[Uncovered Interest Rate Parity and Risk Premium]

1. Market Efficiency Hypothesis and Uncovered Interest Rate Parity (UIP)

A forward exchange rate is a contractual rate established at time t for a transaction that will take place at the maturity time t+T. **Market efficiency hypothesis** is that the forward rate is an unbiased predictor of the future spot exchange rate under the assumptions of rational expectations, risk neutrality, free capital mobility and no taxes on capital transfers. Thus, based on the joint assumptions, the market efficiency hypothesis can be represented by

$$F_{t,T} = E_t(S_{t+T}) \qquad (1)$$

where S_{t+T} denotes the T-period ahead spot exchange rate, F_t refers to forward exchange rate, and $E_t(\cdot)$ denotes an expectation conditioned on the information upto the period.t-1. But, according to Siegel's paradox, $F_t = E_t(S_{t+T})$ is not the same as $1/F_t= E_t(1/S_{t+T})$. In order to avoid the paradox, the market efficiency hypothesis is usually to express in logarithm as,

$$f_t = E_t(s_{t+T}) \qquad (2)$$

where $s_t = \ln(S_t)$ and $f_t = \ln(F_t)$. This equation has become the standard tests for unbiasedness of the forward rate.

Subtracting s_t from both sides in equation (2),

$$f_t - s_t = E_t(s_{t+T}) - s_t \quad (3)$$

Since the left hand side of the equation (3) represents the forward premium, the covered interest rate parity implies $(f_t - s_t) = (i_t - i_t^*)$. Combining the covered interest rate parity with the market efficiency hypothesis, the equation (2) can be rearranged as,

$$(i_t - i_t^*) = (f_t - s_t) = [E_t(s_{t+T}) - s_t] \quad (4)$$

where the corresponding logarithmic values are denoted by lower case variables letters and all exchange rates have the domestic currency as the numeraire currency. Further, i_t denotes the domestic return on an T-period risk free bond at the end of t+T, whereas i_t^* is the foreign currency return on a risk free bond denominated in terms of foreign currency. The equation (4) represents the **Uncovered Interest rate Parity (UIP) condition**.

UIP condition states that under the same joint assumptions of rational expectations, risk neutrality, free capital mobility and no taxes on capital transfers, the interest rate differential between two countries, the forward premium (discount) and the expected percentage change of the spot exchange rate are the same each other. This condition is uncovered because the foreign currency position is not covered, not pre-determined in the forward market but left uncovered or open. So, there exists foreign exchange risk. This UIP condition is important for the following reasons:

1) UIP implies that financial markets are highly integrated despite the presence of the foreign exchange risk.

2) UIP can be used to investigate interest rate linkages across countries.
3) UIP is a component of monetary exchange rate determination model.
4) UIP provides important information for the investment and financing decision of international firms and traders.

2. Forward Premium Anomaly

The empirical tests for the UIP hypothesis implies the relationship,

$$s_{t+T} - s_t = \alpha + \beta \cdot (f_{t,T} - s_t) + u_{t+T}. \tag{5}$$

and the UIP hypothesis implies that $\alpha = 0$ and $\beta = 1$. However, from many empirical tests based on the daily, weekly or monthly level of aggregation, the regressions of the form of (5) invariably found the estimated slope coefficients to be negative rather than a unity. This phenomenon is called "**forward premium (discount) anomaly**". The forward premium, or forward discount anomaly refers to the widespread result that the returns on freely floating exchange rates are invariably negatively correlated with the lagged forward premium. The implication that an appreciating currency results for the country with the higher rate of interest, is generally interpreted as being due to (i) the existence of a time varying risk premium, (ii) peso problem effects, and or (iii) the irrational behavior of market participants.

3. Risk Premium

The UIP condition also implies that the expected real returns in the forward market must be zero,

$$E_t[(f_t - s_{t+T})/p_{t+T}] = 0, \tag{6}$$

where p_t denotes the logarithmic domestic dollar price level. By Taylor series expansion of equation (6) to second order terms,

$$E_t(s_{t+T}) - f_{t,T} = -½ \cdot Var_t(s_{t+T}) + Cov_t(s_{t+T} \cdot p_{t+T}), \tag{7}$$

where p_t refers to the logarithmic price level. Note that, even under rational expectations and risk neutrality the right hand side of equation (7) contains the two conditional second moment terms. Generally, the discrete time, consumption based asset pricing model, provides a risk adjusted equivalent to equation (6), which emphasizes real returns over the current and future consumption streams of the representative investor,

$$E_t\{[(F_t - S_{t+T})/P_{t+T}] \cdot U'(C_{t+T})/U'(C_{t,n})\} = 0, \tag{8}$$

where $U'(C_{t+T})/U'(C_{t,n})$ is the intertemporal marginal rate of substitution. The analogue to equation (7) is,

$$E_t(s_{t+T}) - f_t = -½ \cdot Var_t(s_{t+T}) + Cov_t(s_{t+T} \cdot p_{t+T}) + Cov_t(s_{t+T} \cdot q_{t+T}). \tag{9}$$

where q_{t+T} denotes the logarithm of the intertemporal marginal rate of substitution. The last term, $\rho_{t+T} = Cov_t(s_{t+T} \cdot q_{t+T})$, is <u>a time dependent risk premium</u>.

According to the risk premium approach, the estimation of equation (5) may involve a mis-specification since the conditional variance and covariance terms featured in the above equation have been neglected. Suppose a risk premium is present, then

$$E_t(s_{t+l,n} - s_{t,n}) = (f_{t,n,l} - s_{t,n}) + \rho_{t,n,l}, \qquad (10)$$

Fama (1984) presented that a population value of $\beta < 0$ implies that $Cov[E_t(s_{t+T} - s_t) \cdot \rho_t] < 0$ and also that $Var(\rho_t) > Var[E_t(s_{t+T} - s_t)]$. Hence a negative β coefficient implies the existence of the risk premium and also a negative sample covariance between the risk premium and the expected rate of appreciation. And, he concluded that most of the variation in the forward rate is due to the variation of the risk premium, and that the forward premium and the change in the spot rate are negatively correlated. And, McCallum (1994) reported the estimated slop coefficients around -4 for several different currencies. This value of $\beta = -4$ implies that $Var(\rho_t) > 5^* Var[f_{t+T} - s_t]$, which indicates an extraordinarily high variability of the risk premium. Thus, the general conclusion is that the size and volatility of the risk premium are surprisingly large, or that there is something fundamentally deficient with much of the previous econometric work in this area.

[Foreign Exchange Rate Risk Management]

Foreign Exchange Risk Exposures

Exchange rate risk exposure exists when the value of the assets and liabilities of investors or multinational companies are exposed to unexpected changes in currency values. So, the degree of exchange rate risk depends on how much of the assets and liabilities are exposed. For example, a HK investor holding only assets and liabilities in HK dollar would not be exposed to exchange rate risk. But, a HK company holding a bank deposit of 10M Japanese Yen will expose to the exchange rate risk for 10M Yen.

In order to evaluate the effects of exchange rate risk on the international business, we need to determine the appropriate concept of exposure to foreign exchange rate risk. There are three principal concepts of exchange rate risk exposure:

1) Transaction exposure: It refers to the effects of exchange rate variations on the value of accounts payable and/or receivable. The exposure is resulted from the uncertain domestic currency value of a foreign currency dominated transaction to be competed at the future date.
2) Translation exposure: It is the difference between foreign currency denominated assets and foreign currency denominated liabilities. Since this exposure is a measure of the effects of exchange rate variations on a company's financial statement, this is also known as accounting exposure.
3) Economic exposure: This exposure refers to the sensitivity of a firm's cash flow and market value to variations in the exchange rate.

Managing transaction exposure with hedging techniques

Swap

Swap transaction is that one currency is bought at spot rate and sold for the future delivery (forward) simultaneously. In a swap transaction, the amount of "buy" of a currency is always equal to the amount of "sells". So, there is no the net exchange position.

Representation of Swap rate

The forward premiums or discounts are quoted in basis point ,1/100 percent, or 0.0001 as the swap rates.

Example: for three month swap rate for HK$/US$, 190-180 with spot rate for HK$7.40/US$. HK$ is at forward premium. The first number 190 means that one is willing to sell spot HK$ against US$ at the going spot rate, and buy three-month HK$ against US$ at 190 point below that spot rate (HK$7.381/$ = 7.4-0.0190). The second number 180 means that one is willing to buy spot HK$ against US$ at the going spot rate, and sell three-month HK$ against US$ at 180 point below that spot rate (HK$2.382/US$).

For three month swap rate for HK$/US$, 180-190 with spot rate for HK$7.40/US$. HK$ is at forward discount. So, a investor is willing to sell spot HK$ against US$ at the going spot rate, and buy three-month HK$ against US$ at 180 point above that spot rate (HK$7.4180/$ = 7.4+0.0180) and is willing to buy spot HK$ against US$ at the going spot rate, and sell three-month HK$ against US$ at 190 point above that spot rate (HK$7.4190/US$).

➔The swap rate indicates the number of points at which the quoting party is willing to swap a currency spot against a future maturity of the same currency.

Currency Futures

Comparison of the future contracts with the forward contracts

Similarity: foreign currencies may be bought and sold for the delivery at a future date

Differences:

Futures contracts are trading in standardized contracts and only in a specific geographic location such as the International Monetary Market (IMM) of the Chicago Mercantile Exchange (CME), which is the largest currency futures market.

The currency futures are traded only for a few currencies, the British pound, Canadian dollar, Japanese yen, Swiss franc, Australian dollar, Mexico peso, French franc, German mark, and ECU.

Future contracts mature on the third Wednesday of March, June, September, and December, while the forward contracts are typically 30, 90, or 180 days long.

Future contracts are written for fixed amounts, such as C$100,000 or DM125,000, while the forward contracts are written for any amount agreed on by the parties.

The advantage of the future contracts over the forward contracts is the flexibility: the future contracts can alter the hedging or speculative position as conditions or needs change.

→ Thus, trading currency futures can help institutional investors or multinational company offset the exchange risk related to an investment position.

Market quotations for the future contracts (Handout).

i) the information of each column

Months: the maturity month of the contracts

Open: price of contract at the beginning of business that day

High: high price of contract on that trading day

Low: low price of contract on that trading day

Settle: price at which contracts are settled at the close of trading that day.

Change: change in the settlement price from the previous day

Lifetime high: highest price at which the contract has ever traded

Lifetime low: lowest price at which this contract has ever traded

Open interest: number of outstanding contracts (buying and selling futures) on the previous trading day

Example of the contract:t the September British Pound contract:

On September 9, the contract began trading at $1.6552 per pound so that for £62,500, the contract value was $103,450. Over the course of the day, the price rose to a high of $1.6882, dropped to a low of $1.6510, and settled at $1.6670. The settlement price was up $0.0130 from the previous day. And, over the life of trading in this contract, the highest price was $1.6890, and the lowest price was $1.5690. On the previous day, there were 36,579 outstanding contracts.

Currency Options

The currency options have been traded only since December 1982, when Philadelphia Stock Exchange offered a market.

A foreign Currency option is a contract that provides the right to buy or sell a given amount of currency at a fixed exchange rate on or before the maturity date.

- American Option: the options can be exercised at any time before the maturity date
- European Option: the options can be exercised only at the maturity date.
- Call Option: it gives the holder the right, not the obligation, to purchase the currency at a price (strike or exercise price) set in the contract.
- Put Options: it gives the holder the right, not the obligation, to sell the currency at a price set in the contract.

Two parties of Option contract: Option buyer and Option writer (seller)

- Option buyer who can be a hedger or a speculator essentially purchase a commitment that the option writer will stand ready to sell or purchase a specified amount of the underlying currency on demand. So, the option buyer's cost for this right, the premium, is paid to the option writer. This premium can be very expensive to use so that the use of options is limited compared to the futures.

Option Market Quotations (Handout)

- The Philadelphia exchange offers contracts for A$50,000, £31,250, C$50,000, DM62,500, FF250,000, ¥6,250,000 and SF62,500

- the first row for each currency: the currency being traded and its current spot exchange rates

- the first column: the alternative strike prices available for different months.

- the next two columns: the call option volume and prices or premiums existing at the close of business for different maturity months.

- the final two columns: the put option volume and premium for different maturity months.

the prices are in "cents per unit" of currency, so a price of 0.85 is 0.85 cents or $0.0085.

A option is said to be "in the money" when the option can generate profit for the holder.

→ at the money: the strike price is the same as the spot price

→ out of money: the option can generate loss for the holder.

Hedging and Options

Suppose US importer is buying equipment from a Swiss manufacturer, with SF 1m. payment due in December. The importer can hedge against the appreciation of SF by buying a call option at a specific price.

→ Example (Hedging with call option): Assume the current spot exchange rate is $0.70 per SF, and the SF 1m.would cost $700,000. If the SF expects to appreciate to $0.75 over the next three months, the value of the imports would change to $750,000 over the next three months in the spot market (the increase in the price of imports by $50,00). So, the call options can provide hedge against the change. In order to hedge against the unexpected exchange rate change, the importer can buy a December option. Suppose the importer wants a strike price of $0.71, so that the upper bound on the value of the imports is $710,000. In the table of the handout, a December option with a strike price of 71 sells for $0.0178 per SF (the bottom line where a 71 strike for December costs 1.78). So, one contract for SF62,500 costs $1,112.50 (62,500*$0.0178). To cover SF1 million, the importer must buy 16 contracts since 16*SF62,500 = SF1,000,000, and it costs the premium $17,800 (16*$1,112.50). Then, if the December spot price is $0.75, which is greater than the strike price $0.71, the imports will cost $750,000. Thus, by exercising the option contracts to ensure the price of $710,000 for the imports, the importer can save $40,000 ($750,000-$710,000) (Actually the net saving is $22,200 ($40,000-$17,800, the contract premium). However, if the spot rate is changed less than the old price, $0.70, the importer will expire the option just paying the contract premium, $17,800.