaranteed profit through an easy and inexpensive arbitrage using traded instruments. For this reason, the CIRP condition reliably fits actual data, at least for developed country currencies.

The traditional **UIRP condition** is an economic theory; it is based on much more vague and less realistic notions. And ***empirical research does not support the UIRP condition*** as a fit with actual data.

Possible Reasons for the Forward Premium Puzzle

Forward Premium Puzzle evidence and the speculators' carry trades suggest that the traditional UIRP condition does not always hold. But we do not know the reason.

One possibility is that market participants **systematically underestimate the expected spot FX price** of the higher interest rate currency. We can think of an environment where the theory behind the UIRP works, but with the market's expected spot FX price rather than the true expected spot FX price.

If traders underestimate the expected spot FX rate,
they may think the UIRP condition holds when it does not.

Example: assume $N = 1$, $r^{Sf} = 0.04$, $r^{\$} = 0.06$, and $E(X_1^{Sf/\$}) = 1.57$ Sf/$.
Say traders underestimate the expected **future** FX price of the US dollar and think it is 1.50 Sf/$ instead of the true expected FX rate of 1.57 Sf/$.

Using equation (5.1), the traditional UIRP condition says that **today's** spot FX rate should be $X_0^{uSf/\$} = 1.53$ Sf/$.

Empirical tests will find that **the higher interest rate currency**, the US dollar, **tends to appreciate rather than depreciate**.

Note that it is tempting to regard the forward FX rate as a forecast. This assumption is equivalent to assuming that the UIRP condition holds, so traders who make this assumption would not engage in the trading that is supposed to enforce the UIRP condition. The more that FX market participants use forward FX rate as the source of their FX forecast, the more that the theoretical basis of the UIRP condition would be tautologically empty. The reason is that the UIRP condition (that the forward FX rate is equal to the expected spot FX rate) can only work if enough market participants make informed speculative trades using FX forecasts based on fundamental economic factors, not on the forecasts of the UIRP equation itself.

Another possible reason for the empirical forward premium puzzle result is that speculators' trading activity is insufficient to enforce the UIRP equilibrium because other forces tug the spot FX rate in the opposite direction.

Example: let $N = 1$, $r^{Sf} = 0.04$, $r^{\$} = 0.06$, and $E(X_1^{Sf/\$}) = 1.57$ Sf/$, so that the traditional **UIRP** condition says that **today's spot FX rate should be $X_0^{uSf/\$} = 1.60$ Sf/$**.
What if the **APPP** condition of Chapter 4 says that **today's spot FX rate should be 1.52 Sf/$**?

There will be pressure from the **goods market** that draws the actual spot FX rate toward 1.52 Sf/$ and pressure from the **asset market** that draws the actual spot FX rate toward 1.60 Sf/$.

Sf is stronger force
(against the dollar).

There is no way we can say which effect will "win". But if the actual spot FX rate is somewhere between 1.52 Sf/$ and 1.60 Sf/$ (say it is 1.56 Sf/$) it would not be a big surprise.

An actual time-0 spot FX rate of 1.56 Sf/$ is consistent with neither the UIRP condition nor the APPP condition. **The spot Swiss franc is undervalued relative to the goods market because the actual spot FX rate of 1.56 Sf/$ represents a lower FX price for the Swiss franc than what the APPP condition says it should be, 1.52 Sf/$.** The spot Swiss franc is overvalued relative to the asset market because the actual spot FX rate of 1.56 Sf/$ represents a higher FX price for the Swiss franc than what the UIRP condition says it should be, 1.60 Sf/$.

Note that the expected movement in the spot FX rate, from 1.56 Sf/$ to 1.57 Sf/$, would be consistent with the empirical findings of the forward premium puzzle that the higher interest rate **currency** tends to **appreciate**.

Moreover, if the expected spot FX rate for time 1, 1.57 Sf/$, is based on the APPP condition holding at time 1, this scenario is consistent with the **empirical evidence that APPP violations tend to diminish**. This analysis does not affect the **CIRP condition**, which we assume always holds for developed country currencies.

If the actual spot FX rate is **1.56 Sf/$**, we know the
actual one-year forward FX rate: $F_1^{Sf/\$}$ = (1.56 Sf/$)(1.04/1.06) = **1.53 Sf/$**
which does not equal the assumed expected spot FX rate of **1.57 Sf/$**.

Speculators taking risk in the trading strategy that is supposed to enforce the traditional UIRP condition and might lose money. There is no guarantee of profit on a given trade since the eventual spot FX rate is uncertain and might result in a loss. This is different than covered interest arbitrage where a trader can arrange a *guaranteed* profit, with no risk, if a deviation from the CIRP condition exists. Because a speculative trader only *expects* a profit (but not guaranteed a profit) the trading activity is called **"uncovered"**. Shortly, we'll cover an adjustment that would allow the uncovered speculative trading strategy to expect some compensation for the risk, and we'll call the resulting UIRP condition the ***risk-adjusted UIRP condition*** (as opposed to the traditional UIRP condition that does not consider the issue of FX risk). But the adjustment for FX risk is not major, and researchers have not thought it would explain the forward premium puzzle, (research is ongoing).

A technical issue with the traditional UIRP condition relates to Siegel's paradox. Recall that **Siegel's paradox** reveals that **expectations do not reciprocate**. This causes an immediate problem with the theory that forward FX rates are equal to expected spot FX rates.

Suppose that the forward FX rate *is* equal to the expected spot FX rate from the direction of $/Sf. In that case, the forward FX rate expressed in Sf/$ *cannot* equal the expected spot FX rate expressed in Sf/$. That is, $F_N^{\$/Sf} = 1/F_N^{Sf/\$}$, but we since know from Siegel's paradox that $E(X_N^{\$/Sf}) \neq 1/E(X_N^{Sf/\$})$, the forward FX rate *cannot* be equal to the expected spot FX rate from both currency directions. Since the choice of currency direction viewpoint is arbitrary, Siegel's paradox is a mathematical problem for the traditional UIRP theory that forward FX rates represent expected spot FX rates. But the issue of Siegel's paradox is not major, and would not explain the forward premium puzzle.

Despite the lack of fit with actual data, the UIRP condition is a very useful model. This is somewhat similar to the CAPM. We can use these models to help understand forces that drive markets and prices. We use the traditional UIRP condition for such a task in the next section. Also, **just as the CAPM tells us what an asset's expected rate of return should be, and would be if the asset is correctly valued, the UIRP condition tells us what a currency's expected rate of change should be, and would be if the current spot FX rate is correctly valued**. This will be very important in the rest of the text.

The one-year interest rate in US dollars is 7% and in yen is 2%. The expected spot FX for a year from now is 104 ¥/$. We know that today's spot FX rate should be 109.10 ¥/$ if the traditional UIRP condition holds. Assume the actual spot FX rate is 100 ¥/$. A) Is the yen overvalued or undervalued relative to the asset market? B) Is the expected change in the FX rate consistent or inconsistent with the forward premium puzzle findings?

Answers:
A) The yen is overvalued relative to the asset market.
B) The yen is expected to depreciate, despite having the lower interest rate, which is consistent with the forward premium puzzle findings.

Interest Rate Changes and FX Rates

We now use the traditional UIRP model to analyze the following issue: **If an interest rate abruptly changes, what will be the impact on the spot FX rate**? To address this question, we **assume the traditional UIRP condition holds**. This exercise is meant to help us better understand the dynamic forces that affect FX rates.

Example: assume the one-year r^{Sf} = 4%, the one-year $r^{\$}$ = 6%, and the expected spot FX rate for a year from now is $E(X_1^{Sf/\$})$ = 1.57 Sf/$.

Assume the traditional UIRP condition holds, so that the current spot FX rate $X_0^{Sf/\$}$ = 1.60 Sf/$. Let the one-year Swiss franc interest rate unexpectedly rise from 4% to 4.50%.
What do you expect to happen to the spot FX rate?

There are **two polar extremes of economic theory** on how an interest rate change affects FX rates. They are referred to as the ***Asset Market Theory*** and the ***Fisher Theory***.

ASSET MARKET THEORY: interest rate changes ***are not*** driven by changes in expected inflation. *Under the asset market theory*, ***THE INTEREST RATE CHANGE AFFECTS THE CURRENT SPOT FX RATE*, AND THE EXPECTED FUTURE SPOT FX RATE IS NOT AFFECTED**.

Asset Market Theory

Current Spot FX Rate Responds to

Interest Rate Change, **NOT** Driven by **Inflation Change**

Asset Market Theory: suppose that the unexpected increase of 50 basis points in the Swiss franc interest rate from 4% to 4.50% is because productive Swiss firms unexpectedly need much more capital to exploit profitable economic opportunities. In this case, the asset market theory applies because the interest rate change is not driven by a change in inflation expectations.

UIRP Model

The result of the interest rate change is that the spot FX price of the Swiss franc will immediately appreciate. The reason is that capital in the asset market will flow into Swiss francs to capture the high potential that Swiss investments seem likely to offer.

If $E(X_1^{Sf/\$})$ stays at 1.57 Sf/$, the new current spot FX rate that will re-establish the UIRP condition, given the new Swiss franc interest rate of 4.50%, can be found using equation (5.1),

$$1.57\ Sf/\$ = X_0^{Sf/\$}(1.045/1.06),\quad \text{(eq. 5.1)}$$

implying the *new* $X_0^{Sf/\$}$ = 1.592 Sf/$. In this case, the spot FX price of the Swiss franc rises, since the current spot FX rate changes from 1.60 Sf/$ to 1.592 Sf/$, when r^{Sf} unexpectedly rises from 4% to 4.50%.

The spot FX change to the new equilibrium takes place "instantaneously" in the present time. Since the predicted spot FX rate for one year from now is unchanged, the US dollar is still predicted to depreciate gradually to 1.57 Sf/$. At the new current spot FX rate of 1.592 Sf/$, however, the US dollar is now predicted to depreciate at a lower gradual rate between time 0 and time 1, reflecting the fact that the differential between US dollar and Swiss franc interest rates is less than it was.

A similar asset market scenario occurs if the increase in the Swiss franc interest rate is due to an increase in the Swiss franc discount rate by the Swiss central bank. Often an increase in the short-term interest rate by a central bank is designed to help raise the current spot FX price of the currency. The higher interest rate attracts foreign investors; movement of funds into the currency results in buying pressure on the currency and causes the current spot FX price to increase. If the central bank's interest rate policy causes the one-year Swiss franc interest rate to unexpectedly rise from 4.0% to 4.5%, the new spot FX rate would be the same as the one we just calculated, 1.592 Sf/$.

Figure 5.3 shows the **Asset Market Theory**. The bold spot FX rate at time 0 is the UIRP variable that responds to the interest rate change in the asset market theory.

Date

0 → **1**

Currency

US Dollars $1 x (1 + 0.06) = $1.06

New $\boldsymbol{X_0^{Sf/\$}}$ **= 1.592 Sf/$** → $E(X_1^{Sf/\$}) = \boldsymbol{X_0^{Sf/\$}}(1 + r^{Sf})/(1 + r^{\$})$

= **1.592 Sf/$**(**1.045**/1.06) = 1.57 Sf/$

Swiss francs **Sf 1.592** x (1 + **0.045**) = Sf 1.664

Figure 5.3 Asset Market Theory, showing the traditional UIRP condition where

$N = 1$, $r^{Sf} = 0.045$, $r^{\$} = 0.06$, $\boldsymbol{X_0^{Sf/\$}}$ **= 1.592 Sf/$**, and $E(X_1^{Sf/\$}) = 1.57$ Sf/$.

The traditional UIRP condition holds because $E(X_1^{Sf/\$}) = 1.57$ Sf/$ = (**1.592 Sf/$**)(1.045/1.06).

FISHER THEORY: interest rate changes ***are*** driven by changes in expected inflation. Fisher theory, where inflation rate changes drive interest rate changes, is thus basically a ***goods market theory***. ***Interest rate changes affect the expected future spot FX rate under the Fisher theory***, while the current spot FX rate is not affected.

UIRP Model!

Fisher Theory (Goods Market)
Expected Future FX Rate Responds to
Interest Rate Change **Driven by Inflation Change**

Now let's look at the Fisher theory. Assume that the cause of the unexpected Swiss franc interest rate increase, from r^{Sf} = 4% to 4.50%, is new information about an increase in the anticipated Swiss inflation rate. In this case**, there is (theoretically) *no* immediate reaction in the spot FX market. Instead, the increase in inflation will dictate a lower expected future FX value of the Swiss franc**. You can see this by recalling the purchasing power parity (PPP) ideas of Chapter 4.

Underlying the Fisher theory is the assumption that the real rate of interest is the same across countries.

Using a linear approximation:

Real Rate of Interest = the Nominal Rate of Interest - Inflation Rate

United States real rate of interest: $r^{\$} – E(p^{\$})$, Switzerland real rate of interest $r^{Sf} – E(p^{Sf})$.

Equating the two real rates results in the:

International Fisher Relation: $r^{\$} – E(p^{\$}) = r^{Sf} – E(p^{Sf})$

If the real rates of interest are always equal across countries, then an increase in expected inflation results in an increase in the nominal rate of interest.

In our example, before the increase in the expected inflation rate, the Swiss franc was expected to gradually increase in spot FX price, from a spot FX rate of 1.60 Sf/$ today to 1.57 Sf/$ a year from now.

If the anticipated Swiss inflation rate for the next year suddenly increases, the expectation of the Swiss franc's future FX price will be revised downward from the current expectation of 1.57 Sf/$, based on a PPP argument.

Given that the interest rate change exactly reflects the change in inflation expectations, the impact of the change is on the expected future FX rate, not on the spot FX rate today.

So the current spot FX rate remains at 1.60 Sf/$. We may deduce from the UIRP condition in **equation (5.1)** that **the new expected future spot FX rate is 1.60 Sf/$(1.045/1.06) = 1.58 Sf/$**. This represents a lower expected FX price of the Swiss franc than the initial expectation, 1.57 Sf/$.

Figure 5.4 shows the Fisher theory. The bold expected future spot FX rate is the UIRP variable that responds to the interest rate change in the Fisher theory.

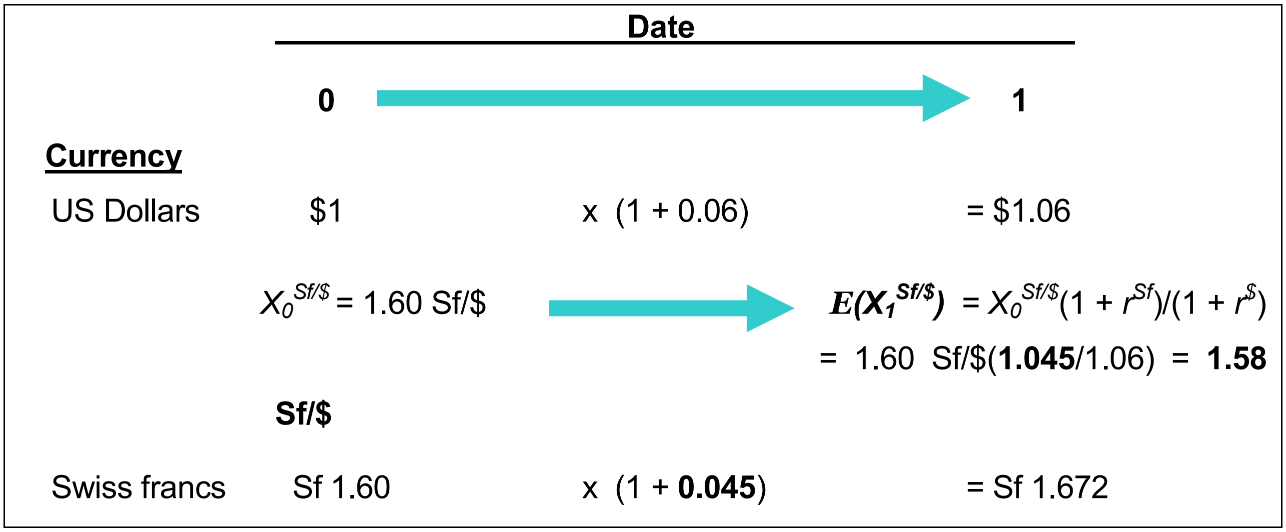

Figure 5.4 Fisher theory, showing the traditional UIRP condition where $N = 1$, $r^{Sf} = 0.045$, $r^{\$} = 0.06$, $X_0^{Sf/\$} = 1.60$ Sf/$, and $\mathbf{E(X_1^{Sf/\$}) = 1.58}$ **Sf/$**. The traditional UIRP condition holds because $E(X_1^{Sf/\$}) = 1.58$ Sf/$ = 1.60 Sf/$(1.045/1.06).

Assume that the spot FX rate for the British pound is currently 1.60 $/£. Assume initially that the one-year US dollar interest rate is 5% and that the 1-year sterling interest rate is 10%. Now let the one-year US dollar interest rate stay at 5% and assume that the one-year sterling interest rate jumps unexpectedly to 12%. (1) Use the traditional UIRP condition in equation (5.1) to determine what spot FX rate change occurs, if any, assuming the asset market theory. (2) If the change in the sterling interest rate is due to revised inflation expectations (Fisher theory), what is the impact on the current spot FX rate, if any?

Answers:

(1) *Given the traditional UIRP condition, the original expected FX rate is (1.60 $/£)(1.05/1.10) = 1.527 $/£. If the sterling interest rate jumps to 12%, the new time-0 spot FX rate is (1.527 $/£)/(1.05/1.12) = 1.63 $/£. This answer means that the spot FX price of the pound is higher (1.63 $/£, compared to 1.60 $/£). This spot FX change takes place "instantaneously." Since the predicted spot FX price of the pound one year from now is unchanged and is still 1.527 $/£, then over the next year, the pound is still predicted to depreciate gradually to 1.527 $/£. At the new current spot FX rate of 1.63 $/£, however, the pound is now predicted to depreciate by a greater amount between time 0 and time 1, consistent with the fact that the new interest rate on sterling deposits is higher than on US dollar deposits by an even bigger difference.*

(2) *If the unexpected rise in the sterling interest rate is due to a revision of inflation expectations, the current spot FX rate is theoretically unchanged, but the expected future FX price of the British pound is revised downward to (1.60 $/£)(1.05/1.12) = 1.50 $/£.*

In reality, the impact of an interest rate change may be more complex than either the asset market theory or the Fisher theory can explain. The interest rate change can simultaneously affect both the spot FX rate and the expected spot FX rate, perhaps by affecting other economic variables that are not explicit in the UIRP condition. In some cases, an interest rate increase can slow an economy (perhaps by design of the monetary authorities). If so, investors may revise their expected future FX price of the currency downward without thinking in terms of inflation. This result could in turn lead to a decline in the current spot FX price of the currency.

Canada experienced this kind of effect in the early 1990s. The Bank of Canada raised short-term interest rates, intending to prop up the Canadian dollar, but the FX market perceived the interest rate hike as being so negative for the Canadian economy that the spot FX price of the Canadian dollar actually fell in response. In 2000, the FX price of the euro similarly fell when the European Central Bank (ECB) announced it would raise short-term interest rates. The market expected the move to hinder economic growth (see the box “August 2000”).

In summary, the actual impact of a change in an interest rate depends on
1) the cause of the interest rate change and
2) the anticipated collateral impact of the change on other economic variables that relate to FX rates.

Equilibrium Expected Rate of FX Change

As we know, **EQUILIBRIUM IN FINANCIAL MARKETS MEANS THAT FINANCIAL ASSETS AND SECURITIES ARE CORRECTLY VALUED**. If the traditional UIRP condition is the correct model of FX value in the financial market, then it would tell us the:

Equilibrium Expected Rate of FX Change: $E^*(x_N^{Sf/\$})$.

More specifically, the notation $E^*(x_N^{Sf/\$})$ denotes the expected annualized percentage change in the FX price of the US dollar relative to the Swiss franc, between now and time N, given that the FX market is in equilibrium with the financial markets. If the traditional UIRP condition is the correct model of FX value in the financial market, then:

Equilibrium Expected Rate of FX Change (annualized): $[\frac{E\left(X_N^{Sf/\$}\right)}{X_0^{uSf/\$}} - 1]^{(1/N)}$

From equation (5.1), we thus have:

$$1 + E^*\left(x_N^{Sf/\$}\right) = \frac{\left(1 + r^{Sf}\right)}{\left(1 + r^{\$}\right)}$$

It is useful to express this relationship as a **LINEAR APPROXIMATION** version, as in equation (5.2):

Equilibrium Expected Rate of FX Change

Linear Approximation—Annualized, Traditional UIRP Condition

$$E^*(x_N^{Sf/\$}) = r^{Sf} - r^{\$} \qquad (5.2)$$

Example: assume $N = 1$, $r^{Sf} = 0.04$, $r^{\$} = 0.06$, and $E(X_1^{Sf/\$}) = 1.57$ Sf/$. Thus the traditional UIRP condition in equation (5.1) says that today's spot FX rate should be $X_0^{uSf/\$} = 1.60$ Sf/$.
The equilibrium expected rate of FX change, given that the traditional UIRP condition holds, is (1.57 Sf/$)/(1.60 Sf/$) – 1 = –0.019, or –1.9%. The linear approximation in equation (5.2) says that $E^*(x_N^{Sf/\$}) = 0.04 - 0.06 = -0.02$, or –2%.

Note that we can use the UIRP condition to find the equilibrium expected rate of FX change even if the UIRP condition does not hold in reality. If the UIRP condition does not hold, the actual expected rate of FX change will be different from the equilibrium expected rate.

Example: assume 1) the expected spot FX rate is 1.57 Sf/$; 2) the time-0 spot FX rate that should hold if the UIRP condition holds is 1.60 Sf/$; and 3) the actual current spot FX rate is 1.50 Sf/$.

Then the actual expected rate of FX change over the next year is (1.57 Sf/$)/(1.50 Sf/$) – 1 = 0.0467, or 4.67%, whereas the equilibrium expected rate of FX change is –1.9%, as we found above.

Assume the one-year interest rates for the US dollar and the euro are 5.8% and 3.5%, respectively. Find the one-year equilibrium expected percentage change in the FX price of the euro using the linear approximation in equation (5.2).

Answer: $E^*(x_1^{\$/€}) = r^{\$} - r^{€} = 0.058 - 0.035 = 0.023$, or 2.3%.