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**CURRENCY RISK MANAGEMENT WITH FINANCIAL
DERIVATIVES: CROSS-HEDGING THE TL WITH DERIVATIVES
IN MAJOR CURRENCIES**

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ABSTRACT

The purpose of this study is to analyse the role of derivatives markets in managing and at some extent controlling the foreign exchange rate risk caused by the huge volatility in the foreign exchange market from the foreign investors point of view. The main focus is placed up on the basic foreign exchange derivative instruments commonly used in developed countries and the strategies with these instruments in avoiding the foreign exchange risk.

To present this, firstly the basics of the international foreign exchange markets are mentioned and the nature and operating character of the market is described. Also, the interrelations between the macro economic parameters and the exchange rates are mentioned with the corresponding well known theories.

Then, the basic financial derivative instruments that could be used in exchange rate risk management are investigated. The possible strategies for this purpose are presented.

The last section includes the methodology for hedging the foreign exchange risk with derivative instruments where no derivatives markets exist in the financial system: Cross- Hedging.

ÖZET

Bu çalışmanın amacı, yabancı yatırımcılar açısından, türev piyasalarının döviz piyasalarındaki dalgalanmadan kaynaklanan kur riskini kontrol edebilmedeki rolünü incelemektir. Temelde bu çalışmada, gelişmiş ülkelerde sıklıkla kullanılan dövize dayalı türev araçları üzerine odaklanılmış ve de kur riskini azaltmada bu araçlarla uygulanabilecek stratejiler üzerinde yoğunlaşmıştır.

Türev piyasaları incelenilmeden önce, uluslar arası döviz piyasalarının temel yapısı ve işleyiş özellikleri üzerinde durulmuştur. Akabinde, temel makro-ekonomik parametreler ile kurlar arasındaki etkileşimi açıklamaya çalışan baz teorilere yer verilmiştir. Kur riskini oluşturan faktörler açıklanmaya çalışılmıştır.

Bu girişten sonra, çalışmanın ana konusu olan kur riskini azaltmada kullanılabilecek dövize dayalı türev araçları incelenmiş; ve de bu bağlamda kullanılabilecek stratejiler üzerinde durulmuştur.

Çalışmanın son bölümünde ise dövize dayalı türev araçlarından olan gelecek kontratlarıyla kur riskinin azaltılmasına yönelik bir uygulama sunulmuştur. Türev piyasalarının bulunmadığı finansal piyasalarda bu aracın kullanım olanakları ve de etkinliği tartışılmıştır.

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1. INTRODUCTION

With the breakdown of the Bretton Woods system in early 1970's, the world is navigated to a freely floating exchange rate system. The massive elimination of government controls and restrictions in nearly all countries leads the international investors to exploit the profit generating opportunities in a globalized financial market, resulting an intensive global asset allocation. Although, the superior performance of the globally diversified portfolios is certain, the foreign exchange rate becomes an inevitable byproduct of the global portfolios. With the transmission to a new system exchange rate become more volatile, deregulation, macro economic shifts in world economy and the international balance of payments problems increased the foreign exchange risk for international investors. As an inefficient foreign exchange risk management can significantly and negatively effect the portfolio returns, the weight of the foreign exchange risk in globally diversified portfolios can not be overstated.

The new pattern of the world financial markets, starting in 1970's, resulted the introduction of the new instruments to the foreign exchange markets: the financial derivatives, which are mainly categorised as the interest linked financial derivatives and the foreign exchange linked financial derivatives. The aim of these instruments is to enhance the ability of managing the interest and the foreign exchange rate risks. The main instruments used in managing the foreign exchange rate risk are the currency futures, currency options and swaps.

The futures, which are exchange trade forward, are first established in mid 1800s with the foundation of the Chicago Board of Trade, (CBOT), where many agricultural products were traded. A future contract is a contractual agreement that one party agrees to buy certain amount of an asset, at a certain price, at a certain time in the future; while another party agrees to sell with the terms. The introduction of the currency futures was

in 1972 again by a branch of CBOT, International Monetary Market, (IMM). With the technological improvements, now the futures can be traded on 24 hours basis.

Following the currency futures markets, the currency option market was established in 1982 in United States, which had its origin in early 1900s with the establishment of *Put and Call Brokers and Dealers Association*. An option is a contract between two parties, in which the buyer has a right to obey the terms of contract while the seller must obey the decision of the buyer.

On the other hand, the swap is an exchange of periodic cash flows between two parties with pre-determined conditions on maturity, timing of the payments, interest rate. There are two main kinds of swaps: interest rate and the currency swaps. The origin of the swap market is started in 1920s.

The international investors can easily use the above instruments in managing their foreign exchange risk. The foreign exchange risk management usually referred as hedging, which is the actions undertaken to minimise the uncertainty in the earning and cash flows dominated in foreign currency. While several other instruments exists in today's financial markets, the effective management of the foreign exchange risk is harder than as it is said. There are several factors to be investigated in making hedging decisions: the investment horizon, the correlation between the domestic market and the foreign market, the percentage of assets exposed to exchange rate risk, the hedge ratio, the selection among the static or dynamic hedging strategies, etc.

In this study, the structure of the international foreign exchange market with the aim of possible usage of the currency derivative instruments in minimising the foreign exchange risk is investigated. In addition, possible application of the currency futures listed on foreign markets in minimising the Turkish lira risk from the viewpoint of foreign investors is examined.

The second part of the study includes general information about the foreign exchange rates: the quotations, forward and spot rates are presented. The main determinants of the foreign exchange rates are investigated.

In the third part, a general information on the international foreign exchange market is given. The historical development of the market, the European Monetary system and two main foreign exchange markets, (i) spot and forward markets (ii) Eurocurrency market, are included.

The fourth part of the study tried to present the factors effects the foreign exchange risk, like the inflation and interest rate risk; and kinds of the foreign exchange risks are defined.

The fifth part of the study devoted to the management of the foreign exchange risk with the major financial derivatives, like the futures, options and swaps. There is general information on the financial derivatives and their usage in the currency risk management. The hedging applications with financial derivatives are investigated in detail.

The last part of the study, includes the cross hedging application with futures traded on Chicago Mercantile Exchange for Turkish lira risk from the viewpoint of a foreign investor. Five major foreign currency futures contract is examined on the basis of their correlation with the Turkish lira. The data for 19 years is investigated for this purpose and optimal risk minimising hedge ratios are estimated with the usage of Ordinary Least Squares (OLS) methodology. The effectiveness of the estimated optimal hedge ratios is *ex ante* (out-of-sample) basis. For the confirmation of the effectiveness of the cross hedges the stability tests for the estimated hedge ratios is implemented. In this section, the opportunity for foreign investors to protect their investments against Turkish lira risk is tried to be point out.

2. THE FOREIGN EXCHANGE CHARACTERISTICS & DETERMINANTS

2.1 THE FOREIGN EXCHANGE CHARACTERISTICS

The foreign exchange is simply the mechanism, which values one currency in terms of another currency. The term foreign exchange, in broadly speaking, includes banks deposits dominated in a foreign currency, foreign currency itself (bills and coins) and other short-term claims on foreigners expressed in foreign currencies¹. Therefore, an exchange rate is the price of one currency vis a vis another currency.

2.1.1 Occurrence of Foreign Exchange

The foreign exchange appeared till the goods and services were transacted in change of money. In today's economically integrated global world, it is very simple that a domestic resident engaging in an international transaction. A Turkish textile producer can buy Chinese fibre to produce towel and sell them to America. Similarly, while Americans are investing in the Istanbul Stock Exchange, the Turkish contractor can engage with the Georgian administration in construction. All these international transactions possess one special characteristic that distinguishes them from the domestic transaction: the participants in the transaction had to have acquired foreign currency. If an American wants to invest in the Turkish market, he/she had to sell U.S. dollars in exchange of T.L. Similarly, the Turkish textile producer had to have Yuan for buying fibre.

As most countries have their own currencies - Turkey has the Turkish Lira, United States the U.S. dollars, Germany the Deutsche mark, England the pound sterling, Japan the yen - in which the residents transact in their home country; some exchange of

¹ Batiz & Batiz, International Finance and Open Macro Economics, Macmillan Publishing Company, p13.

currency is required for to generate the international transactions. So, foreign exchange can be said a base form for the buyers and sellers in the international market place, and the foreign exchange market brings the both parties together to exchange one currency for another.

2.1.2 ISO Codes and Foreign Exchange Quotas

The foreign market operations and much of financial information does not use the full name of the currencies. Rather, the standardised codes are being used (See Table 1). These codes were developed by the International Organisation for Standardisation (ISO). ISO is a non-governmental organisation established in 1947. The mission of ISO is to promote the development of standardisation and related activities in the world with a view to facilitating the international exchange of goods and services, and to developing cooperation in the spheres of intellectual, scientific, technological and economic activity.² Codification is a necessity for in the complex environment of the global exchange market. For example, the U.S. dollar is called USD; the French franc is called FRF, etc. The ISO codes can be used, in individual basis or more commonly in pairs. For example, US dollar/Swiss franc is used as USD/CHF.

Table 1 The ISO Codes.

CURRENCY	ISO CODES
Australian dollar (A\$)	AUD
Australian shilling	ATS
Belgian franc	BEF
British pound	GBP
Canadian dollar (C\$)	CAD
Deutsche mark	DEM
French franc	FRF
Italian lira	ITL
Japanese yen	JPY
Swiss franc	CHF
US dollar (US\$)	USD
Turkish lira	TL

² <http://www.iso.ch> .

However, in the market place, even ISO codes are not used in normal conversations. The traders more commonly use nicknames for the currencies. The US dollars is known as the *buck* or *greenback*, the British pound is generally known as *quid*, the Swiss franc is also called as *swissy* and the French franc is referred as *Paris*. Table 1 displays the ISO codes of some currencies.

Quotas are mainly generated in terms of the amount of one currency required to purchase one unit of the other currency. In an international marketplace, mostly, currencies are quoted against US dollars. For example, the value of the Deutsche mark is quoted as, let's say, 2.00 Deutsche marks per US dollars. In an another saying, one US dollar can be exchanged for 2.00 Deutsche marks in the foreign exchange market. The figure of "DEM/\$" represents that the number of Deutsche marks per dollar, and the "\$/DEM" represents the number of dollars per Deutsche mark. Similarly, the Canadian dollar can be quoted as 1.50 Canadian dollars per US dollar. This represents that one Canadian dollar worth 0.66 US dollar.

$$\text{DEM} / \$ = 2.00$$

$$\text{CAD} / \$ = 1.50$$

and

$$\$ / \text{DEM} = 0.50$$

$$\$ \text{CAD} = 0.66$$

Table 2 Quotations-currency per US dollar. (Source: Wall Street Journal Europe)

QUOTATIONS	
Britain (Pound)	0.6298
Canada (Dollar)	1.4633
Denmark (Krone)	7.8115
France (Franc)	6.8464
Germany (Mark)	2.0414
Italy (Lira)	2020.95
Japan (Yen)	105.75
Netherlands (Guilder)	2.3001
Switzerland (Franc)	1.6435
SDR	0.7646
EURO	1.0437

Depending on the direction of the quotation, an increase in the exchange rate means the appreciation or depreciation of one currency. For example, if the Deutsche marks per US dollars move from 2.00 to 2.50, the Deutsche mark depreciated; vice versa, if the Deutsche marks per US dollars move from 2.00 to 1.50 the Deutsche mark appreciated.

Despite the international interest on US dollars quotation, there is also a natural demand for pricing of foreign currencies in terms of other currencies. The countries that have a huge commercial relation between each other can use the exchange rate between their own currencies. When currencies are traded against another currencies other than US dollar, these prices are told *cross rates*. The most popular currency cross rates are Deutsche mark / Japanese yen, the British pound / Deutsche mark, and the Deutsche mark / Swiss franc (see Table 3). For example, while Deutsche marks per US dollar is 2.00 Deutsche marks and Canadian dollars per US dollar is 1.50 Canadian dollars; the Deutsche mark per Canadian dollar is 0.75 Deutsche marks and Canadian dollars per Deutsche mark is 1.33 Canadian dollars.

$$\begin{array}{lcl} \text{DEM} / \$ = 2.00 & & \text{CAD} / \$ = 1.50 \\ & \text{and} & \\ \$ / \text{DEM} = 0.50 & & \$ / \text{CAD} = 0.66 \end{array}$$

$$\text{CAD} / \$ = 0.75$$

$$\text{DEM} / \text{CAD} = 1.33$$

Table 3 Cross Currency Rates (Sat, 29 Jul 2000, 10:18am EDT)

	USD	GBP	CHF	JPY	CAD	AUD	EUR	NZD	DKK	SEK
SEK	9.1816	13.80	5.4780	8.3690	6.2109	5.3983	8.4751	4.2001	1.1372	
DKK	8.0742	12.13	4.8173	7.3596	5.4618	4.7472	7.4529	3.6935		0.8794
NZD	2.1860	3.2850	1.3042	1.9926	1.4788	1.2853	2.0178		0.2707	0.2381
EUR	1.0834	1.6280	0.6464	0.9875	0.7329	0.6370		0.4956	0.1342	0.1180
AUD	1.7008	2.5558	1.0148	1.5503	1.1505		1.5700	0.7780	0.2107	0.1852
CAD	1.4783	2.2214	0.8820	1.3475		0.8692	1.3646	0.6763	0.1831	0.1610
JPY	109.71	164.86	65.46		74.21	64.50	101.27	50.19	13.59	11.95
CHF	1.6761	2.5187		1.5278	1.1338	0.9855	1.5471	0.7667	0.2076	0.1826
GBP	0.6655		0.3970	0.6066	0.4502	0.3913	0.6143	0.3044	0.0824	0.0725
USD		1.5027	0.5966	0.9115	0.6765	0.5880	0.9231	0.4575	0.1239	0.1089

2.1.3 Spot and Forward Exchange Rates

The spot exchange rate is the rate that how many units of foreign currency can be bought in exchange of one unit of a currency for immediate delivery. On the other hand, the forward rate denotes, how many units of foreign currency can be bought in exchange of one unit of a currency for a future delivery at a forward rate which is determined today.

In the determination of the spot and the forward rates, the interactions between interest rates, inflation rates, future expectation plays an important role. These interactions will be addressed in the following section.

2.2 DETERMINANTS OF FOREIGN EXCHANGE RATES

The central banks have a vital role in the world economy, since they regulate the banks and the other financial institutions in an economy. The actions undertaken by the central banks, either monetary or fiscal policies, effect some important parameters like inflation and interest rates. As each nation has a right to choose a regime to manage their economy, the interest rates and the inflation rates differ. The interrelations between the interest rates, inflation and the exchange rate regime determine the exchange rates.

So as these interrelations effects the formation of the spot and forward prices for foreign exchanges. The effects of such macro economic variables to the exchange rate determination are tried to be described by several studies. Most well known of these theories are the Foreign Exchange Rate Parity Relations, Interest Rate Parity, Purchasing Power Parity and the International Fischer Relation.

However, these interrelations between the macro economic variables are depending on the exchange rate regimes implemented by the central bank. So the exchange rate regimes directly effect the path of the movement in the foreign exchange market.

2.2.1 Foreign Exchange Rate Parity Relations

The fluctuations in the foreign exchange market have a vital effect on the global economy as a whole. The importance of the fluctuations lead many of the theoreticians to model these movements in the economic market place and explain the relation of the foreign exchange rate movements with other economic indicators as the interest rates, inflation and the some other reasons like the international trade.

Instead that the foreign exchange rates are generated by many of the economic and political conditions, most of the theories try to explain the relation by the inflation and the interest rates. In the following section, the foreign exchange parity relations will be illustrated. Namely, interest rate parity relation, purchasing power parity relation and the international fischer relation will be presented. besides, these relations lacks on explaining the foreign exchange movements, the relations can form a base to understand the relations between the main economic indicators.

2.2.1.1 Interest Rate Parity (IRP)

The interest rate parity relation states that the size of the forward premium (discount) should be equal to the difference of the interest rates between to countries. The arbitrage is not possible in the case of IRP, as the interest gain on foreign currency will be offset by the loss on the exchange rate and vice a verse.

Under the interest rate parity relation, the exact mathematical presentation of the forward premium or discount is:

$$P = \frac{(1 + rh)}{(1 + rf)} - 1$$

Where, r_h denotes the interest rate in home country, r_f denotes the interest rate in foreign country. With the linear approximation the premium (discount) should be equal to $r_h - r_f$.

2.2.1.2 Purchasing Power Parity (PPP)

Purchasing power parity relation emphasises the relation between the spot exchange rates and the inflation rates. According to theory, the inflation differential between two countries should totally reflected to the spot exchange rates. There are forms of the purchasing power parity.

- ◆ The absolute purchasing power parity
- ◆ The relative purchasing power parity

The absolute PPP states that if a good is easily traded in different markets, it should effectively sell for same price in all of those markets; that is, exchange rates should simply be a translation of one price into another price.³ That is what we call *the law of one price*. For example; the price of the same product in US is 2 dollars, and the same product worth 1pounds in UK. So the exchange rate should be 2 dollar / 1 pound; 2.

On the other hand, *the relative form of the PPP* states that the price of one product may not be the same on a common currency under the imperfect market conditions. At least the transportation costs and tariffs must be taken into account. So, under the relative version, the purchasing power theory turns out to be the rate of the price change in one product should somehow similar measured in a common currency if the tariffs and the transportation costs remain the same.

³ *Managing Currency Risk*, Association for Investment Management and Research (AIMR), 1997, p.17.

The mathematical presentation of the purchasing power parity is:

$$ef = \frac{(1+ih)}{(1+if)} - 1$$

Where ef represent the percentage change in the value of the foreign currency, ih is the domestic rate of inflation, and if is the foreign rate of inflation. If $ih > if$, then the value of e is positive which denotes that the foreign currency should appreciate when the domestic inflation exceeds the foreign inflation rate. Simply, the relationship can be stated as $ih - if$.

2.2.1.3 International Fischer Relation

The international Fischer relation is closely related to the purchasing power parity, however the international Fischer relation states that the interest rates are the major effects that determines the exchange rate fluctuation. The *Fischer Effect* implies that the interest rate is the combination of the real interest rate and inflation expectation. As the interest rates across the world differ, the reason should be the different expectations of the individuals about the inflation.

The nominal interest rates can be mathematically presented by:

$$1 + r = (1 + q)[1 + E(i)]$$

Where q denotes the real interest rate level. This relation can simply be written as $r = q + E(I)$.

The theory states that the return from a high interest rate country will be offset by the currency depreciation, as the inflation expectation is high.

Table 4 illustrates the main differences of these three theories in explaining the movements in the exchange rates and their short summary respectively. As can be seen from the table, the interest rates differentials and the inflation rate differentials are taken as explanatory variables in explaining the fluctuations in the exchange rates across the world.

Table 4 Comparison of the IRP, PPP, IFR.⁴

Theory	Key Variables of Theory		Summary of Theory
Interest Rate Parity (IRP)	Forward Rate Premium (or Discount)	Interest Rate Differential	The forward rate of one currency with respect to another will contain a premium (or discount) that is determined by the differential in interest rates between two countries. As a result, covered interest arbitrage will provide a return that is no higher than a domestic return.
Purchasing Power Parity (PPP)	Percentage Change in Spot Exchange Rate	Inflation Rate Differential	The spot rate of one currency with respect to another will change in reaction to the differential in inflation rates between two countries. Consequently, the purchasing power for consumers when purchasing goods in their own country will be similar to their purchasing power when importing goods from the foreign country
International Fisher Effect (IFE)	Percentage Change in Spot Exchange Rate	Interest Rate Differential	The spot exchange rate of one currency with respect to another will change in accordance with the differential in interest rates between the two countries. Consequently, the return on uncovered foreign money market securities will on average be no higher than the return on domestic money market securities from perspective of investors in the home country.

⁴ Jeff Madura, *International Financial Management*, West Publishing Company, 4th Edition, 1995, p.225.

2.2.2 Exchange Rate Regimes

The exchange rate system can be investigated in three main categories according to the central banks' intervention in the exchange market. The degree of the intervention depends on the selection of the exchange rate system. Several exchange rate systems can be used, the world practice of the exchange regime can be seen from figure 5. The three main exchange rate systems can be one of the following:

- ◆ Fixed (pegged) exchange rate system
- ◆ Freely flexible (free floating) exchange rate system
- ◆ Managed (controlled) exchange rate system.

2.2.2.1 Fixed Exchange Rate Systems

In a fixed exchange rate system, the exchange rates, which are determined by governments, are either fixed constant or allowed moving within a very narrow limit. These determined exchange rates might not be the equilibrium rate. The central banks intervene the foreign exchange market in order to keep the exchange rate in the prescribed limit or limits. The international reserves will be used for this purpose. However, these determined rates can not be maintained for longer time periods, because of the limited international reserves.

The typical example for the fixed exchange rate system can be observed with the introduction of the Bretton Woods Agreement in 1944 (see section 3.1.2). The U.S. dollar was pegged to gold at a rate of \$ 35 per ounce, and the other currencies were pegged to U.S. dollars with a limitation of fluctuating only one percent on either side of that rate.

Table 5 The Exchange Rate Regimes in the World. (Source: IMF International Financial Statistics; October 1999.)

EXCHANGE RATE REGIMES

Exchange rate arrangements with no legal tender	Antigua & Barbuda Austria Belgium Benin Burkina Faso C. African Rep. Cameroon Chad Congo Cote d'Ivoire	Dominic Equatorial Finland France Gabon Germany Grenada Guinea-Bissau Ireland Italy	Luxembourg Mali Marshall Island Micronesia Netherlands Niger Palau Panama Portugal	San Marino Senegal Spain St. Kitts & Nevis St. Lucia St. Vincent & the Grenadines Togo
Currency board arrangements	Argentina Bosna and Herzegovina Burnie Bulgaria		Djibouti Estonia Hong Kong Lithuania	
Other conventional fixed peg arrangements	<u>Against a single currency</u> Aruba Bahamas Bahrain Barbados Belize Bhutan Cape Verde Comoros Egypt El Salvador Iran Iraq Jordan Lebanon	<u>Against a composite</u> Lesotho Macedoine Mainland Malaysia Maldives Namibia Nepal Netherlands Anthills Oman Qatar Saudi Arabia Swaziland Turkmenistan	United Arap Emirates Botswana Burundi Fiji Kuwait Latvia Malta Morocco Myanmar Samoa Seychelles Solomon Tonga Vanuatu	Bangladesh
Pegged exchange rates within horizontal band	Croatia Cyprus Denmark Greece	Iceland Libyan Ukraine		

Table 5 Continuing

Crawling pegs	Angola Bolivia Costa Rica Nicaragua Tunisia Turkey			
Exchange rates within crawling bands	Chile Colombia Honduras Hungary Israel	Poland Sirilanka Uruguay Venezuela		
Managed floating with no preannounce path for exchange rates	Aethiopia Algeria Azerbaijan Belarus Cambodia Czech Rep. Dominican Rep. Jamaica Kazakhstan Kenya	Kyrgyz Rep. Lao PRD Malawi Mauritania Nigeria Norway Pakistan Paraguay Romania Russian Federation	Singapore Slovak Rep. Slovenia Suriname Tajikistan Uzbekistan	
Independently Floating	Afghanistan Albania Armenian Australia Brazil Canada Congo Ecuador Eritrea Gambia Gana Guatemala Guinea	Guyana Haiti Indenosia India Japan Kazakhstan Korea Liberia Madagascar Mauritus Mexico Moldavia	Mongolia Mozambique New Zealand Papua New Guinea Peru Philippines Rwanda Sao Tome and Principe Sierra Leone Somalia	South Africa Sudan Sweden Switzerland Tanzania Thailand U.K U.S. Uganda Yemen Zambia Zimbabwe

2.2.2.2 Freely Flexible Exchange Rate System

Freely flexible (free-floating) exchange rate system is featured that the market forces, supply and demand, freely determine the exchange rates. There is no intervention by the central bank observed under this regime. If the currency speculation is put apart, under the perfect world the freely flexible exchange rate regime will bring the exchange rate in equilibrium.

Consider a simple world of two countries, freely trading each other, country *A* and country *B*, using currencies *cot* and *pot*. Suppose that country *A* faces with an inflation increase, for some unexpected reason, which in turn raises the prices of domestically produced goods. Increasing prices of the country *A*'s goods will lead a reduction in the demand of country *B* for country *A*'s goods, although the demand of country *A*'s residents for the imported goods from country *B* will increase, as they became cheaper. Hence, this increase in demand for country *B*'s good will increase the demand for *pot*, placing an upward pressure on the exchanger rate. As there is flexible exchange rate system, the market forces (increasing demand) will force the *pot* to appreciate. Increase in the value of the *pot* will increase the *cot* value of the goods, decrease demand of country *A* for imported goods; and increasing the demand of country *B* for imported goods as the *pot* value decreased. Under the flexible system the initial equilibrium is attained.

Under the fixed exchange rate system, the out comes of such inflation increase will differ from the freely flexible exchange rate system. Let's say the exchange rate between *A* and *B* is fixed to *e*. As the price of country *A*'s good become expensive, country *B* reduce the demand for *A*'s goods. On the other hand, domestic residents of country *B* will increase the demand for domestically produced goods, which puts pressure on the domestic prices at a certain level of supply. So, the result will be increasing inflation in country *B*.

2.2.2.3 Managed Exchange Rate System

Under the managed or controlled exchange rate system, the governments intervene to the exchange rate market to keep the exchange rate between non-official limits, allowing little fluctuation. This regime is in some where between the fixed and the fixable exchange rate regime, and commonly known as *dirty float*.

The government intervention to the market can be the results of following tendencies:

- ◆ Reduce the volatility and uncertainty in the market,
- ◆ Prevent the market from the temporary currency crisis,
- ◆ Economic benefits of using non-official limits.

3. INTERNATIONAL MONETARY SYSTEM

3.1 HISTORICAL DEVELOPMENT

The international monetary system may be defined as “ the set of arrangements, rules, practices and institutions under which payments are made and received for transactions carried across national boundaries”. The international system concerned not only with the supply if international money but with the relationship among the hundred or so currencies of individual countries and with pattern of balance of payments and the manner in which they are adjusted and settled. Thus the “system” is broader than “monetary” in that it is concerned with trade relationship and fiscal and national policies as well.⁵

The presence of the international monetary system can be said to be started with the foundation of exchanging goods with money. The money goes back a long time, over 4500 years, when the Egyptians coined the first metal money. The history of the foreign exchange markets finds its roots in ancient Middle East when the Bible reports moneychangers being chased out of Temple by Jesus Christ.

The need for trading the goods and commodities across the borders raised a common standard for assessing the value of each currency. Over many centuries some precious metals like bronze, silver and gold used for this purpose. Silver played an important role until the middle of the nineteenth century. However, after the foundation of gold in America, gold became a common standard.

⁵ Robert Soloman, *Monetary System*, 1945 – 1976, Harper & Row Publishers; 1997, p. 5.

3.1.1 Gold Standard

The system, in which the supply of money is bound to the gold stock, is named the gold standard. Being durable, storable, easily recognised and easily standardisation helped in the dominance of gold as a medium of exchange. In this system, full convertibility is seen; with another saying, as the paper money is valued according to gold; gold can be taken in exchange of the paper money. The dominance of the gold standard system started in second half of the nineteenth century, and lasted until the suspension of the gold standard in 1931.

During the World War I, many countries faced difficulties in exchanging the national money to gold; and the application of the gold standard was interrupted. After the World War I, although some countries returned to the gold standard, the speculation and the volatility on the exchange rate increased. The Great Depression combined with the volatility and currency speculation, increased the inflation and disrupted the reliability of the paper money. In 1931 the gold standard system was suspended. In early 1930's dealing foreign exchange became very difficult. London became the largest center for foreign exchange dealing between the two world wars.

3.1.2 Bretton Woods System

Britain lost much of its financial prominence during the World War II, and following the U.S. dollar became the dominant currency. Toward the end of the war, United States, Great Britain and France met with a United Nations Conference at Bretton Woods, New Hampshire, 1944. The aim of the conference was to develop a framework that would create stability, generate confidence, and foster worldwide growth and prosperity. In order to implement it Bretton Woods Accord focused on two major blocks: the pegging of currencies and the International Monetary Fund.

The major trading currencies were pegged to U.S. dollar, which was pegged to gold at a rate of \$ 35 per ounce, and they were allowed to fluctuate only one percent on either side of that rate. The Bretton Woods system can be described as a gold exchange standard for the currencies other than the U.S. dollars. The U.S. dollars became the reserve currency for many countries as the U.S. guaranteed the convertibility of dollars to gold at the pegged rate. Temporary imbalances were to be financed, partly from national reserves and partly from IMF.

Nearly 20 years the system was applied without any serious problems. The threats to the system started in late 1950s. The international convertibility of many currencies restored and international financial system began to realise exchange rate crisis. First of all, U.S. introduced Interest Equalisation Tax, which is a tax on bonds issues made in United States by foreigners. This tax led to growth of the Eurobond and Eurodollar markets and increasing foreign holdings of U.S. dollars. Later the devaluation of sterling at a rate of 14% triggered the break down of the system. To overcome the balance of payments problems and to create liquidity in the international monetary system IMF introduced Special Drawing Rights (SDRs) in 1968. SDRs can not be described as money or credit but some kind of reserve tool. The value of SDRs is calculated by International Monetary Fund on a daily basis as the sum total of the weighted U.S. dollar values of the four currencies in the basket: the U.S. dollars, the Euro, the British pound, and the Japanese yen (See Table 6).

However, IMF could not help the continuous balance of payments deficit in U.S. and other countries which in turn shaken the trust in the monetary system. As a result of lack of trust, the price of gold in London free market increased above \$35. U.S. gold reserves became inadequate to guarantee dollar convertibility. The U.S. treasury had sold, net, more than U.S. \$ 10 billion worth of gold between December 1958 and August 1971, cutting its gold stock in half.⁶

⁶ Julian Walmsley, *The Foreign Exchange and Money Markets Guide*, John Wiley & Sons Inc., 1992, p.46.

Table 6 SDR Valuation. (Source: IMF)

SDR Valuation Basket On January 3, 2001			
	Currency Amount	Exchange Rate	U.S. dollar Equivalen
Euro	0.426	0.9542	0.406489
Japanese yen	21	114.45	0.183486
Pound sterling	0.0984	1.5077	0.148358
U.S. dollar	0.577	1	<u>0.577</u>
			1.315333
US\$1 = SDR 0.760264			
SDR 1 = US\$ 1.315333			
*The exchange rate for the Japanese yen is expressed in terms of currency units per U.S. dollar; other rates are expressed as U.S. dollars per currency unit.			

The last attempt to protect the system was the Smithsonian Agreement on December 1971 in Washington DC; which had transitional role to the free floating markets. This agreement failed to address the real causes behind the international economic and financial pressures, focusing instead on the increasing the ranges of currency fluctuation. Form 1 percent, the fluctuation bands for currencies relative to U.S. dollars was expended to 4.5 percent. Against each other, then foreign currencies could fluctuate 9 percent.⁷ In 1972, West Germany, France, Italy, the Netherlands, Belgium and Luxembourg developed European Joint Float. Under the system, the member countries' currencies allowed to float with in a band 2.25%, which is called "snake". However, both The Bretton Woods system and the European Joint Float broke down in 1973, mainly because of the payment imbalances among countries and increasing the foreign holding of U.S. dollars. With the Jamaica Agreement in 1976, the freely floating rate was adopted, and the requirement of keeping fixed exchange rates for the IMF member countries for abolished.

⁷ Cornelius Luca, *Trading in the Global Currency Markets*, Prentice Hall, 1995, p.14.

3.1.3 Recent Market Conditions

The 1970s and 1980s were passed with the increasing volatility and unpredictability in foreign exchange markets. Several reasons for this development could be shown, the most important two factor: the increasing number of market participants who were seeking to take the advantage of exchange rate movements, technological development increasing market globalisation.

The 1970s were characterised with the impact of the OPEC countries and the oil crises on the world economy. In 1973, the oil embargo by the OPEC countries somehow help the developing countries as the oil producers' deposits placed in US dollars and sterling used to finance the balance of payments deficits of the developing countries. However, in late 1970s, OPEC gradually increased the oil prices, which in turn put a pressure on the worldwide inflation, increasing the balance of payments deficits of the less developed.

The 1980s, less developed countries realised difficulties in repaying their external debt. The appreciation of the US dollar was vital reason for the situation. Hence, the Mexican financial crisis was said to be first international less developed country debt crisis. The Mexico announced that they were unable to make the interest and the principle payments. The IMF and United States support obstacle the spread of the crisis. The fluctuations the foreign exchange market and the US dollar tried to be restricted by the Group Five (G5) countries by joint intervention to the market.

The 1990s were also characterised with some international financial crisis. The development of the eastern countries including Thailand, Malezia, Korea and Singapore played a significant role in the global economy. However, the fast development brought some problems in the international arena. The exchange rate controls imposed and the relatively high interest rates force the Eastern Tigers into a foreign exchange crisis in

the second half of the 1990s. The first signal of the crisis was seen in Thailand and spread to other eastern countries. The origin of the crisis was the huge foreign investment and borrowing which caused the adverse selection and the moral hazard problems. The increasing degree of the unreturned loans also affected the creditor established in the western developed countries.

In today's world the international market structure and the international monetary organisations are in question. The effectiveness of the IMF in controlling the financial crisis and the IMF lending policies are criticised. Some arguments state that there is no need for an institution like IMF, and on the other hand some say IMF is an inevitable organisation but needs some reforms.

3.2 EUROPEAN MONETARY SYSTEM

The European Union (EU) is the result of a process of cooperation and integration which began in 1951 between six countries (*Belgium, Germany, France, Italy, Luxembourg and the Netherlands*). After nearly fifty years, with four waves of accessions (1973: *Denmark, Ireland and the United Kingdom*; 1981: *Greece*; 1986: *Spain and Portugal*; 1995: *Austria, Finland and Sweden*), the EU today has fifteen Member States and is preparing for its fifth enlargement, this time towards Eastern and Southern Europe.⁸

In the periods between 1900 and 1950, foreign exchange markets realised high volatility. Several reasons lay behind, and several solutions were adopted to overcome the problems. Post World War II the European economic powers started to seek a new economic future for the continent, because the vital element for the rebuilding Europe was a stable economy.

The first action was taken in 1950 when the *European Payment Union*, which aimed to organise the settlement of inter-European international trade transactions. Following

European Coal and Steel Community was formed to promote the European trade and eliminate the restrictions on trade. In 1957, by the Treaty of Rome *European Community* was established with the goal of eliminating custom duties and barriers among member countries. In 1979, the *European Monetary System* (EMS) was formed to develop the monetary cooperation. The EMS was built on the concept of the stable, but adjustable exchange rates, based on central rates defined in relation to the ECU a new creation representing an average of the participating currencies. The EMS was widely regarded as success by both economists and politicians.⁹

3.3 FOREIGN EXCHANGE MARKETS

In a universe with a single currency, there would be no foreign exchange market, no foreign exchange rates, any foreign exchange. But in our world of mainly national currencies, the foreign exchange market plays the indispensable role of providing the essential machinery for making payments across borders, transferring funds and purchasing power from one currency to another, and determining that singularly important price, the exchange rate.¹⁰

The foreign exchange market is the market, in which, individual, firms and banks buy and sell foreign currencies. The market for foreign exchange is a worldwide inter-bank market, in which the dealers are connected with a computerised network of telephone, telex, cable and video screens. The main function of the market is the transfer of the funds from one nation and currency to another. The foreign exchange market is twenty-four hour market, which makes the market highly volatile as the exchange rates can change at any time.

⁸ <http://europa.eu.int>

⁹ www.ecb.int

Until 1970s, all foreign trading was handled *over-the-counter (OTC)* by banks and other institutions. There are no official rules for trading in the OTC market, the hours of trading and terms of transactions are not restricted. However, US Foreign Exchange Committee and the Federal Reserve Bank of New York prepares the Guidelines for Foreign Exchange Trading with the aim of “clarifying common market practices and offer best practice recommendations with respect to trading activities, relationships and other matters.”¹¹ On the other hand, in the organised exchanges the trading activities are different than the OTC market. The organised exchange the trading places have a centralised location, and the trading hours, practices are regulated by each exchange. The products are also standardised in the organised exchanges.

The main participants of the market are the central banks, commercial banks, brokers and the traditional users. Those all have differing aims in participating the market. The traditional users are composed of the importers, exporters, international investors, tourists and also the speculators who are either seeking to make profit from exchange rate movements or satisfying the need of foreign currency for their commercial purpose. They do not actively participate in the market, instead they use mostly the commercial banks. The commercial banks are in the market as they serve to the traditional users. The central banks have a role of controlling the exchange rate volatility, so they intervene the market. Brokers are, on the other hand, having a role of the middleman in the market place. Their main role is to bring the commercial banks together that are willing to sell and buy. The difference between the commercial banks and the brokers is that the brokers do not bear the exchange rate risk, as they do not hold the currency.

The foreign exchange market is the worlds largest and also the most liquid market. The average daily turn over of the market reached \$1.5 trillion.

¹⁰ *The Foreign Exchange Market in United States*, Federal Reserve Bank of New York Publication, 1999, p.3.

¹¹ *Ibid.*, p. 21.

Table 7 Foreign Exchange Market Turnover (Source: Central Bank Survey of Foreign Exchange and Derivatives Market Activity 1998, BIS, 1999)

Foreign Exchange Market Turnover (Daily averages in billions US dollars)				
<u>Category</u>	<u>April 1989</u>	<u>April 1992</u>	<u>April 1995</u>	<u>April 1998</u>
Spot transactions	350	400	520	600
Outright forward and forex swaps	240	420	670	900
Total traditional turnover	590	820	1.190	1.500

The growth of the market accelerated since 1970s. The reasons underlying this acceleration can be bound to the turn over in the market mechanism in the late 1970s, financial deregulation in world, institutionalisation and internationalisation of the saving and investments, technological improvements.

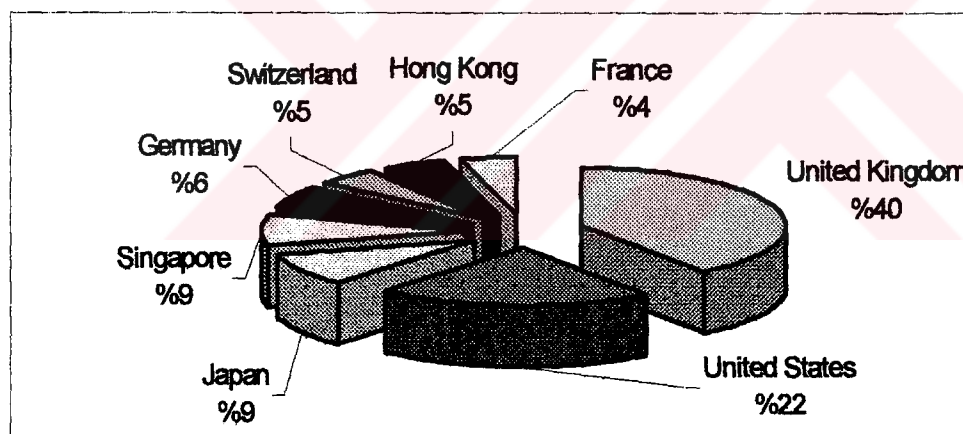


Figure 1 Share of the Country in Foreign Exchange Market -on the average daily foreign exchange turnover as percentage. (Source: BIS)

There is not a central market place for the foreign exchange market. All around the world there are several foreign exchange market places. The most active ones are located in United Kingdom, United States, Japan, Hong Kong, Singapore, Germany, Switzerland and France. The biggest market can be said to be the United Kingdom market. (See Figure 1)

The US dollar is the most active currency in the market place. Nearly 87 % of the market arrangements are handled by use of US dollar. The other active currencies in the market place are Deutsche mark, Japanese yen and the Pound sterling. ECU and the other EMS (European Monetary System) currencies are weak, however gaining strength in the foreign exchange transactions.

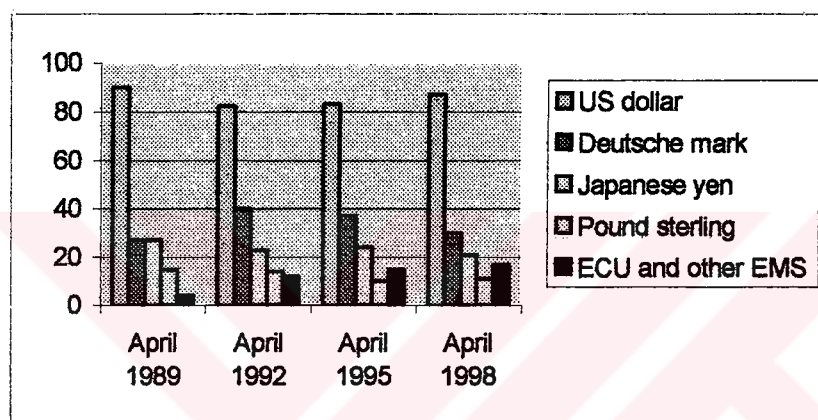


Figure 2 Currency Distribution of the Major Currencies - Global Foreign Exchange Market Activity
Percentage shares of daily turnover. (Source: BIS)

3.3.1 Spot and Forward Markets

The international monetary system can be investigated in two separate, but closely related markets: Spot and Forward markets.

The spot market consists of transactions between two parties arranging in delivery or receiving a specified amount of foreign exchange, within two-business day date of the deal day. It must be understood clearly that the spot does not mean immediate settlement of the transaction. Those transactions with requiring immediate delivery are called *cash* transactions.

When, a closer look is taken from the spot foreign exchange market US dollar is the most traded currency, followed by Deutsche mark and with far distance the Japanese yen and Pound sterling. Instead of being most actively traded currency, US dollar, United States is not the biggest market of the spot transactions. The United Kingdom market dominates the foreign exchange market. The daily averages of the foreign exchange turnover in spot market presents the major markets in spot trading (See Figure 3).

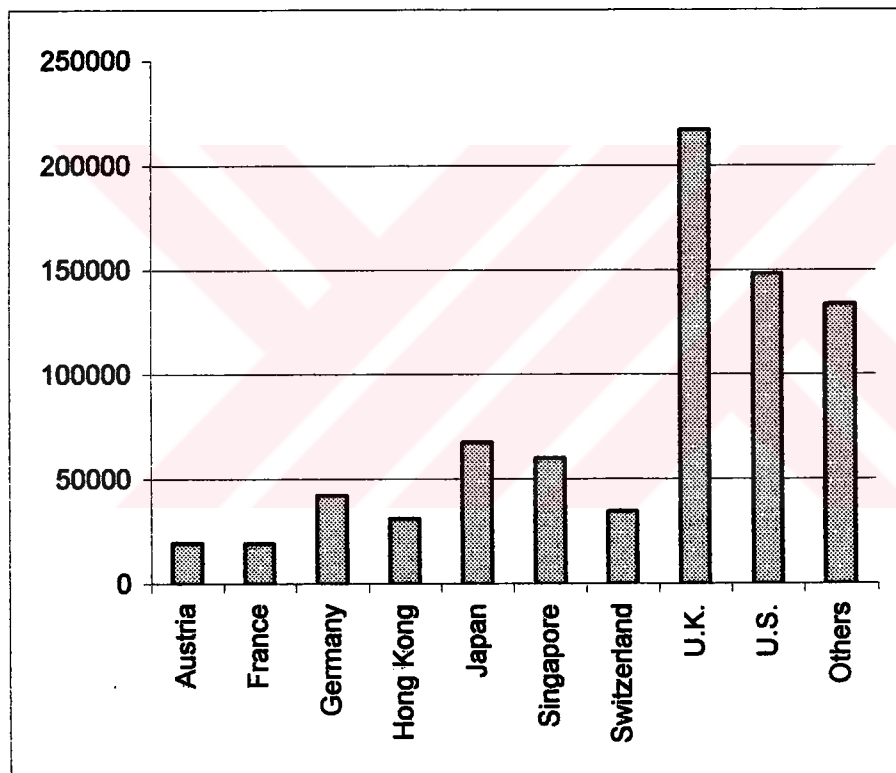


Figure 3 Reported Spot Foreign Exchange Turnover. Daily averages in millions of US dollars.
(Source: BIS)

In the market place, a customer who is willing to buy foreign currency will face two kinds of price: the *bid* and *ask* price. The bid price is the exchange rate that a bank or

dealer is willing to buy a specified foreign currency; and the ask price is the exchange rate a bank or dealer is willing to sell a specified foreign currency. Any amount can be traded in the market, however the standard tends to 100.000.000 US dollars for each transaction. The typical transaction the spot foreign exchange market will be as follows:

A trader from *Banca Prima*, who just heard from one of his market contacts that a large investment bank is buying USD/DEM, calls *AllesBanken* on Monday, August 1 on a dealing system.

Banca Prima: “DEM 10 PLS”. In direct (and polite) translation, this means: “May I have a spot price in USDDDEM 10 million, please?”

AllesBanken’s trader replies: “35 – 40”. In a more complete translation, this may stand for “My price for above amount is 1.7335 – 40.” The big figure (in our case 1.73) is rarely stated, as traders are assumed to know where the market is.

If *Banca Prima*’s trader likes the price and wants to buy at 40, s he will press a preset key (B, for instance) and the software will automatically display on the screen in capital letters: “ I BUY USD/DEM 10.000.000 AT 1.7340 VALUE AUGUST 3. MY USD TO *Banca Prima*/NEW YORK. THAKS VERY MUCH FOR YOUR NICE PRICE.”

Finally, *AllesBanken* confirms the deal by pressing a preset key for confirmation. The software display the following: “ TO CONFIRM I SELL USD 10.000.000 AT 1.7340 VALUE AUGUST 3. MY DEM TO *AllesBanken*/FFT. THKS FOR CALLING. BIFN”. Here, BIFN stands for “Bye for now”. Done deal.¹²

¹² Luca, Op. Cit., p. 161.

The forward market has a different process of transaction. In forward foreign exchange market the currencies are bought and sold for future delivery and payment. There is no standard regarding the contract size and the maturity, the maturity can be between at least three days and so on. Also, like the spot market, there is not a specific market place for the forward market. The forward contracts are bilateral contracts between two parties. In the forward market, there are two instruments: forwards and the swaps.

The *outright forward* is the agreement in which the maturity is longer than the spot. The price is based on the spot rate adjusted for the value of the interest rate differential between two currencies for the number of days to maturity.

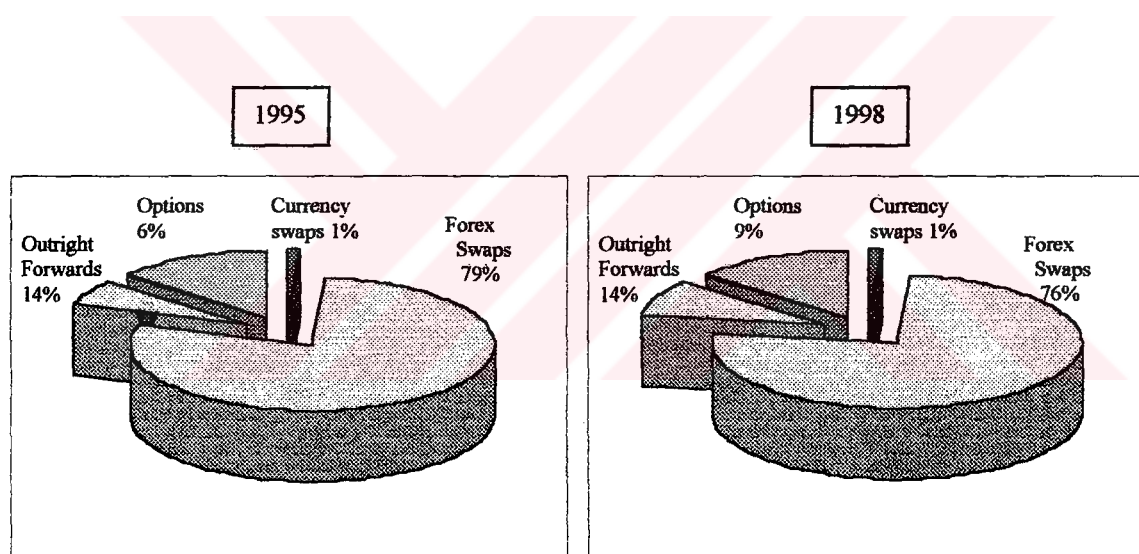


Figure 4 Reported Global Average Net Daily Turnover in OTC Derivatives by Instrument by April 1995 - 1998. (Source: BIS)

On the other hand, there are two kinds of swaps: FX swap and the currency swap. The kinds of swaps are defined as¹³: the *FX swap* is the one spot transaction plus one outright forward transaction for a given amount of the base currency, going in opposite

¹³ *The Foreign Exchange Market in United States*, Op. Cit., p. 66.

direction; or else two outright forward transactions for a given amount of the base currency, with different maturity dates, going in opposite direction. The *currency swap* is an exchange of principle in two different currencies at the beginning of the contract (sometimes omitted) and a re-exchange of same amount at the end; plus an exchange of two streams of interest payments covering each interest payment period, which is conceptually a series of outright forwards, one covering each interest payment period. The following figure presents us the percentage of the instruments used in the OTC market.

The price of a forward contract has two components: the spot foreign exchange rate plus the forward spread. The forward spread can either be forward discount or forward premium. If the forward rate is less than the spot rate then the foreign currency is said to be discount; and if the forward rate is greater than the spot rate, the foreign currency is said to be premium. It is also possible to define the premium and discount as the interest differential between two currencies. The interest parity theorem states this relation, as seen in the previous chapter. The formula stated was:

$$P = \frac{(1+rh)}{(1+rf)} - 1 = \frac{\text{Forward Rate} - \text{Spot Rate}}{\text{Spot Rate}}$$

Where; rh denotes the interest rate in home country, rf denotes the interest rate in foreign country. For example, let's say that the DEM / \$ = 2.00 and the interest rate for Deutsche mark is 15% and 10% for US dollar. What is the forward rate for the DEM / \$?

$$\frac{1+0.15}{1+0.1} - 1 = \frac{\text{Forward rate} - 2.00}{2.00}$$

So, the forward rate for DEM / \$ will be 2.09.

3.3.2 Eurocurrency Market

The term *Eurocurrency* denotes a currency deposited outside of its domestic country. For instance, the dollar deposited outside United States, called Eurodollar, or the Deutsche marks deposited outside Germany, and so on. And these deposits are used by the international banks, international corporation and also by the governments. The market of this kind of borrowing and lending occurs is called *Eurocurrency market*. The origin of the market emerged from the Cold War between United States and the Soviet Union. The communist nations wanted to keep their deposits outside of the United States, as they fear that a political crisis would result their deposits to be frozen. And the other factors contributed in the development of the market can be said as the Federal Reserve imposed interest rate ceilings paid on the time deposits; the restriction of the U.K. government on the financment of the non-residents in 1957.

There are different verity of market participants including international financial institutions like World Bank, central banks and commercial banks. Also non-bank financial institutions like brokerage firms, insurance companies and international corporations participate in the market. The reason for the being popular of the Euromarket is minimum regulation of the market place.

Lending and borrowing occurs in different ways in the market place. There are two types of Eurocurrency deposit instruments: time deposits and Euro-CDs. The *time deposits* are the main instruments of the Eurocurrency market. The depositor provides funds for a certain period of time at a certain interest rate and the deposit can not be withdrawn before the maturity date. The *Euro-CDs* is one of the most popular instruments due to the their liquidity in the secondary market. The CDs can be in the form of fixed- time deposits or tranche CDs in which CDs are divided into several portions.

4. THE FOREIGN EXCHANGE RISK

4.1 THE FOREIGN EXCHANGE RISK COMPONENTS

The differences in the expectations and aversion of risk possessed by the market participants, determines the equilibrium in the markets. The risk in its nature plays an important role in the economic life. The complex nature of the financial markets and the development of most financial market instruments are the results of the risks associated with dealing in the market place. In the absence of the risk, the financial markets will compose of simple interactions with few instruments between participants.

The American Heritage Dictionary of English Language defines uncertainty as “the condition of being uncertain, doubt” and uncertain as “not known or established; not determined, undecided; not having sure knowledge; subject to change, variable”. It defines risk as “the possibility of suffering harm or loss; danger”, but also as “the danger of probability of loss to an insurer; the variability of returns from an investment; the chance of non-payment of a debt”.¹⁴

The risk and the uncertainty denote that there is not a unique expectation about the future developments. At this point, the difference between the risk and uncertainty must be stated. The risk is the numerical presentation of possible outcomes of an investment. On the other hand, if the possibility of the outcomes of an investment can not be presented beforehand, its situation is the uncertainty.

The changes in the foreign exchange rates represent the foreign exchange risk. The complex nature of the financial markets forces the managers to assess the risk that an investment or a project bears. However, in assessing the foreign exchange risk the

¹⁴ Baye & Jansen; Money, *Banking & Financial Markets*; Houghton Mifflin Company; 1995; p:270

associated components of the foreign exchange risk should be investigated. That is the factors force the exchange rates to fluctuated have to be investigated.

There are mainly four components of the foreign exchange rate risk: the interest rates, inflation, credit risk and the political or governmental risk. The effects of these four factors can directly or indirectly lead a change in the exchange rates. The effects of these factors are illustrated in the following sections.

4.1.1 Interest Rate Risk

The interest rate risk stands for the risk capital losses to which the investors are exposed because of changing interest rates after the investment is handled. The interest rate risk is closely related to the maturity of the investments in the foreign exchange market. As the maturity of the investment gets longer, the possibility of the interest rates to change at larger amounts is increasing.

Recalling from previous sections, the interest rate parity relation, it is known that the exchange rate movements among two countries have a high correlation with the interest rate differential. Consider the recent situation that the US Central Bank is expected to increase the interest rates. The possible result of this action by the central bank will increase the demand for US dollars as the dollar returns are expected to increase in the future. Hence, the demand for US dollars will force the value of dollar up and the appreciation of US dollars against the world currencies are inevitable. In an another saying, world currencies are expected to depreciate against US dollars. So, the US investors abroad are subject to a currency risk because of the expected interest rate increase in United States; which will lead a decrease in their US dollar dominated return.

4.1.2 Inflation Risk

The major impact of the inflation, as is well known, is the reduction on the purchasing power; and hence, reduction in the purchasing power lowers the real rate of return on the investments made. So, with the aim of overcoming the decrease in the expected returns the inflation premium has to be built in the investment process.

As a foreign investor, decreasing local purchasing power may seem unimportant; however, the relation between the inflation differential and the exchange rate movements among countries does not prove the same. Regarding the purchasing power parity relation, the exchange rates will change by a percent that reflects the inflation differential between two countries. From the US investor point of view, the inflation realised in foreign markets lowers the US dollar return of the investments.

4.1.3 Credit Risk

The credit risk on a foreign currency position is the possibility that the counter party can not meet its obligation. The credit risk is also closely related to the maturity of the position taken in the foreign exchange market. However, it is not to say that the spot transactions do not possess the credit risk. The spot transactions, as well as the forward contracts, are subject to the same risk.

In the unregulated financial markets, like the forward transactions, the credit worthiness of each party is very important. The credit lines between the participants in the market can be used as a clue in estimating the counterpart's worthiness.

In the cases of the regulated exchanges, the credit risk is said to be minimum or non-existent. The reason is that the regulated exchanges secure the transactions by use of the

clearinghouses. The margin requirements in the futures market are a good example serving for this purpose.

4.1.4 Political Risk

The governments do possess a power to interfere in the foreign currency market by the use of central banks. The central banks' monetary and fiscal policies in controlling or managing the movements of exchange rates design the road of the exchange rate market. The central banks can intervene the currency market directly by selling or buying from international reserves. As denoted in Madura (1995)¹⁵ direct intervention occur when a country's central bank (such as Federal Reserve Bank for United States or Bank of England for Great Britain) sells some of its currency reserves for a different currency. As an indirect method of intervention, the government could influence those factors (such as inflation and interest rates) that effects a currency's value. Alternatively, it could place restriction on international trade or international investments. Central bank intervention can be overwhelmed by market forces, however, and therefore may not always succeed in reversing exchange rate movements, yet it may significantly affect the foreign exchange markets in two ways. First, it may slow down the momentum of the exchange rate movements. Second it may cause commercial banks and other corporations to reassess their foreign exchange strategies if they believe the central banks will continue intervention.

However, this control on the exchange rate can lead the market into an exchange rate crisis. The country risks, resulted from government intervention, should not be confused with the credit risk. The country risk effects the whole financial system in an economy. As observed in the recent crisis in the Asian Tigers market; the controlled exchange rates with high interest rates to attract foreign capital was followed by huge devaluations, foreign exchange shortages and balance of payments problems in most of

¹⁵ Jeff Madura, *Financial markets and Institutions*, West Oublishing Company, 3rd Edition, 1995, p.396.

the far east countries. Banks and also international firms could not pay most of the loans back.

Although the central banks can intervene the foreign exchange market directly, they can also utilise the indirect methods to effect the market conditions, like inflation and interest rates. Another form of the political risk is the governments' interference to the currency market by freezing foreign funds on deposit, tightening the freely flow and transaction of the foreign currency or the war. Freezing foreign funds obstructs the control on the fund and no transaction can be handled on the freeze fund. This situation is mostly a result of war, or political crisis between countries. As seen in the Gulf War, the US authorities freeze the Iraq's deposits in United States.

4.2 THE FOREIGN EXCHANGE RISK MEASUREMENT

For a manager assessing the impact of the foreign exchange rate movements on a firm or an investment is very important, as the movements on the exchange rate can disturb the financial position. The measurement of the foreign exchange rate risk is composed of the determination of the origin of the risk, assessing the magnitude of the risk and stating the possible the impact on the firm or investment.

The exposures to foreign exchange rate movements are not the same with the currency risk. Not all the transaction of a firm is subject to the foreign exchange exposure. For example, the domestic sales and the domestic borrowing are not subject to currency exposure. However, the import, export, foreign debt and receivables are directly effected from the currency movements; and they are subject to foreign exchange exposure. The currency risk, on the other hand, denotes the unexpected fluctuations in exchange rates causing the changes in a firm's gains and losses. With another saying,

risk is the unexpected changes in the accounts that are subject to foreign currency exposure.¹⁶

As a general, the foreign exchange risk measurement is investigated under three main categories: the translation exposure, the operating exposure, and the economic exposure and transaction exposure.

4.2.1 The Transaction Exposure

The foreign currency translation exposure is the degree to which the value of a corporation's future foreign currency payments or received loans effected from the exchange rate movements. The transaction exposure denotes the effects of the exchange rate movements on the specific operations performance of a corporation.

The foreign transactions are composed many interactions like the sale or purchase of goods dominated in foreign currency and other financial transactions. In these cases, corporations need foreign currency for fulfilling obligations resulting from foreign transactions, and also they have to convert foreign currency inflows to meet their domestic obligations. The need for foreign currency or exchange of foreign currency for domestic purposes increases the currency risk beard by the corporations. If the local currency weakened, the obligations dominated in foreign currency will result in increasing currency risk; and vice versa, if the local currency strengths, the currency risk will be lower. This possibility of changing currency risk is called the transaction exposure.

A typical example for the transaction exposure can be observed in the import and export transactions. After the agreement made for import or export, the exchange rate movements between the contracting date and payment date will effect the corporation's

¹⁶ Halil Seyidoğlu; *Uluslar Arası Finans*; Güzem Yayınları; 2 th Edition; 1997; p: 177.

value of cash flows. The same logic is applicable in the case of foreign debts. Whatever the transaction type is, the transaction exposure became effective after the agreement made for the price or the payment schedule.

The transaction exposure has a vital effect on the multi national corporations' (MNC) operations. MNC has to identify their net transaction exposure on their all over activities on the currency by currency basis. There are mainly three important decisions for a MNC in dealing with the transaction exposure:

1. Identifying the degree of the transaction exposure;
2. To hedge or not to hedge the exposure position;
3. If hedging is necessary, decide on hedging fully or partly and the hedging technique.

Identification of the transaction exposure is composed of managing each subsidiary's expected inflows and outflows. The net transaction exposure will present if there is a need for hedging. The degree of the net exposure in specific currency or currencies is the important element in the decision of hedging. The selection of the technique and the instruments to hedge the position is varying. The selected hedging technique can be a long hedge, short hedge, or handled by the minimum variance approach. The instruments are also having many different kinds; options, futures, forwards and swap and their combinations can be utilised.

4.2.2 The Operating Exposure

The operation exposure is the total effect of the currency movements on the firms' future inflows, outflows, accumulated receivables and debts. Unlike the transaction exposure, the operating exposure has a longer perspective on the firms' performance. The management can change the operating exposure by altering the input-output relation or changing the choice of the product, market and also the financial sources.

The effects of the currency movements on the operating exposure of a firm realised in the inflows and outflows; and the direction of the effect depends on the price elasticity of demand for domestic exports and the price elasticity of demand for domestic import of the consumers. The decrease in the value of a currency will lead the following effects on the domestic firms' operations as a whole. The local currency depreciation causes an increase in the relative price of imports in terms of exports, and hence the price of the domestically produced goods will have competitive advantage on the imported goods. The demand for the domestically produced goods will increase, and creates extra inflows. However, if the domestically produced goods use imported inputs in production, a negative effect will be realised as the cost of imported input increased. The increase in the demand and the increasing cost of imported inputs form the total effect of the currency depreciation. The effect purely depends on the price elasticity of the domestic and foreign consumers. If the price elasticity of demand for domestic good and the price elasticity of demand for imports are higher; it is more likely that the effect of the depreciation will be positive. Vice versa, if the price elasticity of demand for domestic good and the price elasticity of demand for imports are at low levels, the result will be negative.

The sources of the operating exposure are the cash flows as a result of foreign trade, input costs and financing activities. To minimise the operating costs, multinational employ the following strategies:

1. MNCs invest in countries where the dollar value of the cash flows can be preserved; for example, countries with currencies that have shown a persistent trend toward appreciating against the parent companies base currency. These are so called "hard currency" nations.
2. Source components from the countries where hard currency costs are projected to be low.
3. Develop markets in countries where the dollar value of the sales revenues and dividend remittances can be easily protected.

4. Finance company needs that limit currency exposure and the possibility of company losses.¹⁷

4.2.3 The Economic Exposure

The value of a firm is the present value of its expected potential future inflows. Thus, the economic exposure measures the degree that a firm's present value of the future cash flows are subject to change as a result of the currency movements. The economic exposure can be described as the long-term cash inflow risk.

The economic exposure is the combination of the transaction exposure and the operating exposure. The actions of a firm creating economic exposure can be summarised as : local sales, exports dominated in local currency, exports dominated in foreign currency, imported inputs, and the interest received or payed from the foreign investment.

The measurement of the economic exposure is not an easy process; because of the difficulties lie in the prediction of the future cash flows and their sensitivity to the exchange rate movements. The main determinants of the economic exposure that are needed to be predicted are:

- ◆ The elasticity of earning to exchange rates.
- ◆ The elasticity of the cash flows to the exchange rates.
- ◆ The price elasticity of the demand for domestic and foreign markets.

4.2.4 The Translation Exposure

The translation exposure denotes the distortion on the gains and the losses in the financial statements as a result of converting foreign transaction to local currency, and / or converting the financial statements of foreign affiliate and consolidation of financial

¹⁷ Maximo V. Eng, Francis A. Lees, Laurence J. Mouer, *Global Finance*, HarperCollinsCollage Publisher, 1995, p.521.

statements with the parent company's financial statements. The exchange rate movements observed until the consolidation and valuation process distort the financial statements and results artificial gains and losses.

The measurement of the translation exposure is a simple process. However, selection of the valuation method is not at all. There are mainly four methods used for the valuation¹⁸:

Current – Noncurrent Method under this method, current assets and liabilities are translated at current exchange rate; the noncurrent assets and liabilities and the shareholders' equity are translated in the historical rates.

Monetary – Nonmonetary Method; this method implies the importance of the nature of the accounts in the valuation process. Under monetary – nonmonetary method, monetary assets and liabilities are translated with current exchange rates and the nonmonetary assets and liabilities and the shareholders' equity are translated in historical rates.

Temporal Method; according to this method cash, receivables and payables (current or not) are translated in current rate. Other assets and liabilities are translated in historical or current rate, depending on the characteristics of the costs carried by the account.

All Current Method; this method requires valuation of all assets and liabilities at the current rate except the net worth. As the accounts are translated with the same currency rate, the ratio of earnings to sales will be same.

¹⁸ Radebaugh & Gray; *International Accounting and Multinational Enterprises*, John Wiley & Sons Inc., 1992, p:340-341..

5. MANAGING FOREIGN EXCHANGE RISK

5.1 FINANCIAL DERIVATIVES

The financial markets have experienced a huge expansion in terms of volume and the tools used in the transactions, over the past two decades. The expansion in the market led the introduction of trading precious metals, some commodities, currencies and stocks. This expansion also produced its medicine for risk management associated with the increasing usage: the derivative products.

The derivative products are mainly categorised as the interest rate linked derivatives, foreign exchange rate linked derivatives, equity linked derivatives and the commodity linked derivatives. The derivative products can also be categorised according to the type of the derivative products: the financial derivatives, commodity derivatives and equity derivatives. These instruments can either be traded on the organised exchanges or in the over-the-counter markets.

When the financial derivatives are the subject of the deal, there are mainly two kinds of the financial derivatives: the interest rate linked derivatives and the foreign exchange rate linked derivatives. The products associated with these categories can be the financial futures, forwards, options and the swap arrangements.

In the following sections the foreign exchange rate linked financial derivatives will be the subject of deal. The forwards and futures on the foreign exchange rate will be illustrated by presenting their differences. The currency options and the currency swaps will be the following sections dealing with the main trading procedures. And hence, the usage of the financial derivatives in foreign currency risk management will be illustrated.

5.1.1 Currency Forwards and Futures

In the financial market places, participant in as usual transaction will agree with one and another to buy or sell an instrument for delivery at a predetermined future date. There are two possible ways of doing this: with a forward contract or with a futures contract.

The forward foreign exchange contract is a bilateral agreement between two parties for exchanging the underlying currencies at future date and at a price determined today. As mentioned in the preceding sections, there is no centralised market location for the forward transactions. The forward agreements do not have a uniform standard of contracts. The contract can be at any amount depending on the agreement of the parties. Also, the maturity can be any day in the future, but the most common maturity dates are 30, 60, 90, 180 and 360 days.

The forward contracts and the future contracts do possess the same characteristics in their nature: agreement on buying or selling an instrument at a future date. However, there are some key elements that differentiate them from each other. The differences can be summarised as:

- ◆ The futures contracts are traded in an organised and centralised exchanges, which are regulated some institutions, like in United States the regulations by Commodity Futures Trading Commission. However, the forward contracts are traded in the over-the-counter market, not centralised and standardised.
- ◆ The terms of the contracts (the size, maturity, trading rules etc.) in the futures market is predetermined by the exchange. In contrast, in the forward market the trading parties set the terms of the contracts in the bilateral negotiations.
- ◆ The system of trading in the futures market is based marking-to-market procedure, which is each position is netted at the end of each day, and the operation are guaranteed against the default risk by the exchanges. On the other

hand, in the forward market the transactions are settled at the end of the contract period and there is no guarantee against a default risk.

- ◆ In the futures market, the positions are closed prior to the maturity, but in the case of the forward transactions the positions are closed with the delivery of the exchange or by the cash settlement.

5.1.1.1 Currency Futures Market

The futures are the exchange traded forward contracts. The market for futures trading was established in mid 1800s with the foundation of the Chicago Board of Trade (CBOT). The main aim of the CBOT was standardising grain trade and the agreements, by means of the quantity traded and quality, between farmers. Chicago Mercantile Exchange (CME) followed the CBOT, the original name was Chicago Produce Exchange, which was established to trade many agricultural commodities.

The increasing interactions between nations and international trade, plus the exchange rate volatility in the second half of the twentieth century raised the need for the financial futures. The branch of Chicago Mercantile Exchange, International Monetary Market (IMM), introduced the foreign exchange futures in 1972. Not only the foreign exchange futures were introduced, also the futures for stock indexes and interest rates. In addition to International Monetary Market of CME, the currency futures are traded in Philadelphia Stock Exchange, FINEX a part of New York Cotton Exchange, MidAmerica Commodity Exchange, and around the world Tokyo International Financial Futures Exchange (TIFFE), Singapore International Exchange (SIMEX) and the others.

Technological improvements navigate the foreign currency futures market to a new direction: GLOBEX. GLOBEX is an electronic trading system created by the cooperation between Chicago Mercantile Exchange, Chicago Broad of Trade, and

Reuters PLC. As an project GLOBEX was introduced in 1987 by the Chicago Mercantile Exchange, and the transaction in the GLOBEX market began in 1992. GLOBEX is designed to trade futures in 24 – hour basis, the trading hours are between 6:00 PM and 6:00 AM; which enables the European investors to participate in the market at the day time. Many futures contracts can be traded, like currency, interest rates and equity indexes. As a part of the GLOBEX market, GFX began its operations in 1997.

Trading futures in a centralised market possess some advantages for the investors. These advantages can be summarised as:

1. First of all, the individual investors can participate in the market as the transactions can be made with small amounts and with little cost, in comparison to the forward markets.
2. The futures markets prove security for investors against default risk of the parties in transaction.
3. The liquidity of the market gives the investors freedom in opening and closing their positions and the immediate profit or realisation.
4. The meeting of the investors, hedger and speculator in the market place forms a base for the price determination and expectations for the currencies.

5.1.1.2 Currency Futures Basics

Different types of participants meet in the future market place: investors, speculators, exporters and importers. While investors and speculators are expecting profits from the price movements, the importers, exporters and also the companies with overseas operations seek hedging of their operations against foreign currency risk. For example, a Turkish importer made an agreement with a German car producer for the purchase of a

specified number of cars, and the transaction will be handled in Deutsche marks. As the payment will be made in future, the importer is subject to risk of increasing value of the Deutsche mark. To hedge this risk, the importer can purchase Deutsche mark futures at an amount of future payment (assuming the existence of futures in Turkish financial markets). If the spot price for the Deutsche marks increase, the value of the futures contract will also increase and the increase in cost of Deutsche marks will be offset by the profits from the futures contract. Hence, the position on the futures can be closed by the reverse operation, selling futures of Deutsche marks. However, trading in the futures is not basic at all, a trader should have knowledge on the contract specifications, the futures quotations and margins on the underlying currency.

Contract Specifications

The specifications of a contract present mainly the size of the contract, delivery agreements, delivery months, method of quotation, the final day of trading, and minimum price fluctuation. The Table 7 represents the specifications of foreign exchange futures in Philadelphia Stock Exchange.

The size of the contract denotes the amount of currency that will be delivered at the end of the maturity for one contract. The contract sizes are different for different currencies. While the contract size is 62,500 units for the Deutsche marks, the size for the Japanese yen is much higher 12,500,000 units in PHLX.

The quotations for the contracts are dominated in US dollars and stand for amount of cents for per underlying currency. However, this is different in French francs and Japanese yen; 10 French francs and 100 Japanese yens are considered.

The price movements are limited for the contracts, which is called *minimum price change*. Every contract has a lower and upper limit in the day of transaction. For example, the price limit for the Australian dollar is \$10 in a day. Which is the price for the Australian contract can increase or decrease by \$10. The aim of the minimum price

limit is preventing the speculative attacks on the underlying asset. Again, with the purpose of protecting investors, there is limit for individuals for holding maximum number of contracts. This is seen as position accountability standard.

Table 8 Currency Futures Contract Specifications-Philadelphia Board of Trade (Source: PHLX)

	Australian Dollar	British Pound	Canadian Dollar	Deutsche Mark	Swiss Franc	French Franc	Japanese Yen
SYMBOL	ZA	ZB	ZC	ZD	ZS	ZF	ZJ
CONTRACT SIZE	100,000	62,500	100,000	125,000	125,000	500,000	12,500,000
QUOTATIONS	Cents/Unit	Cents/Unit	Cents/Unit	Cents/Unit	Cents/Unit	1/10 of a Cent/Unit	1/100 of a Cent/Unit
MINIMUM PRICE CHANGE	\$(.00)01= \$10.00	\$(.00)01= \$6.25	\$(.00)01= \$10.00	\$(.00)01= \$12.50	\$(.00)01= \$12.50	\$(.00)01= \$10.00	\$(.00)01= \$12.50
POSITION ACCOUNTABILITY STANDARDS	6,000 Contracts	6,000 Contracts	6,000 Contracts	6,000 Contracts	6,000 Contracts	6,000 Contracts	6,000 Contracts
CONTRACT MONTHS	March, June, September and December and two additional near term months.						
LATS TRADING DAY	Friday before the third Wednesday of the month.						
DELIVERY SETTLEMENT DATE	Third Wednesday of month.						
TRADING HOURS	2:30 A.M - 2:30 P.M. ET*						
ISSUER & GUARANTOR	International Clearing Corporation						
* Trading hours for the Canadian dollar are 7:00 A.M. to 2:30 P.M. ET.							

The *contract months* represents, the months of futures contracts available on trading. And these contracts can be traded until specified day called *last trading day*.

Table 9 Currency Futures Quotations (Source: The Wall Street Journal Europe, April 13, 2000)

	Open	High	Low	Settle	Change	Lifetime		Open
						High	Low	Interest
JAPAN YEN (CME) - 12.5 million yen; \$ per yen (.00)								
June	.9453	.9618	.9450	.9556	+ .0110	1.0175	.8619	70,779
Sept	.9725	.9730	.9695	.9708	+ .0110	1.0272	.9315	887
Dec	.9880	.9885	.9870	.9866	+ .0110	1.0434	.9225	321
Est vol 11,782; vol Tue 7.664; Open int 73,067, - 1,738								
DUITSCH MARK (CME) - 125,000 marks; \$ per mark								
June	.4922	.4954	.4865	.4910	- .0015	.5350	.4852	1,059
Est vol 33; vol Teu 39; Open int 1,060, - 2								
CANADIAN DOLLAR (CME) - 100,000 dlrs; \$ per Can \$								
June	.6844	.6853	.6831	.6849	+ .0004	.7005	.6547	42,27
Sept	.6855	.6869	.6855	.6865	+ .0004	.7017	.66630	6,584
Dec	.6885	.6885	.6885	.6881	+ .0004	.7025	.6640	1,587
Mr01	....	....	....	.6897	+ .0004	.7040	.6790	410
June	....	....	....	.6913	+ .0004	.6990	.6923	94
Est vol 4,548; vol Teu 6,402; Open int 50,945, + 96								
BRITISH POUND (CME) - 62,500pds; \$ per pound								
June	1.5858	1.5892	1.5830	1.5868	....	1.6780	1.5600	38,414
Dec	....	....	....	1.5878	....	1.6500	1.5640	225
Est vol 4,096; vol Teu 4,716; Open int 38,671, - 742								
SWISS FRANC (CME) - 125,000 francs; \$ per franc								
June	.6131	.6137	.6075	.6106	- .0029	.7040	.5989	40,206
Sept	.6125	.6160	.6125	.6158	- .0029	.7063	.6042	205
Est vol 11,911; vol Teu 14,419; Open int 40,415, - 223								

Quotations

The quotations for the currency futures can be found in the new papers and also on the internet. The figure 12 indicates the currency futures quotations published in The Wall Street Journal Europe, April 13, 2000. Each currency is listed with the bold characters specifying the size of the contract and the quotation against US dollar. The rows below to the underlying currency specify the contract settlement months. The second, third and the fourth columns shows the date's open, highest, the low and settle prices respectively. In the fifth column the price change from the previous day settlement is disclosed. The sixth column represents the lowest and the highest price since the future is started to trade actively in the market. The last column at the right, open interest discloses the number of existing contracts outstanding. The open interest is the sum of

the long (buying) futures and short (selling) futures. However, it reports the trading volume for the day before the trading day presented in the table. After price for each currency presented, in the last row right before another currency is presented, estimated volume of trading for all contracts that are matured in previous day; and the actual volume of trading, open interest for all contracts in two days before; and the change from three day before and two days before.

In Table 8, there are five currency futures presented (the bold characters). The contract size for the Japanese yen 12,500,000 yen and the quotation is 100 yen per US cents. The figure indicates that the contracts for Japanese yen are expiring in June, September and December. The Japanese yen future for June, started the day with the price of \$ 0.009453 and the highest price for the day was \$ 0.009618 while the lowest was \$ 0.009450; hence the daily closing price for Clearing House was \$ 0.009556. The contracts outstanding for April 11, 2000 Japanese yens June futures are 70,779. The estimated trading volume for the contracts matured on April 12, 2000 was 11,782; and the actual trading volume for April 11, 2000 was 7,664. Hence, the open interest for all contracts in April 11, 2000 was 73,067, which is 1.738 lower than the open interest volume in April 10, 2000.

Margins on Currency Futures

One of the advantages of futures trading is the immediate realisation of the profits or losses. One contract, if the position is not closed, lasted until the maturity. However, system works as if the position is closed. The name of this procedure is called *marking to market*. The marking to market is closely related to the margin requirement.

Margin is the equivalent of a 'good faith' deposit; it is the amount of the money deposited by a customer to ensure the broker or the clearinghouse against losses on the current futures position. It's a small percentage, usually between two and 10 percent, of the value of the contract that is deposited with a broker. Margin deposits are set by the

exchange and are subject to change with price movement and market volatility. There are two types of margins: *initial margin* and *variation or maintenance margin*.

Table 10 Margin Requirements (Source: CME)

Currency Futures - Outrights US\$ Denominated Contracts	SPEC INITIAL	H/MEM I&M SPEC MAINT.
British Pound (BP)	\$1,722	\$1,275
Canadian Dollar (CD)	\$675	\$500
Deutsche Mark (DM)	\$1,249	\$925
French Franc (FR)	\$1,485	\$1,100
Japanese Yen (JY)	\$3,645	\$2,700
Mexican Peso (MP)	\$2,500	\$2,000
New Zealand Dollar (NE)	\$1,485	\$1,100
Russian Rubble (RU)	\$3,000	\$2,000
South African Rand (RA)	\$1,755	\$1,300
Swiss Franc (SF)	\$1,755	\$1,300
Brazilian Real (BR)	\$2,800	\$2,000

The initial margin is the amount to be deposited at the time of the purchase of the futures contract; that is the margin level protects the broker from possible losses as a result of adverse price movements. The margin amount is adjusted according to the loss or the gain each day after the market closed; which is called marking to market. On the other hand, the maintenance margin is at an amount lower than the initial margin. The maintenance margin can be described as the last limit that the initial margins drop. For example: Let's an investor entered in Canadian dollar futures for December. The size of the contract is 100,000 CAD and the exchange future rate is 0.6885; that means if the future ratio do not change until the maturity the investor can exchange 100,000 CAD to 68,850 US dollars. The initial margin is \$675 and the maintenance margin is \$500 (See figure 13). If the future rate falls to 0.6880, the investor will lose \$0.0005 in exchange

for per Canadian dollars. In total the loss will be $0.0005 \times 100,000 = \$50$. As a result of the marking to market procedure, the initial margin will be adjusted and fall to \$625; that is $675 - 50 = \$625$. If the future rate continue to fall in the next day and say to 0.6860, than the additional loss will be \$200. The initial margin will fall to \$425. At this point the investor will receive the margin call, as the margin amount falls below the maintenance margin. The investor has to deposit extra money to protect his/ her position in the contract. If extra fund are not supplied by the investor, the broker will close out the position.

5.1.2 Currency Options

As a definition, an option is a contract between buyer and seller, which gives the buyer the right to do or not to do something; and on the other hand the seller (writer) must obey the decision of the buyer.

There are mainly two types positions in an options: *call option*, which gives the buyer to buy a specified amount of an underlying asset, at a predetermined price and date; and the *put option*, which gives the buyer to sell a specified amount of an underlying asset, at a predetermined price and date. The preset price can be called exercise or the strike price and the preset date can be called exercise date or strike date. An option can either be an *American type* that can be exercised at any time by the buyer, or *European type* that can be exercised only on the specified date.

5.1.2.1 The Currency Option Market

The first option type trading can be seen in Europe and United States in the Eighteenth century. The organisation of the market was started in 1900s with the establishment of the *Put and Call Brokers and Dealers Association*. The organisation was formed by some member firms and the one, who was willing to trade, had to contact one of the member firm. In the late 1900s, the organised exchanges were formed for the option

transactions. The first option market on stock options was the Chicago Board Options Exchange established in 1973. This development was followed by the establishment of several exchanges in different parts of the world and in different assets.

The currency option market is one of the major part of the international currency market. Presented in Figure 7, the percentage of option trading in global OTC market increased 3% from 1995 to 1998. There are some reasons why are the options are traded and popular in all around the world. The high volatility and liquidity of the foreign currency market borne risks and the need of the traders to insure against those risks is increasing the trading volume of the currency options. The OTC market options are non-tradeable and which can be exercised only on the exercise date. So, they are European type options.

In the foreign exchange market, the options can be traded in OTC markers and in the organised exchanges. Unlike the OTC market, in the organised exchange currency options are traded with standardised contracts, including the trading amount, exercise price and the expiration date. The transactions are cleared in the clearinghouses, which guarantees against the default of one party in the transaction. The foreign currency options were introduced in United States in 1982. The Philadelphia Stock Exchange (PHLX) and the Chicago Mercantile Exchange (CME) are the main markets for the standardised foreign exchange options transaction. The Securities and Exchange Commission (SEC) and the Commodity Futures Trading Commission (CFTC) regulates the over all market for options in United States. The Singapore, Amsterdam, Paris and Brussels are other trading centers for the currency options.

Different types of options are being traded in worldwide option market. There are four main option types: Options on physical sums of currency, Currency futures options, Currency warrants and the Options on Dollar – Index.

Table 11 Principle Listed Currency Options (Source: David F. Derosa, *Options on Foreign Exchange*, Irwin Professional Publishing, 1992, p. 36)

Instrument	Location	Settlement
Options on Physical Sums of Currency	Philadelphia Stock Exchange (PHLX)	Actual Currency
Currency Futures Options	Chicago Mercantile Exchange (CME) Singapore International Monetary Exchange (SIMEX) MidAmerica Exchange	Deliver a Currency Futures Contract
Currency Warrants	American Stock Exchange New York Stock Exchange	Cash Settle on an Exchange Rate Index
Options on Dollar - Index (USDIX)	FINEX division of New York Cotton Exchange	Cash Settlement

The Philadelphia Stock Exchange (PHLX) trades the option contracts on the spot foreign exchange. The main currencies traded are Deutsche mark, Japanese yen, British pound, Canadian dollar, Australian dollar, French francs, Swiss francs, and ECU. The option on PHLX can be American or European option. The currency warrants are being trade in American Stock Exchange since 1987. A company or a financial institution normally issues the warrants and they are all American type. If a warrant is in the money, it is exercised immediately. The Chicago Mercantile Exchange (CME) trades options on currency futures. All the options on CME are American type. Another type of currency option is being traded in FINEX, a division of New York Cotton Exchange, and the option on US dollar index. The US dollar index is consists of the weighted average of ten foreign currencies against the US dollars; which is helpful in evaluating the general value of the US dollars.

5.1.2.2 Currency Options Basics

As mentioned in the previous section, there are two main positions to be taken in an option: Call option and Put option. One can buy or sell both types of options. The return and the loss properties of the action taken are changing according to the position taken.

Buying a call option means that the buyer has the right to decide on buying or not buying the option. So, the holder of the option will generate profits if the value of the option at expiration is greater than the premium; which means that the spot price of the currency is above the option exercise price plus the premium. Call options are mostly used against the currency appreciation. A currency put option gives its owner a right, but not the obligation, to sell currency at a predetermined price. The option holder will realise the profits if the spot market price for the underlying currency falls below the option exercise price by an amount greater than the option premium. The currency put options are being used for to insure against the currency depreciation. The graphical representation of both buying call and buying put can be seen in figure 5.

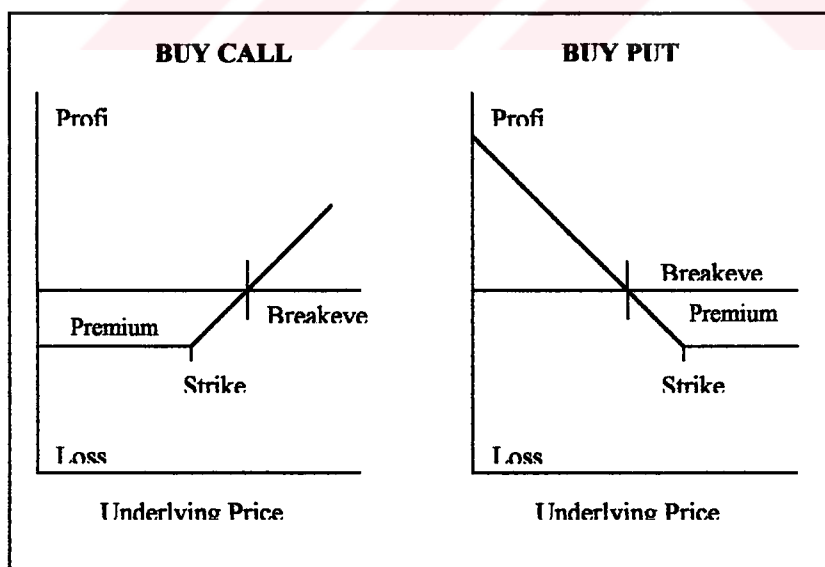


Figure 5 Position of Buying Call and Put.

As can be seen from the Figure 5, the loss on the buying a call or a put option limits the loss on the transaction with the premium paid.

However, selling an option, regard less of being call or put, has a limited opportunity of generating profits, which is equal to the premium. In the case of selling a call option, the breakeven is where the price of the currency exceeds the strike price by an amount equal to the premium generated by selling the option. Potential loss on writing a call option is unlimited, as the price of the underlying currency can increase in enormous amounts. The loss on writing a put is some how can be said to be limited with zero, as the price of the underlying currency can not fall below zero.

Premium

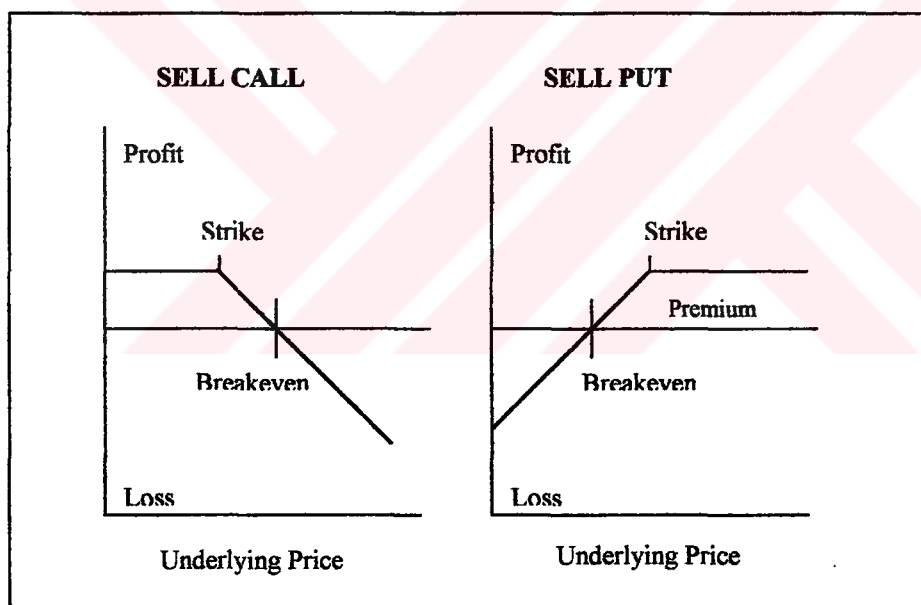


Figure 6 Positions of Selling Call and Put.

The quotations of the currency options for different exchanges are presented in the new papers. The quotations are composed of the strike price, expiration date and the premium, which is the price of the option, for the call and the put options. A basic scheme is given in figure 12 from the Wall Street Journal Europe.

The first column in Table 12 represents the strike price of the option, and the following columns shows the premiums for call and put options for different expiry dates. For example, one contract, which is traded at minimum amount of 12,500,000 yen, and the cost for one contract which is quoted for 1.91 (Call on May) is $12,500,000 \times 0.000191 = \$2387.5$, remember that the Japanese yen is quoted for 100 yens per dollars. The dots in the figure denote that there is not an option at that date.

Table 12 Options on Currency Futures. (Source: The Wall Street Journal Europe, April 13, 2000)

JAPANESE YEN (CME)						
12,500,000 yen; cents per 100 yen						
Strike Price	Calls - Settle			Puts - Settle		
	May	June	Jly	May	June	Jly
9450	1.91	2.63	....	0.85	1.58	....
9500	1.62	2.36	....	1.06	1.81	....
9550	1.36	2.12	....	1.30	....	....
9600	1.14	1.90	3.11	1.58	2.34	....
9650	0.95	1.70	....	1.89	2.63	....
9700	0.80	1.51	....	2.23	2.94	....

Est vol 1,643 Tu 1,499 calls 9 11 puts
Op int Tues 26,177 calls 29,516 puts

There is a relation between the option strike price and the spot price of the underlying currency. At April 12 the spot price for Japanese yen was \$0.009456. In Table 12, one strike price is lower and the other are higher than the spot price. According to being lower or higher than the spot price, an option can be *in the money*, *at the money*, or *out of money*. An option, which has a higher strike price than the spot price, is called in the money. An option, which has a strike price equal to the spot price is called at the money; and hence, an option with lower strike price than the spot price is called out of money. If the strike price of a call option is lower than the spot price then the option is in the money; for the put options if the strike price is lower than the spot price, the option is out of money.

The price of the currency, strike price, volatility of the currency, expiry date, interest rate differential and the type of the option are the factors effecting the price, premium, of an option. Also the *intrinsic value* has a vital impact on the option price. The definition of the intrinsic value is given by Eng & Lee & Mayer as: the intrinsic value can be defined as the financial benefit to be derived if an option exercised immediately. Basically, the intrinsic value reflects the difference between the exercise price and the market price of the underlying currency.¹⁹ As can be seen from Table 12, when the spot price of Japanese yen is \$0.009456 and the price for the call option is 0.009500, the intrinsic value of the option is -0.000044.

5.1.3 Currency Swaps

A swap is an exchange of periodic cash flows between two parties under preset conditions; like the interest rates, the maturity and the timing of the payments. The main aim in a swap transaction is to minimise the risk emerging from the fluctuations in the interest rates and the exchange rates. The most common types of the swaps are the interest rate swaps and the currency swaps.

The interest rate swaps are designed to exchange periodic cash flows under same currency with differing interest rates. There are two main kinds of the interest rate swaps: i). *Plain Vanilla* or *Coupon Swap* : One side of the swapping party accepts to make fixed interest payments while getting interest payments according to a floating index; ii). *Basis Swap*: Exchanging of the interest payments according to two different indexes.²⁰

¹⁹ Eng & Lee & Mauer, Op. Cit., p. 128.

²⁰ İhsan Ersan, *Finansal Türevler*, Literatür Yayıncılık, 2nd Edition, 1997, p. 166.

two parties in the transaction, called “legs”. The logic of legs entering in such a transaction is to utilise the comparative advantage of one party over the other in the different interest rate markets.

The currency swaps have several applications:

1. Taking advantage of the currency and expected changes in the interest rate differentials;
2. Hedging is an important application of currency swaps, because their use eliminated exchange rate fluctuations.²¹

5.1.3.1 Development of the Swap Market

The first swap transaction was seen in 1923 when the Australian Central Bank sold the Australian shilling against the British pound in the spot market and bought back from the forward market.²² The financial markets volatility and the international cash flows controls imposed by the governments fasten the development of the market.

After the break down of the Breton Woods system in 1970's, the introduction of the floating exchange rate system increased the risks associated with the foreign currency transactions. The financial crisis, like the oil shocks, forced the governments and the multinational companies to find new, and also cheaper, sources of financing which can also be used as a hedging tool for the foreign exchange risk.

The first currency swap transaction was seen in England in 1970's, as a “back-to-back” and / or “parallel” loan. The main development in the swap market was observed after the World Bank entered in market. The World Bank, as it is well known, is the main creditor (and also debtor for creating funds) for many countries, for many projects and

²¹ Luca, Op. Cit., p. 192.

²² Ali Ceylan, *Finansal Teknikler*, Ekin Kitabevi, 3rd Edition, 1998, p. 169.

in different currencies. The World Bank raises funds mostly in US dollars, however it also needs some other currencies like Swiss francs, Deutsche mark etc. Although World Bank can borrow directly from the financial markets, the financial markets can somehow be inefficient to supply the needed funds in currencies other than US dollars. So, World Bank chooses to swap its dollar dominated funds for another currency. The typical example is the World Bank – IBM swap in 1981. The World Bank wanted CHF and DEM, but had issued a lot of bonds in Switzerland and Germany. IBM wanted to crystallise its foreign exchange gains on some existing CHF and DEM bonds outstanding. The solution benefiting both was for the World Bank to issue US\$ bond and swap the proceeds with IBM.²³

The rapid development of the market and some problems in the parallel swap agreements, like the default risk, forms the base for an organisation in mastering the swap agreements: International Swap and Derivatives Association (ISDA) in 1986.

5.1.3.2 Types of Currency Swaps

There are mainly four types of the currency swaps:

- i). Parallel loans and Back-to-back loans;
- ii). Fixed-to-fixed currency swaps;
- iii). Fixed-to-floating currency swaps;
- iv). Floating-to-floating currency swaps.

i). Parallel loans and Back-to-back loans:

²³ Julian Walmsley, *New Financial Instruments*, John Wiley & Sons, 2th Edition, 1998, p. 120..

In the early times of the currency swap arrangements, the swap is made as the exchange of the borrowings. The parallel loans and the back-to back loans were the first type of the currency swaps used in the very early times of the currency swap arrangements.

In the case of the parallel loans, two party exchange loans in two different currencies with utilising intermediaries. In the parallel loans, the principle amount is paid at the end of the agreement period and the maturity can be between 5 to 10 years. In the agreement period, the interest rates are fixed and determined according to the both countries accepted interest rates.²⁴

For example, one US company needs British pound for its investment in England and it has excess US dollar funds; and at the same time one British company needs US dollars for its US dollars based debts and has excess pounds in hand. Let's say that the exchange rate is 2 \$ per Pound. The figure presents the relation:

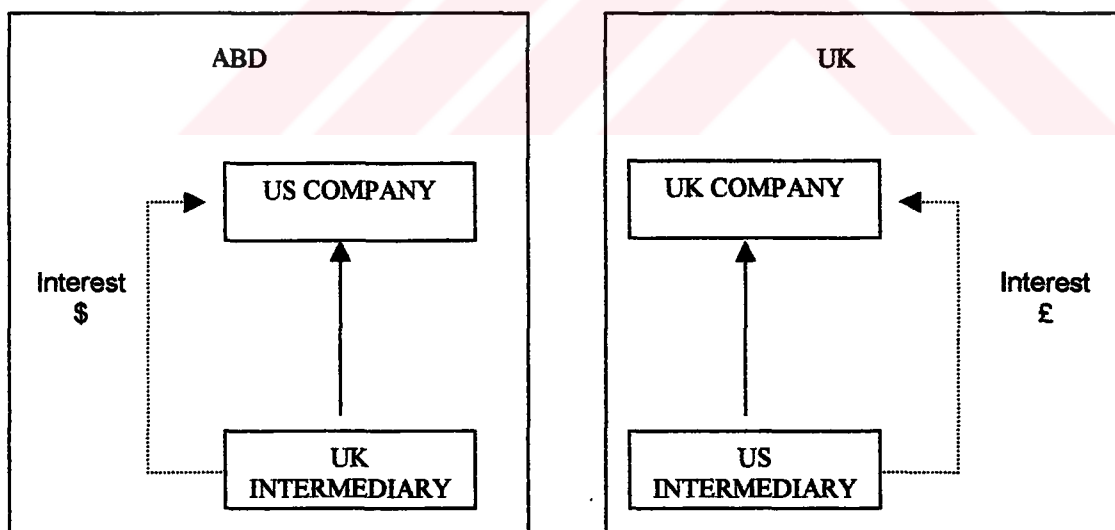


Figure 7 Parallel Credits

²⁴ Ersan, Loc. Cit.

The other type of early swap is the back-to-back loans. The difference between the parallel loans and the back-to-back loans is the unexistence of the intermediaries in the transaction. The parties are directly interacting and the transaction is made.

The basic transaction is depicted in Figure 8. The principle amounts, the predetermined interest payments and the maturity of the transaction is set between the parties. At the maturity the principles amounts are reexchanged.

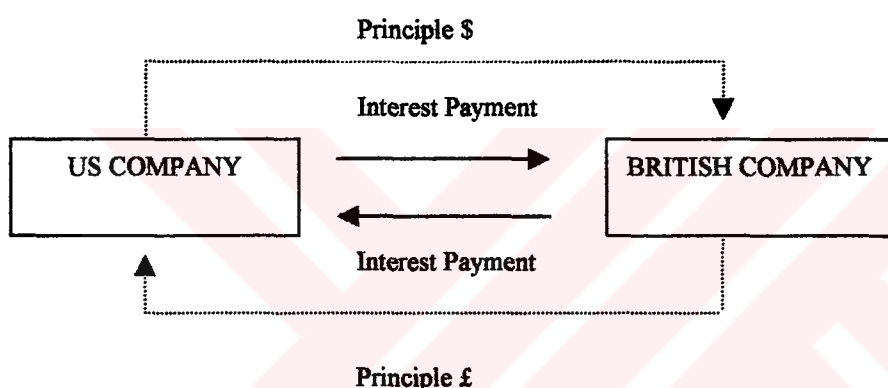


Figure 8 Basic Currency Swap Transaction.

ii). Fixed-to-fixed currency swaps:

In the fixed-to-fixed currency swaps, two different currencies are exchanged with fixed interest payments between each party. The transaction between parties can be clearer by an example:

Suppose a British firm needs fixed rate US dollars funding for a period of five years. At the same time, an American firm needs fixed rate pound sterling funding for a period of five years. Now assume that the British firm can borrow fixed rate pounds in its domestic markets at a rate of 9.50 % and it can borrow dollar in the Eurobond market at a fixed rate of 11.50 %. The American firm, on the other hand, can borrow fixed rate dollars in its domestic capital markets at a rate of 11.75 % and it can borrow pound in

the Eurobond market at a rate of 10.25 %. It is clear that the British firm has a absolute advantage in both pound and dollars. Suppose now that each firm borrows in its domestic market and that the two firms enter into a fixed-to-fixed currency swap with American firm paying the British firm 9.75 % GBP and the British firm paying the American firm 11.50 % USD. The structure is depicted below in Figure 9:

Ignoring the fact that USD interest rate differentials and GBP interest rate differentials are not directly comparable, except as first approximations, we can see both firms have obtained the from of financing that they required and , at the same time, have reduced their financing costs. The British firm for example, has obtained five year fixed rate dollars at a cost of approximately 11.25%. The cost of calculation is:

$$\begin{aligned}\text{British Firm's cost} &= 11.50\% \text{ USD} + 9.50\% \text{ GBP} - 9.75\% \text{ GBP} \\ &= 11.50\% \text{ USD} - 0.25\% \text{ GBP} \\ &\approx 11.25\% \text{ USD}\end{aligned}$$

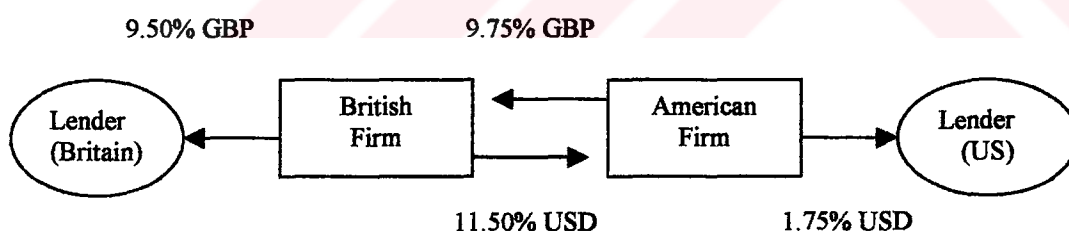


Figure 9 Fixed-to-fixed Currency Swap²⁵

The World Bank and IBM mostly use this king of swap technique.

iii). Fixed-to-Floating Currency Swap:

²⁵ John Marshall & Kenneth Kapner, *Understanding Swaps*, John Willey & Sons, Inc., 1993, p. 83.

Under the fixed-to-floating currency swaps the mechanism of the swap arrangement is like the fixed-to-fixed currency swap. However, the interest paid by one of the party in the transaction is floating while the other's interest rate is fixed. This kind of swaps includes both the currency and the interest rate swap.

For example, a British firm took credit of £50 million at a rate of 6%; and at the same time an American firm took credit of \$100 million at a floating rate of Libor +1/2. Assume that the exchange rate for \$/£ is 2. Each party is wishing to swap their liabilities. With the help of an intermediate institution transaction between the parties occurs as presented in the Figure 10:

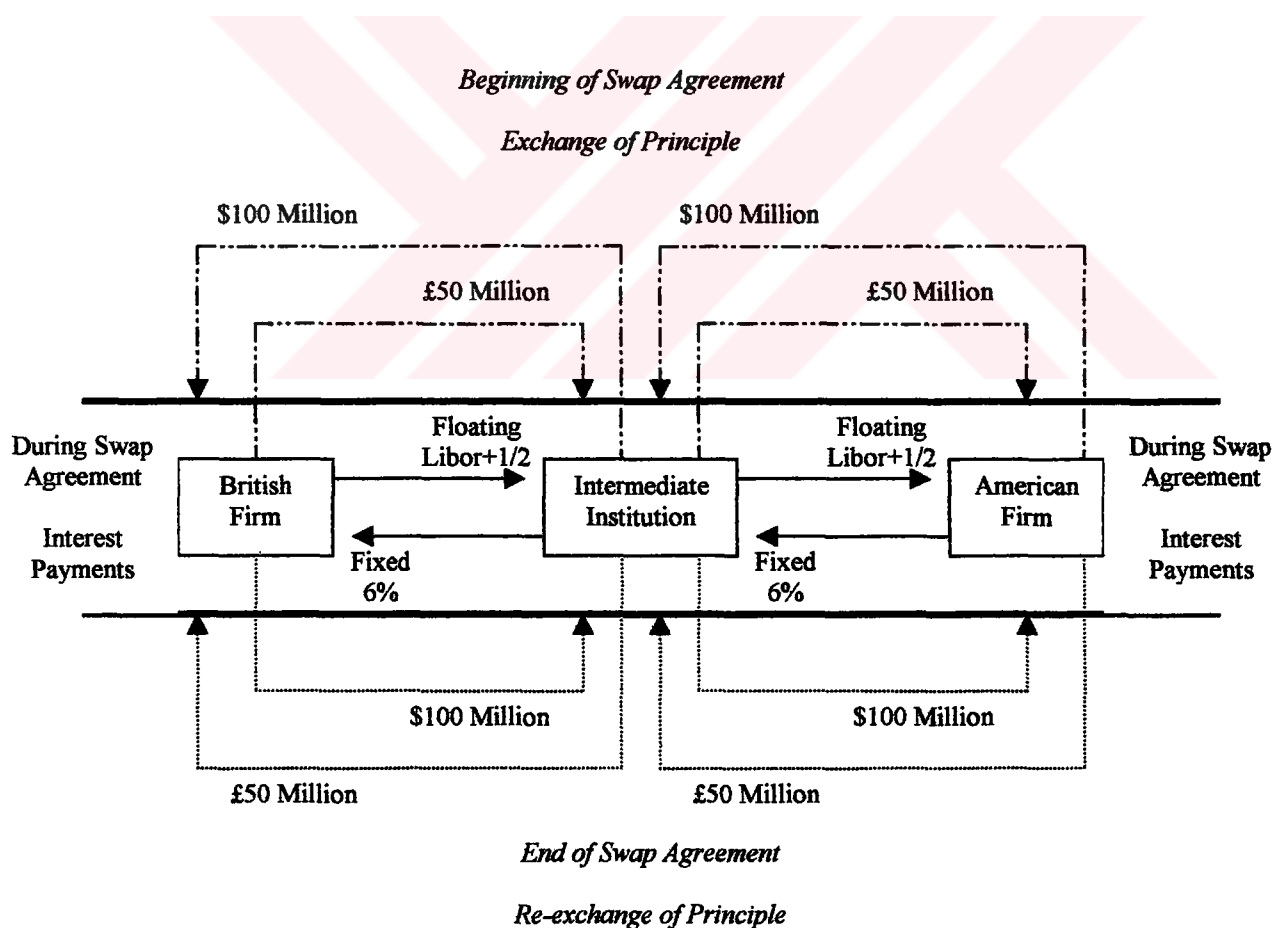


Figure 10 Fixed-to-Floating Currency Swap

iv). Floating-to-floating currency swaps:

In the case of the floating-to-floating currency swaps, both parties are obliged to pay other party's credit or debts according to a floating rate. The most common floating rates used is the Libor and the Prime rates. In these swap agreements, the parties try to utilise the comparative advantage on other in different floating interest rate markets.

5.2 HEDGING WITH FINANCIAL DERIVATIVES

Currency hedging refers to a strategy that strives to minimise the exposure to exchange rate fluctuations, thereby minimising the uncertainty of future transactions dominated in a foreign currency and providing some stability to earning and cash flows. This is typically accomplished through the use of options and futures contracts. The underlying principle of a hedging strategy to construct a portfolio consisting of a long position in the foreign currency asset and a short position in a foreign currency asset such that gains on one offset losses on other. This is achieved by using derivatives whose price movements are highly correlated with movements in the spot market.²⁶

The hedging of foreign asset exposure is one of the most debated topics in international finance, and strong theoretical arguments exist both for and against hedging foreign exchange risk. Supporters of hedging states that hedging reduces portfolio risk and maintain returns of initial investment. On the other hand, the opposite side of hedging argues that it reduces returns; entails significant transaction cost, and monitoring cost; and increases the risk of correlated returns. Glen & Jorion (1993)²⁷ stated that even if currency hedging reduces the volatility of portfolio returns, hedging will be beneficial only if this risk reduction is not accompanied by an offsetting decrease in returns.

²⁶ *Hedging Currency Risk with Options and Futures*, p2,
www.goldencapital.com/reseach/reports/hedging.htm, 25.06.200

Once an investor decides to hedge its current exposure, there are several questions to be answered.

The hedging decision raises a lot of questions:

- Should the investor hedge symmetrically, minimising both currency gains and losses with forward and futures contracts?
- Should the investor hedge asymmetrically, to preserve some currency gains while protecting against currency losses, using option strategies?
- Does the investor want to manage FX risk passively, periodically reexamining a static hedging policy?
- Does the investor want to manage FX risk actively, hedging when returns are unfavourable and decreasing the hedge when returns are favourable?²⁸

Whatever the product chosen, futures or options, for hedging; there are two main strategies for hedging an exposure: *Static (passive) hedging* and *Dynamic (active) hedging*.

Static Hedging: Refers that the selected hedge ratio is constant over the hedging period. The static hedging strategy does not take into account the future expectations of the price movements and the expectations. In another saying, as Chakraborty & Barkoulas (1999)²⁹, stated the static hedging model with futures contracts assumes that the joint distribution of the spot and futures returns is time-variant and therefore the optimal hedge ratio (OHR), defined as the optimal number of futures holdings per unit of spot holdings, is constant over time.

²⁷ Jack Glen & Philippe Jorion, *Currency Hedging for International Portfolios*, Journal of Finance, vol. 48, no. 5, 1993, p. 1884.

²⁸ AIMR, Op. Cit., p. 17.

²⁹ Atreya Chakraborty & John T. Barkoulas, *Dynamic Futures Hedging in Currency Markets*, The European Journal of Finance, vol. 5, 1999, p. 299.

For an investor who owns a foreign asset such as equity of value a_j , hedging means holding short position of size $-s_j$ in the underlying j th foreign currency. He will try to minimise the volatility of the value of his total position, which is subject to FX rate fluctuation. The hedging ratio h_j is defined as³⁰

$$h_j = \frac{s_j}{a_j}$$

To minimise the volatility of return in portfolio choosing the best hedging ratio depends on the investment time horizons. The optimal hedging ratio for long time zones is probably zero or very closer to zero; and for the short periods of investment the optimal hedge ratio for static hedging is one or close to one.

Dynamic Hedging: the logic of the dynamic hedging is that a hedge ratio can not always be successful for all periods of investment and a hedge ratio is only successful for a given period of time. A part from the static hedging, the dynamic hedging requires the adjustment of the hedge ratio over time. The adjustments are implemented according to the forecasts on the future patterns of the exchange rate and interest rate movements. These forecasts determine the position to be hedged. Chakraborty & Barkoulas (1999) states that the dynamic hedging model accounts for the time variation in the joint distribution of the spot and future price changes thus the resulting in a sequence of time-varying optimum or risk-minimising hedge ratios.³¹

When one compare the advantages and the disadvantages of both strategies, the dynamic hedging is superior to the static hedging. While reduction of the risk is the major goal for both strategies, adaptability to market in the case of static hedging is less

³⁰ Ulrich A. Müller, *Hedging Currency Risk- Dynamic Hedging Strategies Based on O&A Trading Models*, O&A Research Group, p. 3, www.olsen.ch/library/research/research.html.

³¹ Chakraborty & Barkoulas, Op. Cit., p.300.

than the dynamic hedging. The cost of transaction is always high in dynamic hedging as periodic market and portfolio analyses required, but on the other hand the management cost may have high costs depending on the strategy chosen in both strategies.

Table 13 Comparison of Static and Dynamic Hedging Strategies (Source: Managing Currency Risk; AIMR; p 20).

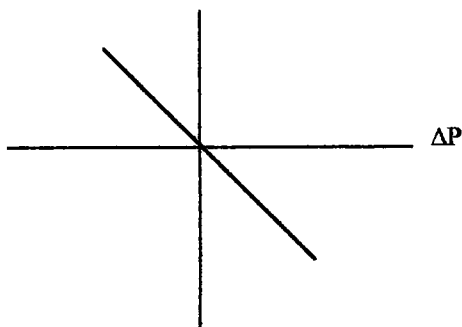
Feature	Static Hedge	Dynamic Hedging
Adaptability to market	Less	More
Reduced risk	Major goal	Major goal
Increased returns	Some potential	Major goal
Transaction cost	Depends on strategy	More
Managed costs	Depends on strategy	Depends on strategy

5.2.1 Hedging With Futures and Forwards

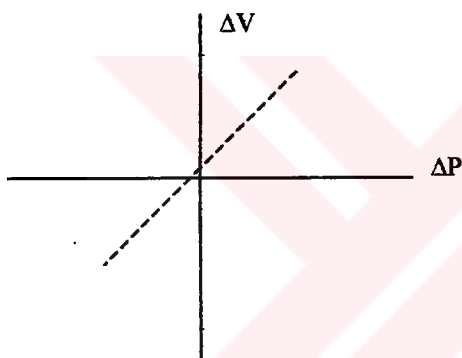
The main feature of hedging is the transformation of risk. With the forwards and futures contracts the risk is transformed to other parties or the institutions. As seen in the preceding chapter, the financial forwards and futures stabilises the interest rates and/or the exchange rates related to a specific transaction that will be handled in the future.

The implication of the hedging with futures and forwards depends on the position taken in the financial assets. The logic of using futures to an underlying exposure is apparent in Figure 11. If the firm has an inherent short position in a financial asset – if increases in the price of the asset will decrease the value of the firm the hedge will be constructed by buying the appropriate number of appropriate futures contracts for the appropriate expiration date.³²

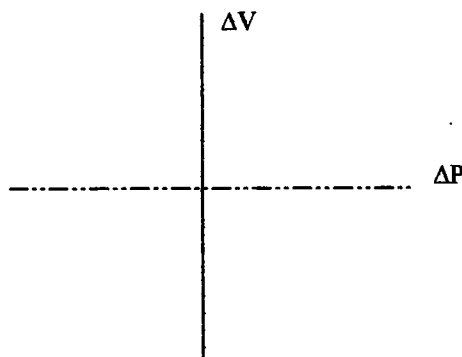
If the firm has an inherit short position



The hedge will be created by buying the appropriate number of the appropriate futures contract

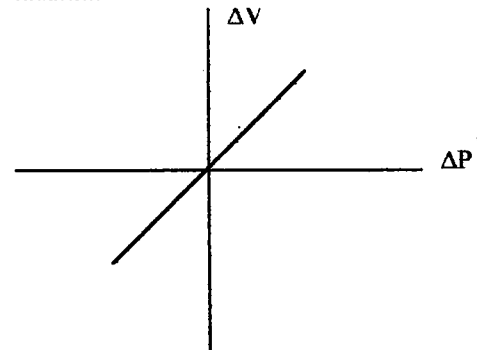


To neutralise the position.

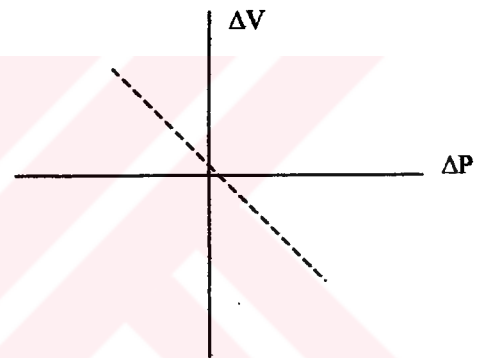


(a)

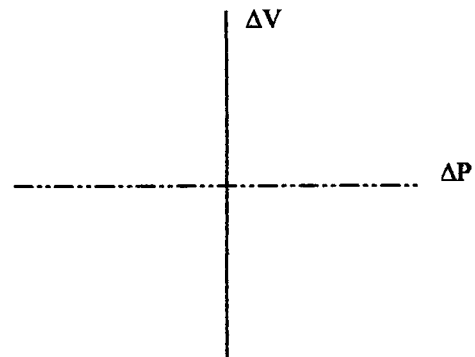
If the firm has an inherit long position



The hedge will be created by buying the appropriate number of the appropriate futures contract



To neutralise the position.



(b)

Figure 11 The Logic of the Futures Hedge (a) Long Hedge, (b) Short Hedge.

(Source: Smithson, W. Charles; Smith, W. Clifford; Wilford, Skyes; *Managing Financial Risk*; Irwin Professional Publishing; p.212; 1995.)

³² Charles W. Smithson & Clifford W. Smith & Skyes Wilford, *Managing Financial Risk*, Irwin Professional Publishing, 1995, p. 210..

As described in Figure 11, there are two positions existing for an investor on an asset, the long position and the short position; the long hedge and short hedge. Basically, hedging with futures can be divided into two according to the position taken.

A hedge can generally be classified as a cash hedge or an anticipatory hedge. A cash hedge is the hedging of an existing position in the spot (cash) market. An anticipatory hedge involves hedging a cash position that has not been taken but is expected to be taken in the near future. A cash hedge generally involves selling futures contracts to cover the positions and is usually referred as a short hedge. In contrast, the anticipatory hedge generally involves buying futures contracts in anticipation of a cash purchase. This is usually referred as a long hedge, since the investor is long in futures contract.³³

The logic of the long hedging is to lock the price of the asset(s) that is expected to be purchased in the future. The expectation of the future price increase forces the investor to hedge.

Long hedges are sometimes considered speculative, since the hedger is attempting to offset a projected position rather than a current position. However, if the future cash flows can be forecasted accurately, if these funds are invested and if the interest rates are forecasted to decline (prices expected to increase), then executing a long hedge locks in the current forward rate existing in the market. Consequently, a long hedge creates profits that offset the subsequent higher price in the cash market. A long hedge is also known as an *anticipatory hedge* because it is effectively a substitute position for a future cash transaction.³⁴

Example: Now suppose, in June 2000, a German computer producer enters in an agreement to purchase DM 125.000.000 worth of hardware from an American producer.

³³ Bruno Solnik, *International Investments*, Addison-Wesley Publishing Company, 3rd Edition, 1994, p. 418.

³⁴ Robert T. Daigler, *Managing Risk with Financial Futures*, Probus Publishing Company, 1993, p. 201.

The total amount is to be paid in September. The spot rate of \$ / DM on the agreement date is 0.6830. It is clear that the German company is subject to currency risk. The German producer have doubts about the exchange rate so he/she longs \$ / DM futures for September in which the futures rate \$ / DM is 0.6865. It is known that the \$ /DM futures contract's size is 125.000DM, so 100 contracts are needed to satisfy the German producer needs. Under different situations, the results of the hedging activity can be seen.

1. Situation: On the last trading date if the \$ / DM is 0.7200.

Spot market cost: $125,000,000 \times 0.7200$	=	90,000,000\$
Gain on futures: $(0.7200 - 0.6865) \times 125,000 \times 1000$	=	-4,187,500
		85,812,500 \$

2. Situation: On the last trading date if the \$ / DM is 0.6300

Spot market cost: $125,000,000 \times 0.6300$	=	78,750,000
Gain on futures: $(0.6300 - 0.6865) \times 125,000 \times 100$	=	+7,062,500
		85,812,500 \$

As a result, regardless of the value of the \$ / DM, the cost of transaction to the German producer those not change and lock to \$85.812.500.

On the other hand, the short hedges are to be used when the investor currently owns an asset and expects to sell the asset in the future. The short hedge is initiated when the holder of an asset is expecting a price decline in the future.

Consider the situation that, a German company has an apartment building in New York City and wants to sell it in a few months. And he German company agreed with a US company at a price of \$1,000,000 payable in 3 three months. Now, the German

company knows that they will profit if the value of US dollar increase relative to DM in 3 three months; but on the other hand, they will realise a loss if the value of US dollar decrease relative to DM in 3 three months. As a result, a short futures position will bring profit if the US dollars increase in value and loss if value of dollars decrease.

Example: In March 2000, a US grain exporter agreed to sell corn to an Canadian firm at the total cost of 1,200,000 Can \$. The total amount will be made on 3 equal payments; 400,000 Can \$ in June, 400,000 Can \$ in September, and 400,000 Can \$ in December. US company afraid that the Canadian dollars value, against US dollar and also against other currencies, will decrease according to the expectation of interest rate decreases by the Canadian Central Bank in the following months. So, US company shorts (sells) \$ / Can \$ for June, September and December 400,000 Can \$ each. Note that the futures contracts for \$ / Can \$ are traded at a size of 100,000 Can \$; and the US company has to trade 4 futures contracts for each transaction. If the results of situations presented blew is investigated, it is seen that the US company locks the future value of its receipts to \$822,000. No fluctuation in the exchange rates effects the outcome for the US company.

1. **Situation:** Can \$ value increase against US dollars. Expectation of US company does not realised.

	<u>In March future prices \$ / Can \$</u>	<u>Spot prices \$ / Can \$</u>
March	-----	0.6700
June	0.6800	0.6825
September	0.6850	0.6900
December	0.6900	0.6925

Result:

Receipt in June	400,000 Can \$ x 0.6825	= 273,000\$
Futures Loss	(0.6800 – 0.6825) x 100,000 x 4	= -1,000
		<u>270,000</u>

Receipt in September	400,000 Can \$ x 0.6900	= 276,000\$
Futures Loss	(0.6850 – 0.6900) x 100,000 x 4	= <u>-2,000</u>
		<u>274,000</u>
Receipt in December	400,000 Can \$ x 0.6925	= 277,000\$
Futures Loss	(0.6900 – 0.6925) x 100,000 x 4	= <u>-1,000</u>
		<u>276,000</u>
Total receipt in December \$		822,000\$

2. **Situation:** Can \$ value decrease against US dollars. Expectation of US company realised.

	<u>In March future prices \$ / Can \$</u>	<u>Spot prices \$ / Can \$</u>
March	-----	0.6700
June	0.6800	0.6725
September	0.6850	0.6700
December	0.6900	0.6650

Result:

Receipt in June	400,000 Can \$ x 0.6725	= 269,000\$
Futures Gain	(0.6800 - 0.6725) x 100,000 x 4	= <u>3,000</u>
		<u>272,000</u>
Receipt in September	400,000 Can \$ x 0.6700	= 268,000\$
Futures Gain	(0.6850 - 0.6700) x 100,000 x 4	= <u>6,000</u>
		<u>274,000</u>
Receipt in December	400,000 Can \$ x 0.6650	= 266,000\$
Futures Gain	(0.6900 - 0.6650) x 100,000 x 4	= <u>10,000</u>
		<u>276,000</u>
Total receipt in December \$		822,000\$

5.2.1.1 Basis Risk

In the past examples, it is seen that the exposure to currency risk can easily be managed by buying or selling appropriate number of futures contracts with appropriate maturity. However, it is not that easy for a finance manager to find appropriate maturity for satisfying the company's hedging needs.

The reason reasons are as follows:

1. The assets whose price is to be hedged may not be exactly the same as the asset underlying the futures contract.
2. The hedger may be uncertain as to the exact date when the asset will be bought or sold.
3. The hedge may require the futures contract to be closed out well before the expiration date.

These problems give rise to what is termed basis risk.³⁵

In the theoretical context, it is expected that the futures prices and the spot prices will converge and be equal at the end of the maturity. During the period till maturity of the futures contract, the difference between the spot price and the futures price is called *Basis*.

$$\text{Basis} = \text{Spot Price } (P_s) - \text{Futures Price } (P_f)$$

The basis on an asset can either be negative or positive; $P_s - P_f < 0$, or $P_s - P_f > 0$. The fluctuation in the basis determines whether the basis is strong or weak. A weaker basis occurs when the proportional increase in future price is less than the cash price proportional increase; or vice versa, the future price proportional decrease is more than the cash price proportional decrease. In both cases the basis decrease. On the other hand, if the proportional increase in future price is more than the cash price proportional

increase; or vice versa, the future price proportional decrease is less than the cash price proportional increase, the basis decrease and called stronger basis.

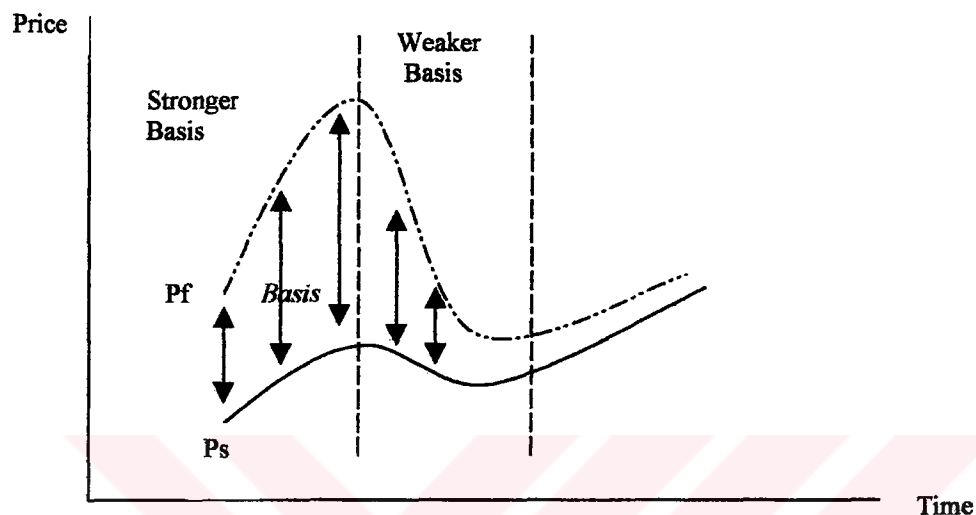


Figure 12 Variation of the Basis over time.

Figure 12 illustrates the graphical presentation of the basis. The P_f denotes price of the future and the P_s denotes the price in the spot market. As the time to maturity comes closes the basis becomes very little; hence the spot and the future prices has a little difference.

The results of the basis fluctuation have different effects on the hedged assets whether it is along hedge or a short hedge. The negative basis with the short hedge will result a positive return, but a positive basis will result a negative return. And also, a weaker basis in combined with a short hedge generates negative returns. Thus, for a short hedge, the long cash position losses are more than the short futures position. Controversially, if the long hedge is being used the weaker basis will result a positive return as the short cash position losses are less than the short futures position.

³⁵ John Hull, *Introduction to Options and Futures Markets*, Prentice-Hall, Inc., 1991, p. 88.

Table 14 Effect of Weakening and Strengthening of the Basis. (Source: Daigler, T. Robert; Managing Risk with Financial Futures; Probus Publishing Company; p 210; 1993)

BASIS MOVEMENT		EFFECT			
<u>Basis</u>	<u>Price Movements</u>	<u>Type of Hedge</u>	<u>Type of Basis</u>	<u>Direction of Basis</u>	<u>Return</u>
<i>Weakens</i>	Ps increases less or falls more than Pf	Short	Ps-Pf>0 (Positive)	Norrows	Negative
			Ps-Pf<0(Negative)	Widens	Negative
		Long	Ps-Pf>0 (Positive)	Norrows	Positive
			Ps-Pf<0(Negative)	Widens	Positive
<i>Strengthens</i>	Ps increases more or falls less than Pf	Short	Ps-Pf>0 (Positive)	Widens	Positive
			Ps-Pf<0(Negative)	Norrows	Positive
		Long	Ps-Pf>0 (Positive)	Widens	Negative
			Ps-Pf<0(Negative)	Norrows	Negative

5.2.1.2 Mismatches in Futures Hedging

Recalling from the previous section, there are several reasons of the basis risk. One of the reason presented is that the hedge may require the futures contract to be closed out well before the expiration date.

In examples given before, the futures contracts those have the same delivery date with the hedging period expiration were chosen. However, in the real world the fluctuations in the prices of the futures contracts show sudden ups and downs as the maturity comes closer. This kind of fluctuations may force the holder to have the physical delivery of the asset, which is not desirable in most cases for the cost of physical delivery. The best solution will be to select the nearest futures contract that is after the end of the hedge

period. The reasoning is that the basis risk increases as difference between the future date and the spot date increases.

The remaining two factor effecting the basis risk are, the hedger may be uncertain as to the exact date when the asset will be bought or sold; and the hedge may require the futures contract to be closed out well before the expiration date. The solutions for these factors are the strip hedge and rolling hedge; and the cross hedge respectively.

5.2.1.2.1 Strip Hedge and Rolling Strip Hedge

In the market place, sometimes it becomes difficult to estimate the future cash needs because of the difficulties in estimating the future economic structure, collectibility of the receivables and also because of the difficulties in estimating the future sales. This problem becomes more important for the multinational enterprises as they face with the risk of exchange rate movements.

Consider the situation that an American exporter firm *ABC* is making business with Canadian firms mostly. However, according to the economic recession realised in British economy, *ABC* is uncertain about the future sales to be made to Canada. The *ABC*'s management expects the following sales figures in the following three-month periods on March 1.

June	Can \$ 10,000,000
September	Can \$ 17,000,000
December	Can \$ 15,000,000

In this case, to hedge the forecasted sales figures the *ABC* can *sell a strip of futures contracts* on March 1. Sell 100 June futures contracts, 170 September futures contract, and 150 December futures contract (as the size of the Canadian \$ futures contracts are traded on 100.000 Can \$). And hence, on June 1 *ABC* has to close out its current futures

position existing in June, so buy 100 June futures contracts; and the following on September 1, buy 170 September futures contracts; and on December 1, buy 150 December futures contracts.

Table 15 Strip Hedge

March 1 Hedge:	March 1	Sell 100 June futures contracts
		Sell 170 September futures contracts
		Sell 150 December futures contracts
	June 1	Buy 100 June futures contracts
	September 1	Buy 170 September futures contracts
	December 1	Buy 150 December futures contracts

The example illustrated above, Table 15, is a classical *Strip hedge*. In the strip hedge all the positions subject to the currency exposure is hedge with underlying closer time futures contracts. The outcome of the strip hedge is closely related with the basis existing at the time of the closing each contract.

However, in some cases it is impossible to find the appropriate futures contracts to cover whole the of the exposure period. That is the expiration date of the hedge can be longer than the delivery date of the futures contracts useable at the time of hedging.

At the same time, there can some doubts about the future liquidity of the long-term futures contract. Remember that in the above example ABC sells three futures contracts in March 1 and expects that the long-term contracts – June and December contracts- will be liquid when the time come for closing the futures position.

In these kinds of situation, the *Rolling Strip Hedge* is preferred, instead of the strip hedge. So the hedger rolls the hedge forward, which is closing out a position on futures

and opening same position on future with a later delivery date. If the rolling hedge is used in the above example the strategy will as follows:

Table 16 Rolling Strip Hedge

March 1 Hedge:	March 1	Sell 420 June futures contracts
	June 1	Sell 320 September futures contracts Buy 420 June futures contracts
	September 1	Sell 150 December futures contracts Buy 320 September futures contracts
	December 1	Buy 150 futures contracts

As can be seen from Table 16, in March 1 the hedging is implemented for to cover the whole exposure. When the exposure to currency movements decreased, the decreased portion of the hedging is closed. The hedge can be rolled many times to cover the hedge period.

5.2.1.2.2 Cross Hedge

Cross hedging can be thought of as the use of one or more futures contracts or options for hedging a cash position that is not directly deliverable under the terms of the futures contract. It is a technique to reduce risk when direct hedging of a position is inefficient or impossible, as in the case of many emerging markets currencies, where markets for forward and futures contracts and for options are either non-existent or inadequate.³⁶

When the appropriate contract for hedging do not match with the hedger's exposure directly, formation of a cross hedge can create a protection for the exposure. However,

³⁶ Raj Aggarwal & Andrea I. Demaskey, *Cross-Hedging Currency Risks in Asian Emerging Markets Using Derivatives in Major Currencies*, Journal of Portfolio Management, New York, Spring 1997, p. 89.

the construction of a cross hedge is not a straightforward process. Several calculations and steps have to be made by the hedger to construct an effective cross hedge.

The construction of a cross hedge requires that the hedger do the following:

1. *Determine the appropriate futures contract to use as the hedge.* In general, the appropriate futures contract is the one that is most closely correlated with the underlying exposure. However, an alternative futures contract may be selected if there is insufficient liquidity in the preferred contract.
2. *Determine the appropriate number of futures contracts.* The appropriate number of futures contracts is determined by (a) the relation between movements in underlying exposure and the price of the futures contract used in the hedge and (b) the effect of one unit change in the financial price on the underlying exposure versus the effect of this unit change in the financial price on the value of the futures contract.³⁷

The determination of the appropriate futures contract to hedge the underlying position is, somehow, an easy process, when compared to the determining the number of contracts to construct the hedge. The selection of the futures contract is based on determining most highly correlated with the underlying exposure. In the econometrical literature, the correlation coefficients between the returns of selected assets are being used to find out the correlation between these assets. The correlation coefficient of both assets can simply be found by utilising the past data, which presents the fluctuations in returns of these assets during the selected period. However, in some cases the most highly correlated futures contracts may not be the appropriate futures contract as these contracts may have liquidity problems. Hence, in selecting the futures contract to hedge the rule is to select the liquid and most highly correlated futures contract.

³⁷ Daigler, Loc.Cit., p. 201.

The second part of the problem in selecting futures contract for cross hedging is determining the appropriate number of futures contract, which is the hedge ratio. The determination of the hedge ratio is the universal argument in the hedging procedure. Also, the hedge ratio concept is applicable to all of the hedging techniques, not only the cross hedging. There are several hedge ratio concepts and will be considered in the following section, as they are applicable to all hedging concepts.

5.2.1.3 Hedge Ratio

In determining the number of appropriate futures contracts, the hedge ratio, the major objective is to determine the best hedging ratio that provides the best risk-return trade off. The hedge ratio is defined as the ratio of the total value of the futures contracts to be used in hedging the total value of the cash asset.

A practical and general extension of the hedge ratio definition is as follows:

$$\text{Hedge Ratio} = \frac{\text{Number of Contracts} \times \text{Size of Contract} \times \text{Spot Price}}{\text{Market Value of Asset Position}}$$

$$= \frac{N \times \text{Size} \times S}{V}$$

where, N is the number of futures contracts used to hedge;

S is the spot price of the asset; and

V is the market value of the cash asset position.³⁸

Consider that an American firm is subject to currency exposure because of the 12,500,000 DEM receivable from its German client. The firm shorts the DEM futures contract, which have a size of 125,000 DEM. At the mean time the spot price is (\$ /

³⁸ Solnik, Op. Cit., p. 424.

DEM) 0.6500; and the market value of the assets position is \$ 8,125,000 (12,000,000 x 0.6500). The number futures contracts to bought is decided to be 100. The So;

$$\text{Hedge Ratio} = \frac{N \times \text{Size} \times S}{V} = \frac{100 \times 125,000 \times 0.6500}{8,125,000}$$

In the example, the hedge ratio is found to be 1, which means that full hedging is attained by the choice of the number of the futures contracts.

Another simplified definition of the hedge ratio is the ratio of the change in the cash price to the change in the futures price. This simplified hedge ratio can be developed by assuming that the goal is to offset completely the adverse price change from the cash position for any one-time period. Consequently, the cash price change in combination with the future price change is zero if the risk is eliminated:

$$\Delta P_c + \text{HR } \Delta P_f = 0$$

where HR = the hedge ratio between futures and the cash instruments that forms one period hedge to eliminate the risk;
 ΔP_c = the cash price change per unit of the period;
 ΔP_f = the futures price change per unit of the period.

Solving for HR, the hedge ratio, we find the value of the ratio that causes a net change of zero for the combined cash and futures position:

$$\text{HR} = -[\Delta P_c / \Delta P_f]$$

The purpose of determining the hedge ratio is the reduce the basis risk between the cash and the futures price changes. The minus sign refers to taking the opposite position in

the futures compared to the cash asset. For example, futures contract is sold of offset the change in the long position, creating a short hedge.³⁹

Despite, this simplified foundation of the hedge ratio, several techniques are used in protecting the cash assets from the price fluctuations. The techniques in assessing the hedge ratios range from the naive techniques to the regression analysis. In the below, these techniques will be illustrated.

5.2.1.3.1 One-to-One Hedge

Normally this hedging technique is utilised against for the hedging of risk of price fluctuations indebt instruments, like bonds. The hedge ratio is found by dividing the par value of each cash instrument to par value of futures contract.

$$HR_1 = \text{Par value of each cash instrument} / \text{Par value of futures}$$

$$N_1 = [\text{Total par value of cash} / \text{Par value of one cash instrument}] (HR_1)$$

Where, HR_1 = the hedge ratio

N_1 = The number of contracts.

An adjustment to the one-to-one debt method, which also provides a naive method for stock and currency hedges, employs the current prices of the cash and futures instrument.⁴⁰

$$HR_2 = \text{Cash price per unit} / \text{Futures price per unit}$$

$$N_2 = [\text{Total cash value} / \text{Underlying value of one futures contract}] (HR_2)$$

Suppose that an American grain exporter made an arrangement with a German firm for sale of 100,000,000 DEM worth of corn, on June 15. The payment will be made two

³⁹ Daigler, Op. Cit., p. 218.

⁴⁰ Ibid., p. 219.

months later, on August 15. The American firm decided to hedge its exposure because of the high volatility in the currency market in recent times. The current spot rate for \$ / DEM is 0.6675. The American firm decided to hedge its position with the September futures, which have a future price of 0.6865, but unsure about the hedge ratio and the number of contracts to be bought. If the firm use the one-to-one hedge, the result will be as follows:

$$HR_2 = \text{Cash price per unit} / \text{Futures price per unit}$$

$$HR_2 = 0.6675 / 0.6865 = 0.9723 \text{ Hedge ratio.}$$

After the hedge ratio is computed, the number of contracts to be bought for protection against risk:

$$N_2 = [\text{Total cash value} / \text{Underlying value of one futures contract}] (HR_2)$$

$$N_2 = [100.000.000 / 125.000] (0.9723)$$

$$N_2 = 777.84 \approx 778 \text{ futures contract.}$$

The one-to-one hedge ratios are mainly used as the construction of such hedge ratio is very simple. but, this does not mean that these ratios are not very effective. They can be effective as sophisticated ratios if the nature of the hedges permits.

5.2.1.3.2 Equal Position

Another simple hedge ratio is the equal position, which does not require complex measurements and calculations. The reasons for usage of these ratios are same as one-to-one-hedge.

In the naïve approach the principal value of a futures contract is chosen to be equal to the principal value of the asset position. The hedge ratio is therefore one. This is the

traditional approach in the commodities, in which the hedging is based on the exact quantities of goods held. It makes sense for commodities in which futures are traded on an identical commodity. However, if the quality of the commodity differs among the cash futures or if cross hedges are required, this hedging strategy may not be optimal.⁴¹

Both the hedge ratio approaches presented above are not effective in the sense of efficiency. The efficiency in the case of the hedging is that: the hedges should protect the investments while somehow permitting little extra returns with minimised cost. In both of these ratios the hedge ratio is close to one and the number of the contracts to be purchased increase, increasing the cost of the hedge. Thus more efficient ratios are to be implemented in hedging decision. Another factor is that the price movement relation between the cash position and the futures position is very important, which is ignored in the above approaches. The difficulty of the measuring the sensitivity of the futures prices to the cash price is that this relation may subject to change.

5.2.1.3.3 Minimum Variance Hedge Ratio

Similarly, the hedge ratio is the ratio of the futures position to the cash asset position, which is subject to currency risk. As mentioned above, the main aim in hedging is to provide the minimum risk combined with the maximum rate of return on the investments. Which can be accomplished through the determination of the optimum-hedging ratio that results with the higher protection from the price fluctuation risk, but with enhancing returns. Most of the investors cares about the variance of returns on their investments; so in another saying the optimal ratio is the one which minimises the variance of returns.

The deviation of the minimum variance hedge ratio is as follows:⁴²

⁴¹ Solnik Op. Cit., p.71

⁴² Solnik Op. Cit., p. 436.

Let's consider a portfolio of assets with market value V . this portfolio is hedged selling N futures contracts of a specified size. The spot and futures prices are S and F . From period 0 to period t , the profit (or loss) on the hedged position is given by:

$$\text{Profit} = (V_t - V_0) - [N \times \text{Size} \times (F_t - F_0)]$$

Introducing the hedge ratio h

$$h = \frac{N \times \text{Size} \times S_0}{V_0}$$

We have,

$$\text{Profit} = (V_t - V_0) - \left[\frac{N \times \text{Size} \times S_0}{V_0} \left(V_0 \frac{F_t - F_0}{S_0} \right) \right]$$

The rate of return on the hedge position, R_H , is equal to

$$\text{Rate of Return} = R_H = \frac{V_t - V_0}{V_0} \left[\left(\frac{N \times \text{Size} \times S_0}{V_0} \right) \left(\frac{F_t - F_0}{S_0} \right) \right]$$

Where; R_H is the rate of return on hedged portfolio,

R_P is the rate of return on asset portfolio

R_F is the rate of return on futures $\left(\frac{F_t - F_0}{S_0} \right)$, and h is the hedge ratio.

So the above equation is equivalent to

$$R_H = R_P - hR_F$$

The variance of the return is equal to

$$\sigma_{H^2} = \sigma_{P^2} + h^2 \sigma_{F^2} - 2h\sigma_{PF}$$

Where σ_H^2 , σ_P^2 , and σ_F^2 are the variances of R_H , R_P and R_F , respectively; and σ_{PF} is the covariance of R_P and R_F . Setting the derivative of σ_H^2 one can see that the variance of the hedged position is minimised for the hedged ratio given by

$$2h\sigma_F^2 = 2\sigma_{PF}, \text{ so } h = \frac{\sigma_{PF}}{\sigma_F^2}$$

Note that the optimal hedge ratio is the slope of the regression:

$$R_P = a + hR_F$$

The regression given above can be illustrated by a figure (Figure 13).

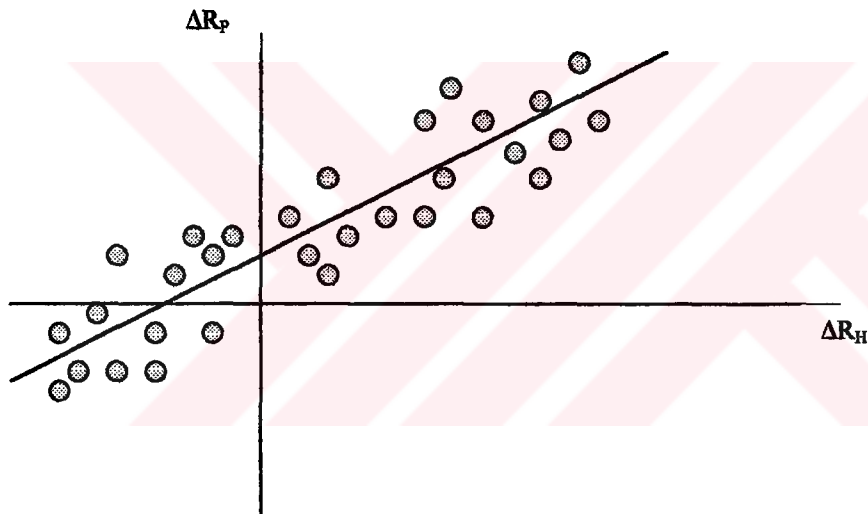


Figure 13 The Minimum Hedge Ratio (regression line.)

The regression gives the theoretical relation between the return on portfolio and return on the futures. The constant term “a” denotes the return on portfolio if the return on futures is zero. The term “h”, which is the hedge ratio represents the degree of the effect caused by the return on futures. For example, if the return on futures is 2, then the effect will be 2h. The regression line presented in Figure 13 shows this relation. The points on the figure represent the error terms, in another saying the fluctuations from the theoretical relation. The aim of the regression equation is to minimise the errors. The

ability of regression to explain the relation between the dependent and independent variables is measured by the coefficient of determination (R^2).

5.2.2 Hedging With Currency Options

The basic strategies in option trading is longing (buying) or shorting (selling) the call or put options. However, those are not the all strategies can be implemented by option traders, there are many complex strategies.

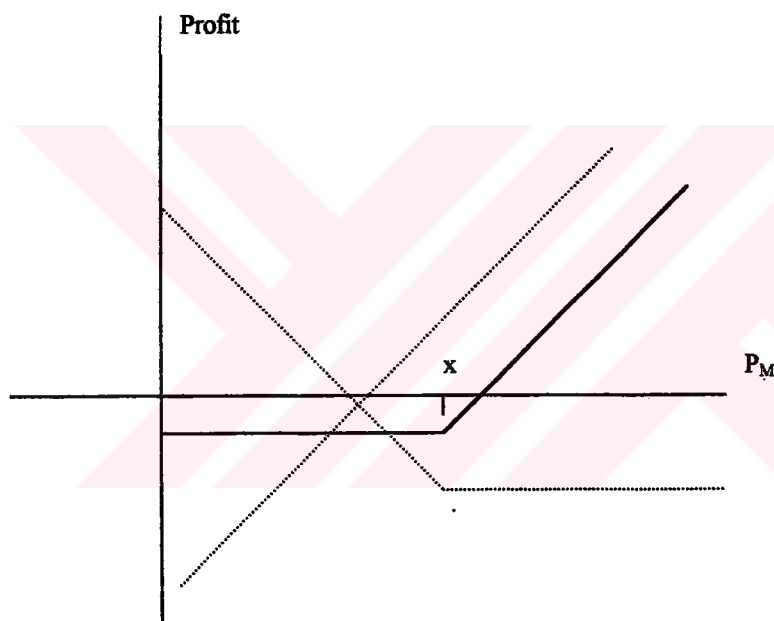


Figure 14 Protective Put

Most of times the traders in the option markets had already had the assets that they buy or sell futures; on the other times they may not. The trading in the option market without an offsetting position on the asset is called *naked position*. The naked position can both exist in call options and put options. If the trader had already had the asset and short in call, the whole position is called *writing a covered call*.

On the other hand, if the trader longs put option while holding the asset, it is called *protective put*. Suppose that a trader holds a cash position or a long futures contract and unwilling to face with a potential loss resulting from the exchange rate movements. If the trader, in what direction the exchange rate fluctuates, implements the protective put strategy, the trader guarantees the payoff equal to the put option's exercise price as the put option gives the trader to sell the cash position at the exercise rate.

In Figure 14, x is the exercise price of the put option at the expiration date and the P_M is the price of the underlying assets till the maturity (the spot exchange rate at maturity); the dashed lines denotes the separate position in the long asset and in the long put, while the line denotes the position in the protective put. As depicted in the figure, if the trader just holds the long position in asset, there is an unlimited potential of loss. However, the combination provides a limit to potential loss while creating an unlimited profit opportunity. The protective put strategy provides a form of portfolio insurance, as it offers some insurance against the price declines.

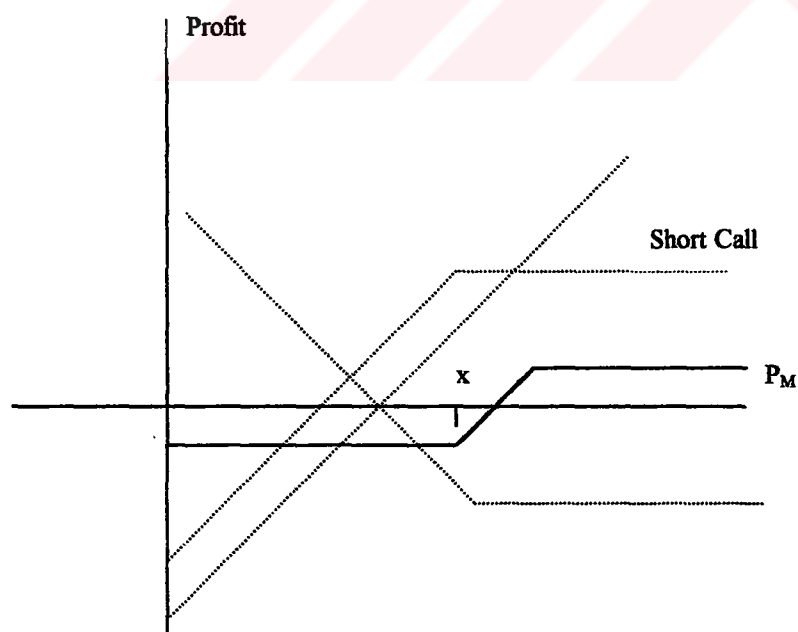


Figure 15 The Collar (A Protective Put + Short Call)

Another strategy related with the protective put is *The Collar*. If the protective put is combined with the short sale of a call option, it is called collar. The purpose of combining the protective put with a short call is offsetting some or all portion of the cost associated with longing put.

In the cases where, the shorting of a call totally covers the cost longing put, it is called *zero-cost collar*. The collar limits the potential profits of protective put while covering the cost of long put. If the price of the asset is higher than the exercise price than the maximum profit is the gains on the long position on asset plus the difference between costs of shorting call and longing put.

In the following sections, more sophisticated option strategies will be illustrated. These strategies are designed according to the expectations of the traders about the future price fluctuations and also utilising of volatility of the assets price as profit making instrument. Main headings for these strategies are the *directional strategies* and the *volatility based or combination strategies*.

5.2.2.1 Directional Strategies

Recalling from the previous section, the implementation of a call or a put strategy is a result of the future expectations about the exchange rate movements. The currency put options are being used for to insure against the currency depreciation and the currency call options are being used against the currency appreciation. So the traders are taking position according to the expected direction of the exchange rate movements.

The directional strategies are formed by taking position in two or more options, which are the same type; either some have same exercise prices and exercise dates or some have different exercise prices and exercise dates. The logic behind implementing a directional strategy that these strategies limit the down side risk, while generating

somehow satisfying profits. The most common types of the directional strategies are the bull and the bear spreads, which are also called vertical spreads.

The vertical spreads are created with the use of two calls or two puts, of which one of them is short and the other is long. The traders choose one of the strategies according to her/his expectation about the future direction of the exchange rates.

Why enter into a vertical spread instead of simply buying a single call or put? the answer is leverage. The proceeds of the sale of short option position reduces the cost of the position, making possible to buy additional spreads so as to leverage a fixed amount of capital. Using the spread transaction also lowers the break-even point of the directional bet.⁴³

5.2.2.1.1 Bull Spreads

The bull spreads are created with the expectation of the exchange rate increases. One creates a bull call spread or put call spread with the same expectation. In the case of bull call spreads, the trader longs a call option, while shorting another call option with same expiration date but with a higher strike price.

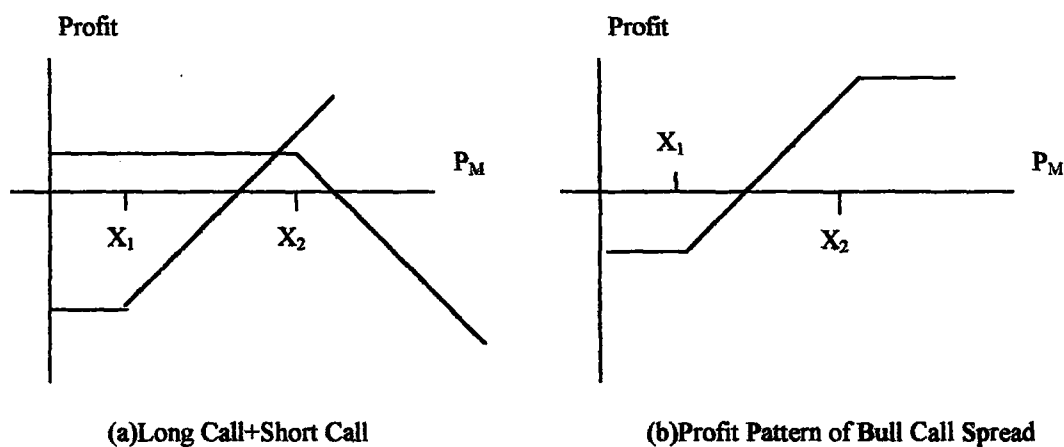


Figure 16 Bull Call Spread

⁴³ Derosa, Op.Cit., p. 72.

The call bull spread limits the potential of profit and the loss on the options. From the Figure 16 (a), if the exchange rate is higher than x_2 at the expiration, the long call option will be exercised but at the same time the short option will have to be exercised. So the initial profit from the bull call spread in the case of $P_M > x_2$ will be strike of long option (x_1) plus premium from shorting option (P_S) minus the strike of short option (x_2) and premium paid for gathering long option (P_L). If the exchange rate is between x_1 and x_2 , then the profit will be the strike price of long option (x_1) plus premium from short option minus the premium paid for long option. The shorting an option will have no value as the exchange rate is higher than the strike price and it will not be exercised. Hence, if the exchange rate is lower than x_1 , $P_M < x_1$, the profit will equal to the difference between the premium gathered from shorting an option and premium paid for gathering a long option. Both of the contracts will not be exercised. It is worth to remind that, the value of a long call option will always be greater than the value of a short call option as the strike price increases will decrease the price of a call option.

Table 17 Profit Pattern of Bull Call Spread

	$P_M > x_2$	$x_1 < P_M < x_2$	$P_M < x_1$
Long Call	$P_M - (x_1 + P_L)$	$P_M - (x_1 + P_L)$	$-P_L$
Short Call	$(x_2 + P_S) - P_M$	P_S	P_S
Total Profit	$(x_2 + P_S) - (x_1 + P_L)$	$P_M - (x_1 + P_L) + P_S$	$P_S - P_L$

Suppose that, at the mean time, options on April the Swiss Franc is quoted as 0.60 and 0.65 for the long call and short call respectively. The cost of long position is 0.0035 and cost for short position is 0.0020. If, at the expiration date, the spot price of the option reaches the at an exchange rate of 0.70, the total profit on one unit for the bull spread will be:

Long Call	$= P_M - (x_1 + P_L)$	$= 0.70 - (0.60 + 0.0035)$	$= 0.0965$
Short Call	$= (x_2 + P_S) - P_M$	$= (0.65 + 0.0020) - 0.70$	$= -0.0480$
Total Profit	$= P_M - (x_1 + P_L) + (x_2 + P_S) - P_M$	$= 0.0965 - 0.0480$	$= 0.0485$

If the spot price falls to 62.0 at the maturity;

Long Call	$= P_M - (x_1 + P_L)$	$= 0.62 - (0.60 + 0.0035)$	$= 0.0165$
Short Call	$= P_S$	$= 0.0020$	$= 0.0020$
Total Profit	$= P_M - (x_1 + P_L) + (x_2 + P_S) - P_M$	$= 0.0165 - 0$	$= 0.0185$

Hence, if the spot price is 0.55 at the maturity:

Long Call	$= -P_L$	$= -0.0035$
Short Call	$= P_S$	$= 0.0020$
Total Profit	$= P_S - P_L$	$= 0.0165 - 0 = -0.0015$

On the other hand the bull put spreads can be created as shorting put option while simultaneously longing a put with lower strike price but with same maturity. The results of the bull put strategy are same as the bull call strategy.

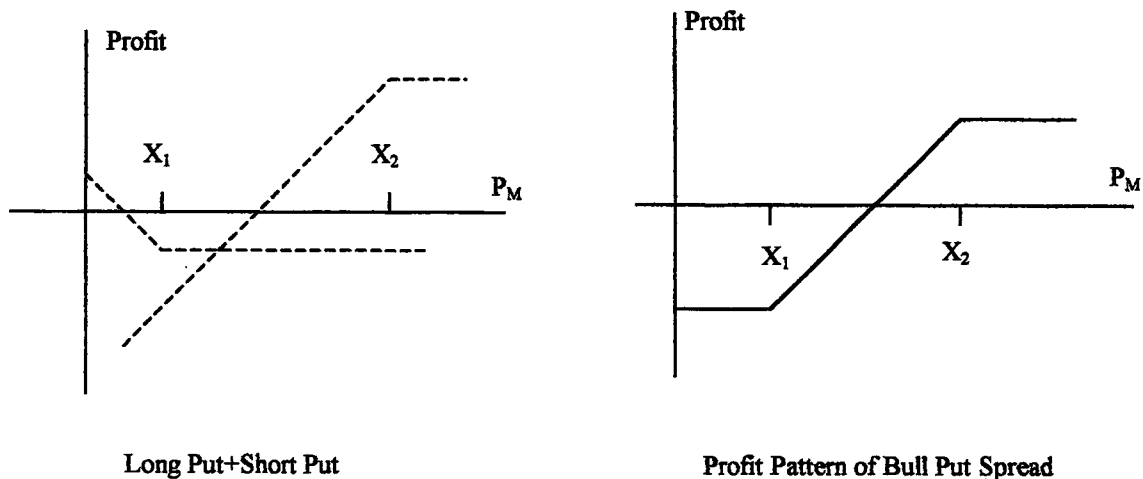


Figure 17 Bull Put Spread

5.2.2.1.2 Bear Spreads

The bear spreads are created with the expectation of exchange rate drop. The bear spreads can also be created as a bear call and bear put. In the case of the bear call spreads, the trader short a call option and long a call option which have higher strike

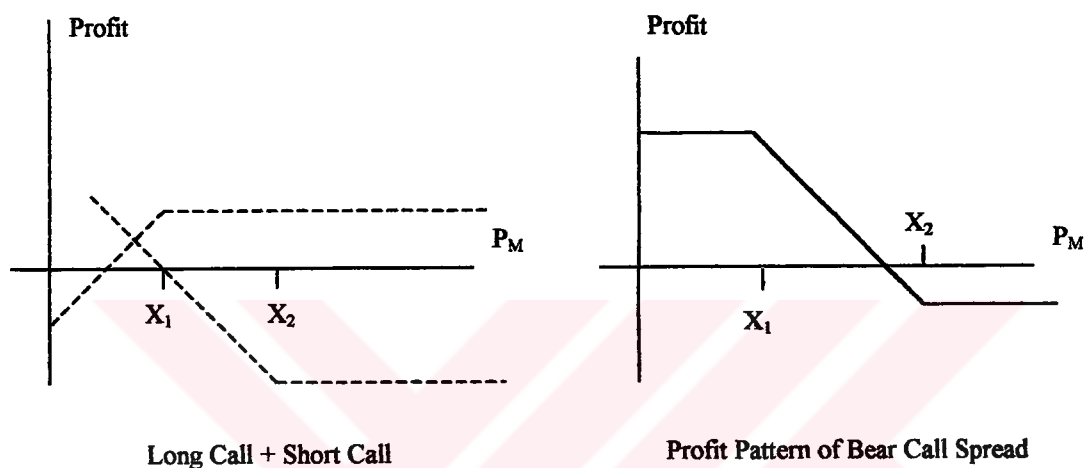


Figure 18 Bear Call Spread

price than the short call. Both options have the same maturity. The profit pattern of such strategy is illustrated below. From the Figure 18, it is easily tracked that the bear spreads, like the bull spreads, limit the potential loss while simultaneously limiting the potential profits.

On the other hand, the bear put spreads can be created by the same way, longing put option with simultaneously shorting another put which has a lower strike price. The profit pattern of such strategy will depend on the spot price at maturity. If the spot exchange rate is greater than x_2 , $P_M > X_2$, the long put and short put on hand will be worthless and the cost of gathering long put will be lost, while cost of gathering options determining the loss. However, on the other hand, if the spot exchange rate lies in between the exercise prices of the long and short put. The result will be: the short put

will be worthless as it will not be exercised, but there will be a gain from the premium taken for shorting put option; plus, x_2 minus the spot exchange rate minus the cost of gathering the long put option.

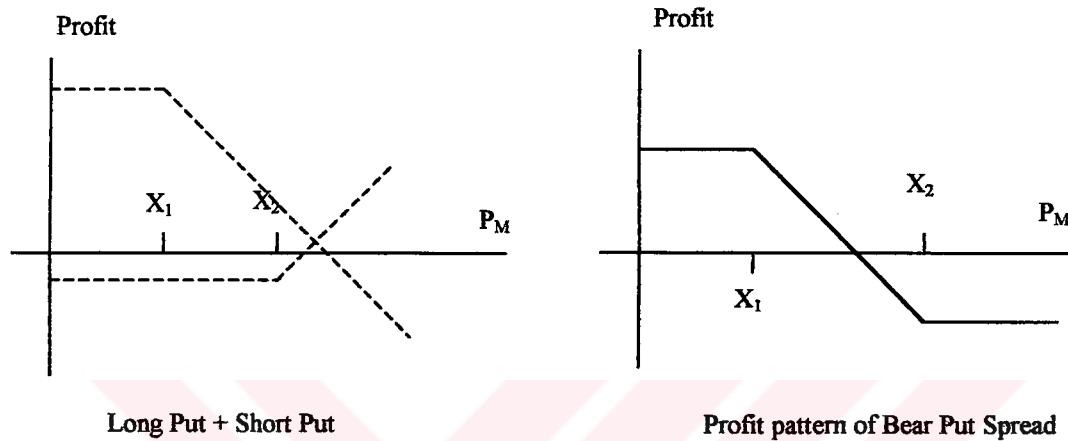


Figure 19 Bear Put Spread

And hence, if the spot price at maturity is below than x_1 , $P_M < x_1$, than both options will be exercised and the profit pattern will be x_2 minus spot exchange rate, minus the cost of acquiring the long put; plus, x_1 minus spot exchange rate plus the premium on shorting put option.

Table 18 Profit Pattern of Bear Put Spread

	$P_M > x_2$	$x_1 < P_M < x_2$	$P_M < x_1$
Long Put	$-P_L$	$x_2 - (P_M + P_L)$	$x_2 - (P_M + P_L)$
Short Put	P_S	P_S	$(P_M + P_S) - x_1$
Total Profit	$P_S - P_L$	$x_2 - (P_M + P_L) + P_S$	$(x_2 - x_1) + (P_S - P_L)$

Take the example that two put options have a strike of 0.70 and 0.65, of which one of then long put and the other is short put options respectively. The cost of long put option is 0.0060; and the cost (premium) of the short put option is 0.0020. If the spot exchange rate at the exercise date is 0.80, than the result will be:

$$\begin{array}{llll}
 \text{Long Put} & = -P_L & = & -0.0060 \\
 \text{Short Put} & = P_S & = & \underline{0.0020} \\
 \text{Total Profit} & = P_S - P_L & = & -0.0040
 \end{array}$$

If the spot exchange rate is in between both of the options strike price 0.67, than the result of the strategy will be:

$$\begin{array}{llll}
 \text{Long Put} & = x_2 - (P_M + P_L) & = 0.70 - (0.67 + 0.0060) & = 0.024 \\
 \text{Short Put} & = P_S & = 0.0020 & = 0.0020 \\
 \text{Total Profit} & = x_2 - (P_M + P_L) + P_S & & \underline{\hspace{1cm}} \\
 & = 0.70 - (0.67 + 0.0060) + 0.0020 & & = 0.026
 \end{array}$$

Hence, if the spot exchange rate is lower than the strike of long put option, 0.50, then the profit will be:

$$\begin{array}{llll}
 \text{Long Put} & = x_2 - (P_M + P_L) & = 0.70 - (0.50 + 0.0060) & = 0.194 \\
 \text{Short Put} & = (P_M + P_S) - x_1 & = (0.50 + 0.0020) - 0.65 & = -0.148 \\
 \text{Total Profit} & = (x_2 - x_1) + (P_S - P_L) & & \underline{\hspace{1cm}} \\
 & = (0.70 - 0.65) + (0.0020 - 0.0060) & & = 0.046
 \end{array}$$

5.2.2.2 Volatility Based Strategies (Combinations)

In the foreign exchange market, there are several types of participants, central banks, commercial banks, brokerage firms, arbitragers, speculators and etc. with different aims. While some are trying to control the exchange rate, the others are trying to carry out

international commerce. On the other hand, some portions of the participants are seeking profit-generating situations in the market place. The volatility in the exchange rate market creates an opportunity for these kinds of participants.

Both call and put prices are positive functions of the volatility of the exchange rates. Using, options, it is possible to take position that are designed to profit from anticipated changes in volatility- something that is not possible using only forward and futures contracts. For example, a long volatility strategy is designed to increase in value when the market experiences or comes to anticipate higher levels of volatility in the exchange rates.⁴⁴

So far, the strategies consist of just put options or just call options are discussed. In the case of the volatility-based strategies both, put and call, will be used in the same strategy. The most common types of volatility based strategies are straddle, strangle, butterfly spreads and the backspreads.

5.2.2.2.1 The Straddle

The traders of the foreign exchange market create straddle strategies for benefiting from the volatility of the market. The straddle is composed of one put option and one call option with same exercise price, both must be long or short. If the straddle is created with longing one put option and one call option, this means that the trader expects huge fluctuations, volatility, in the exchange rates. It is because generation of profit from the long straddle depends on the ability of profit in covering the costs of the longing one put and one call option. This structure can be seen from the figure presented below.

As can be tracked from the figure, the maximum loss on the strategy is limited with the cost of both options. To generate profit, the exchange rate must be lower than B_1 or higher than B_2 ; where B_1 and B_2 denotes the breakeven points for the strategy. The loss

⁴⁴ Ibid.

is limited with the cost of both long options ($P_L^P + P_L^C$). P_L^P and P_L^C denote the cost of long put and long call. There can be three out come of the strategy according to the spot price at the exercise date; $P_M < B_1$, $B_1 < P_M < B_2$, $P_M > B^2$.

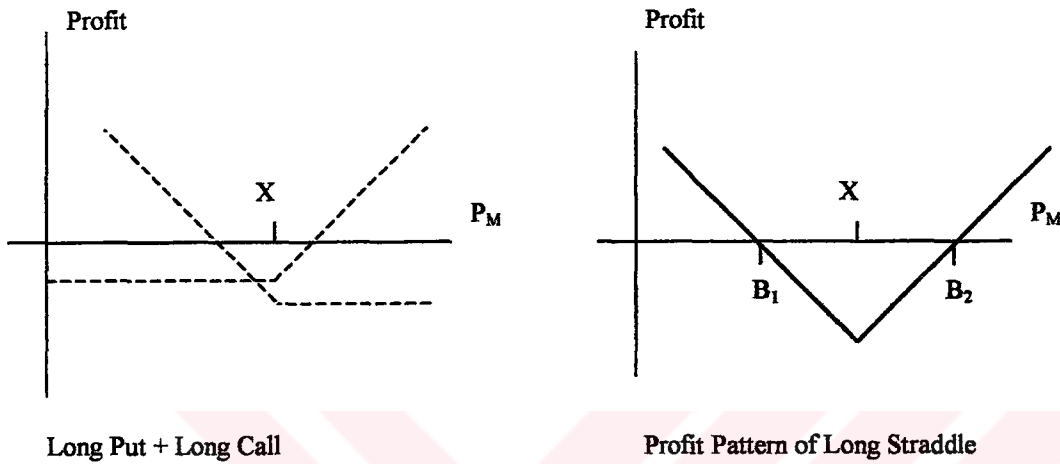


Figure 20 Long Straddle (Bottom Straddle)

It is interesting to discover that the profit formulation of the $P_M < B^1$ and $B_1 < P_M < x$; and the profit formulation of the $P_M > B^2$ and $x < P_M < B_2$ are the same. However, the outcomes for both is differing, while $P_M < B^1$ and $P_M > B^2$ are generating profits, $B_1 < P_M < x$ and $x < P_M < B_2$ are incurring loss. This is because the profit on one option is not high enough to cover the cost of obtaining both options. The maximum loss is realised when the spot exchange rate is equal to the strike price at the maturity.

Table 19 Profit Pattern of Long Straddle

	$P_M < B_1$	$B_1 < P_M < B_2$		$P_M > B_2$
		$B_1 < P_M < x$	$x < P_M < B_2$	
Long Put	$x - (P_L^P + P_M)$	$x - (P_L^P + P_M)$	$-P_L^P$	$-P_L^P$
Long Call	$-P_L^C$	$-P_L^C$	$x - (P_L^C + P_M)$	$x - (P_L^C + P_M)$
Total Profit	$x - (P_L^P + P_L^C + P_M)$	$x - (P_L^P + P_L^C + P_M)$	$x - (P_L^P + P_L^C + P_M)$	$x - (P_L^P + P_L^C + P_M)$

Besides the long straddles created with the expectation of high volatility, the short straddles are created with the expectation of stable exchange rate movements. The trader thinks that the exchange rate will move in a narrow band around the exercise price. The creation involves shorting one put option and one call option with same exercise price. The creation involves shorting one put option and one call option with same exercise price.

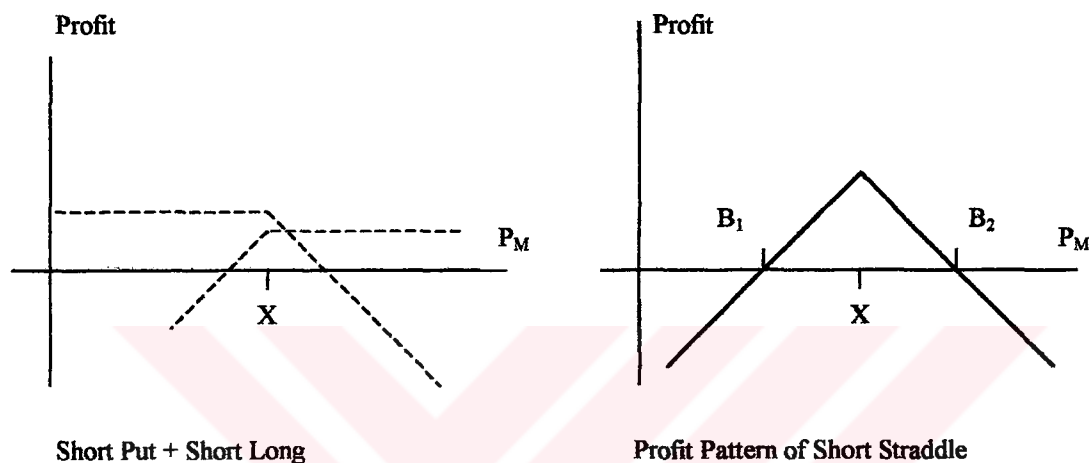


Figure 21 Short Straddle (Top Straddle)

The profit on the short straddle realised if the spot exchange rate at the time of maturity lies in between the breakeven points, B_1 and B_2 . The profit is also limited with the sum of the two premiums received; and realised when the spot exchange rate is equal to the strike price at the maturity. On the other hand, potential loss is incurred if the spot exchange rate exceeds is lower than B_1 , or higher than B_2 , and unlimited.

5.2.2.2.2 The Strangle

Another type of the volatility based strategy is the strangle, which is composed of longing or shorting one put and one call option with different strike prices. The strangle strategy is a very close strategy to straddle, however, in the case of strangle the traders expect huge volatility in the foreign exchange market than in the case of the straddle. And another factor distinguishing the strangle and the straddle is that the calls have higher strike price than puts when forming a strangle.

One can talk about two different strangles, like in the straddle. One is created with longing and the other is created by shorting one put and one call; they are called bottom vertical combination and top vertical combination respectively.

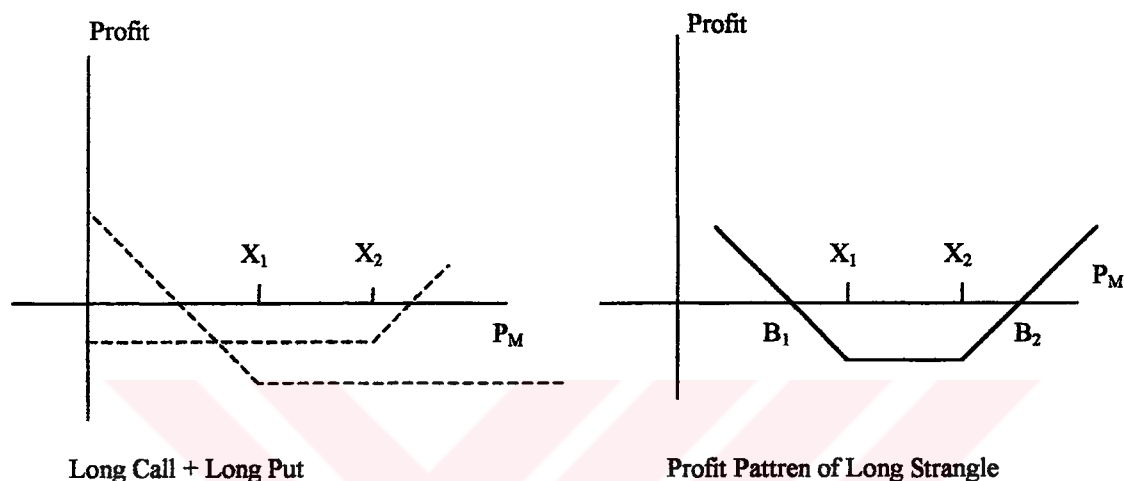


Figure 22 Long Strangle

The long strangle is the combination of longing one call option and longing one put option that has a lower strike price than the call option has. In the long strangle, the profit generation depends on high volatility, than in straddle, in the market.

Note that only one of the options can generate positive cash flows, and these cash flows must be higher than cost of acquiring one long put option and one long call option. If the exchange rate is in between the B_1 and B_2 at the maturity the loss is incurred; however the maximum loss is limited with the cost of acquiring the options. To the left hand side of B_1 and right hand side of B_2 is the profit generating values for exchange rate at the maturity.

On the other hand, traders create short strangle (top vertical combination) when they expect low volatility in the foreign exchange market. The short strangle is created with the same logic of long strangle, shorting one put and longing one call which have higher strike price than the shorted put.

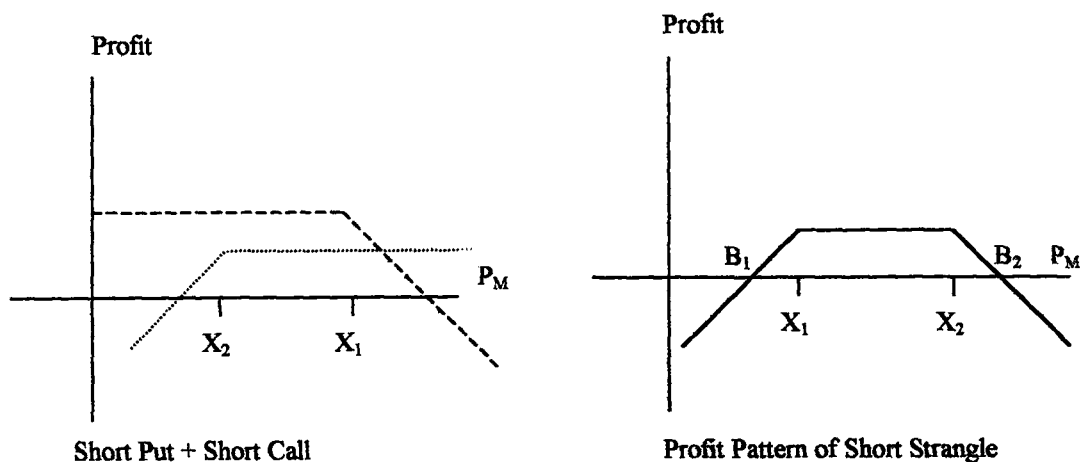


Figure 23 Short Strangle

The short strangle is more conservative strategy than the short straddle, as can be seen from above figure, because the profitability band (B_1 to B_2) in short strangle is higher than as it is in the short straddle. To the left hand side of B_1 and right hand side of B_2 is the loss incurring values for exchange rate at the maturity. The maximum profit is attained when the spot price at the maturity is in between x_1 and x_2 .

Table 20 Profit Pattern of Short Strangle

	$P_M < B_1$	$B_1 < P_M < B_2$		$P_M > B_2$
		$B_1 < P_M < x_1$	$x_2 < P_M < B_2$	
Short Put	$(P_s^P + P_M) - x_1$	$(P_s^P + P_M) - x_1$	P_s^P	P_s^P
Short Call	P_s^C	P_s^C	$P_M - (P_s^C + x_2)$	$P_M - (P_s^C + x_2)$
Total Profit	$(P_s^P + P_s^C + P_M) - x_1$	$(P_s^P + P_s^C + P_M) - x_1$	$x_2 - (P_s^P + P_s^C + P_M)$	$x_2 - (P_s^P + P_s^C + P_M)$

	$B_1 < P_M < B_2$		
	$B_1 < P_M < x_1$	$x_1 < P_M < x_2$	$x_2 < P_M < B_2$
Short Put	$(P_s^P + P_M) - x_1$	P_s^P	P_s^P
Short Call	P_s^C	P_s^C	$P_M - (P_s^C + x_2)$
Total Profit	$(P_s^P + P_s^C + P_M) - x_1$	$P_s^P + P_s^C$	$x_1 - (P_s^P + P_s^C + P_M)$

To be more clear take the example, that a trader expects a little volatility in the French franc for the following year, and implements a strangle strategy. The put and call strikes of French franc options are x_1 and x_2 for, respectively. And the cost of short put is P_S^P , while the cost for call option is P_S^C . The possibility of outcomes is structured in the Table 20.

5.2.2.2.3 Butterfly Spreads

When the traders in the foreign exchange market expect that for the following period time, there will be no huge fluctuation in the market place. The spot price of a specific currency will turn around at the mean time's spot rate for the following days. This expectation can lead the trader to a profit generating strategy under the expected foreign exchange market condition in the option market.

The generation of the butterfly spread is composed of trading four options at the same time with the same maturity, but differing exercise prices. The butterfly spread can also be created for call options and for put options. The butterfly option created with longing calls or longing puts result in the similar outcome. To create a butterfly spread using call option requires longing a call option with strike price of x_1 ; shorting two call options with strike price of x_2 ; and hence longing one more call option with the strike price of x_3 . The same is true for the butterfly spreads created by put options; long one put option with strike of x_1 ; short two put options with strike of x_2 ; and hence long one more put option with strike of x_3 .

The positions of both are illustrated in Figure 20. As can be seen from the figure, the strike price in both of the butterfly spread is ranked through lowest to highest. Whatever the price of the currency is closer around x_2 , left and right hand side, at the exercise date will generate a limited profit for the trader. And a limited loss will be incurred if the spot price at the exercise date is placed far distance to x_2 .

The mechanism of the butterfly spread can be more meaning full with an example illustrating the butterfly spreads with put options. Suppose that a foreign exchange participant expects a stable market for the following months. He/she follows the following strategy.

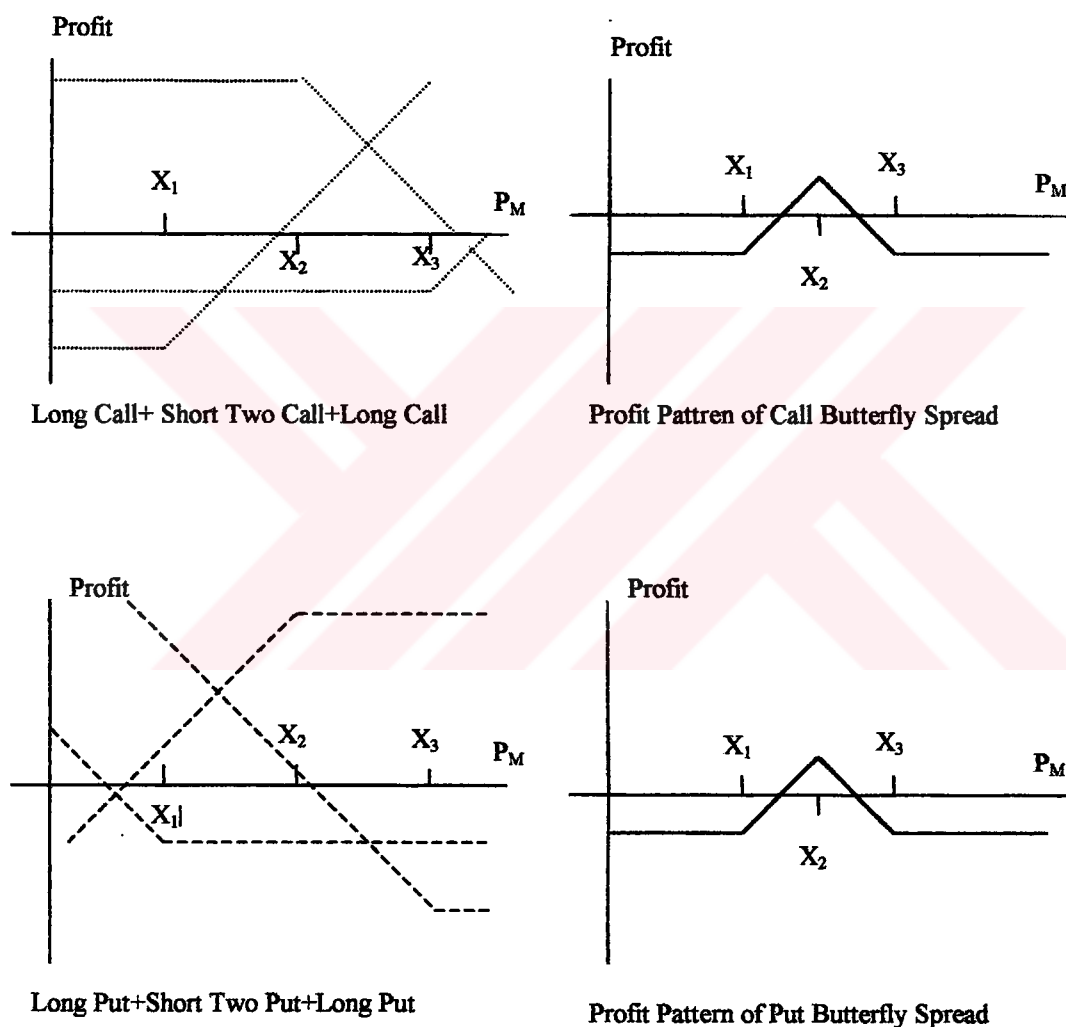


Figure 24 Butterfly Spread with Call and Put Options

First of all, longs two French Francs put options with strike prices 0.50 and 1.00 with same exercise date; which have cost of 0.0020 and 0.0060 respectively. And at the same time, shorts two put options with the strike of 0.75, maturing at the same dates with the

long put options, which have 0.0055 premium on. The results of the butterfly put spread under different spot rates at the maturity will be as follows (supposing that only one option contract is being used).

The spot price at the maturity can take four different values between the strike prices of the options longed as shorten: $P_M > x_3$, $x_3 > P_M > x_2$, $x_2 > P_M > x_1$, and $x_1 > P_M$. Under these possibilities of the spot prices at the maturity the profit from the strategy is illustrated below, Table 21.

Table 21 Profit Pattern of Butterfly Put Spread

	$P_M > x_3$	$x_3 > P_M > x_2$	$x_2 > P_M > x_1$	$x_1 > P_M$
Long Put with 0.50	$-P_{L0.50}$	$-P_{L0.50}$	$-P_{L0.50}$	$x_1 - (P_M + P_{L0.50})$
Long Put with 0.70	$-P_{L0.70}$	$x_3 - (P_M + P_{L0.70})$	$x_3 - (P_M + P_{L0.70})$	$x_3 - (P_M + P_{L0.70})$
Two Short	$2P_S$	$2P_S$	$2(P_M + P_S) - 2x_2$	$2(P_M + P_S) - 2x_2$
Total Profit	$2P_S - (P_{L0.50} + P_{L0.70})$	$x_3 - (P_M + P_{L0.70}) + 2P_S - P_{L0.50}$	$x_3 - (P_M + P_{L0.70}) - 2(P_M + P_S) - 2x_2 - P_{L0.50}$	$x_1 - (P_M + P_{L0.50}) + x_3 - (P_M + P_{L0.70}) + 2(P_M + P_S) - 2x_2$

Now, what is the out come of the strategy:

If $P_M > x_3$; P_M is 0.80 at the time of maturity.

Long Put 0.50	$= -P_{L0.50}$	$= -0.0020$	$= -0.0020$
Long Put 0.70	$= -P_{L0.70}$	$= -0.0060$	$= -0.0060$
Two Short Puts	$= 2P_S$	$= 2 \times 0.0055$	$= 0.0110$
Total Profit	$= 2P_S - P_{L0.70} - P_{L0.50}$		$= -0.0030$

If $x_3 > P_M > x_2$; P_M is 0.85 at the time of maturity.

Long Put 0.50	$= -P_{L0.50}$	$= -0.0020$	$= -0.0020$
Long Put 0.70	$= x_3 - (P_M + P_{L0.70})$	$= 1.00 - (0.85 + 0.0060)$	$= 0.0144$
Two Short Puts	$= 2P_S$	$= 2 \times 0.0055$	$= 0.0110$
Total Profit	$= 2P_S x_3 + (P_M + P_{L0.70}) - P_{L0.50}$		$= \underline{0.0234}$

If $x_2 > P_M > x_1$; P_M is 0.65 at the time of maturity.

Long Put 0.50	$= -P_{L0.50}$	$= -0.0020$	$= -0.0020$
Long Put 0.70	$= x_3 - (P_M + P_{L0.70})$	$= 1.00 - (0.65 + 0.0060)$	$= 0.3440$
Two Short Puts	$= 2(P_M + P_S) - 2x_2$		
	$= 2(0.65 + 0.0055) - 2 \times 0.75$		$= -0.1890$
Total Profit	$= x_3 - (P_M + P_{L0.70}) - 2x_2 - 2(P_M + P_S) - P_{L0.50}$		$= \underline{0.1530}$

If $x_1 > P_M$; P_M is 0.35 at the time of maturity.

Long Put 0.50	$= x_1 - (P_M + P_{L0.50})$	$= 0.50 - (0.35 + 0.0020)$	$= 0.1480$
Long Put 0.70	$= x_3 - (P_M + P_{L0.70})$	$= 1.00 - (0.35 + 0.0060)$	$= 0.6440$
Two Short Puts	$= 2(P_M + P_S) - 2x_2$		
	$= 2(0.35 + 0.0055) - 2 \times 0.75$		$= -0.7900$
Total Profit	$= x_3 - (P_M + P_{L0.70}) - 2x_2 - 2(P_M + P_S) - P_{L0.50}$		$= -0.0002$

Here, the profit pattern of the butterfly put spread is presented; the butterfly call spread's profit pattern can also be structured with the same logic. On the other hand, the butterfly spread can also be created by the use of shorting options. In the case of this shorted butterfly, the traders expects huge fluctuations in the market and trying to take the advantage of the fluctuations. Shorting two puts or calls with the strike prices x_1 and x_3 ; and longing two puts or calls with the strike of x_2 , which is $x_1 < x_2 < x_3$, creates this strategy. Figure 25 presents the strategy.

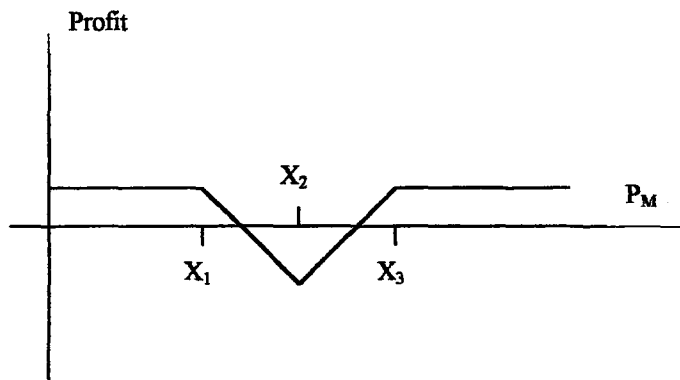


Figure 25 Profit Pattern of Butterfly Spread using Shorts with Different Strikes

5.2.2.2.4 Backspreads

The last type of the volatility strategy to be considered is the backspread. The backspreads consist of long and short positions in puts or calls; however the number of long option position exceeds the number of short option positions. There are mainly two kinds of backspreads, call backspreads and the put backspreads.

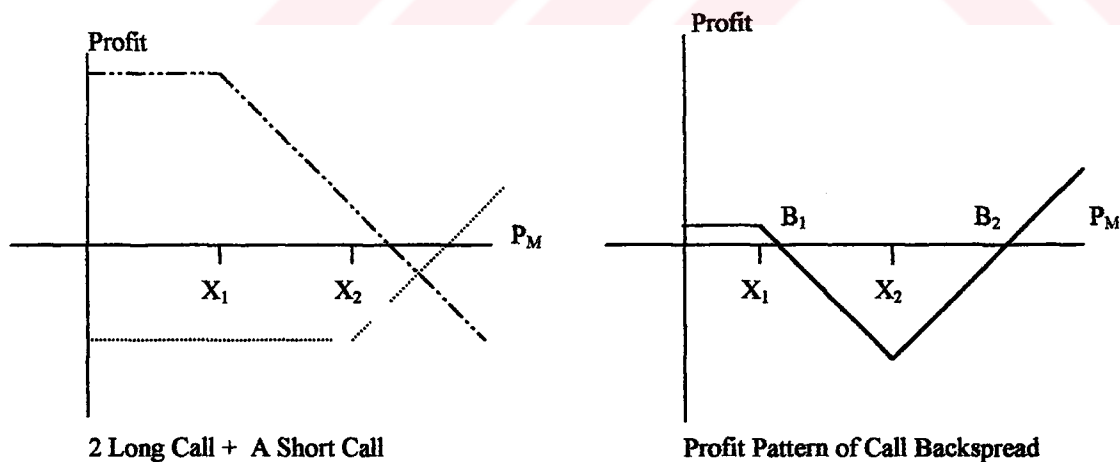


Figure 26 Call Backspreads

The call backspread is the combination of some numbers of long calls and fewer numbers of short calls with lower strike price than the long calls. The graphical

illustration of the strategy is illustrated in Figure 26. The profit potential of the strategy is unlimited, when spot exchange rate at maturity of the option (P_M) is higher than the strike price of call option at a certain degree. This degree is the breakeven point of the strategy (B_2), which there is no profit for the trader. The maximum loss is incurred when the long option is at-the-money, which is the exchange rate at maturity is equal to strike of long call.

Table 22 Profit Pattern of Call Backspreads

	$P_M < x_1$	$x_1 < P_M < x_2$	$P_M > x_2$
Short Put	$x_1 - (P_M + P_S)$	P_S	P_S
Long Put	$-2P_L$	$-2P_L$	$P_M - (P_L + x_2)$
Total Profit	$x_1 - (P_M + P_S + 2P_L)$	$P_S - 2P_L$	$(P_S + P_M) - (P_L + x_2)$

On the other hand, the put backspreads are created by long and shorting put options with the same procedure. The maximum loss is incurred when the spot exchange rate at the maturity of option is equal to the long puts strike. The maximum profit potential is limited with the zero value of the exchange rate at maturity.

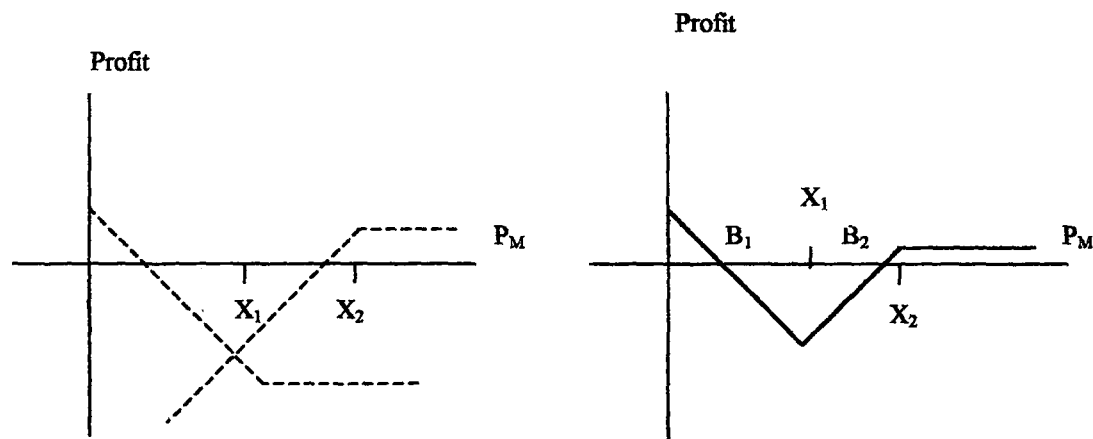


Figure 27 Put Backspreads

5.2.2.3 Delta, Gamma, Theta and Rho

Besides the strategies used for hedging the current position in the market, the determination of the relations between the price of the option with the market components is a vital task for the international money management. In the preceding sections, it is mentioned that several factors are effecting the price of the options, and the price pattern of the options under different situations is taking an important part in the hedging decision. The price pattern of an option is measured by the use of several parameters called: delta, gamma, theta, vega, and rho.,

The *delta* of an option, which is also named as delta hedging, represents sensitivity of the option price to spot market exchange rate changes. That is the change in premium for a small change in the underlying spot market exchange rate.

$$\Delta = \frac{\Delta P_0}{\Delta P_S}$$

The equation above represents the foundation of delta. ΔP_0 is the change in the price of an option call or put, and ΔP_S represents the change in the spot exchange rate.

The delta also reflects the probability that the option will expire in-the-money. Delta ranges from 0.0 for far out-of-money option to 1.0 for deep in-the-money options. Delta is obviously affected by the relationship of strike price to the current market rate; it can also be affected by the volatility of the option market and the time to expiry.⁴⁵ The possibility of the buyer of the option, which is deep in-the-money, would exercise the option as there is little chance that spot price of the assets will exceed the strike price. The vice versa is true for in deep out-of-money call option. In another saying as delta of an option increases the possibility of the option being exercised is also increases.

The delta of an option is subject to change over time, as it is effected from the changes in the spot market and the volatility of the option market. So, in the case of a delta hedging the, the hedging should be periodically examined and adjusted.

The *gamma* basically measures the frequency of the adjustments to the delta hedging of a portfolio. That is, the gamma is the measure of the change in delta as result of change in the spot market; in another saying, it is the sensitivity of delta to the exchange rate changes in the spot market. If the gamma is low, this denotes a stable delta over time and no need for a frequent adjustment. However, if gamma is high than frequent adjustment is necessary, as delta is highly sensitive to the spot market fluctuations. In the case of a portfolio consists of options, the holder of the portfolio tries to make his/her portfolio *gamma neutral*.

As the price of the underlying contract changes by a certain amount, delta changes by gamma times that amount. Gamma is largest for options which are at-the-money, and decreases steadily to zero for options which are very deep in-the-money (where delta is close to 1 and approximately constant) or out-of-the-money (where delta is close to zero and approximately constant). This is shown in Figure 28.⁴⁵

The *theta*, on the other hand reflects the change in the value of an option or portfolio of options according to change in the time to expiry. Knowing how time decay works is important in establishing strategies. If one shorts options, one would like to structure the deal so that time decay is faster rather than slower. Similarly, if one were long options, one would tend to avoid strategies with rapid time decay, all else being equal.

The volatility of the option market may have an important effect on the value of an option or the value of a portfolio of options. Thus, *vega* measures the effects of

⁴⁵ Paul Bishop, & Don Dixon, *Foreign Exchange Handbook*, McGraw-Hill Inc., 1992, p. 296.

⁴⁶ Richhild Moessner, Over the Counter Interest Rate Options, Research Papers in Finance, Center for Central Banking Studies, Bank of England, February 2001, p.68.

volatility on the value of the option. The vega is normally positive for long option positions, and negative for short option positions.

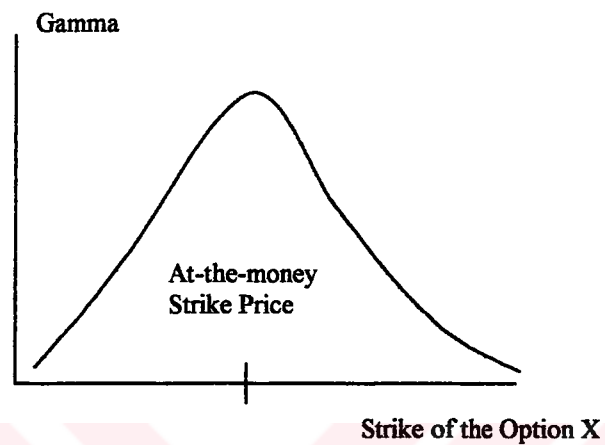


Figure 28 Gamma of a long call or put option position. (Source: Richhild Moessner, Over the Counter Interest Rate Options, Research Papers in Finance, Center for Central Banking Studies, Bank of England, February 2001, p. 69).

The interest rates are the main components of the economy, thus all of the assets are effected from the changes in the interest rates. In determining the specific hedging strategy the sensitivity of the asset to the interest rates is very important. So, hence, the last parameter to be considered is the ρ ; which is the measure of the interest rate effects on the value of the option.

6. AN APPLICATION OF CROSS HEDGING

The rapid globalisation of the world economy geared up the competition in the world trade, and force the worldwide companies and investors to find new cost reducing and return increasing sources. The result is the increasing volume of the foreign direct and portfolio investments. The overseas investments are mostly directed to the so called "Emerging Markets" and "Developing Countries". There are mainly two reasons for this direction: The first one is the huge human resources offered by these countries with lower costs compared to the developed countries; and the second one is the better risk/return investment combinations (Harvey 1994).⁴⁷

At the same time, the investors faced with a risk, which is directly effecting the variance of the investment's returns, called the foreign exchange rate risk. The foreign exchange rate risk is broadly the risk of exchange rate fluctuations within the investment time horizon. If the investment is made in the developed countries, there are several ways to overcome the exchange rate risk. The main procedure is using the financial derivatives to hedge the current risk. The main instruments are the forwards, futures, options and the swaps contracts. This procedure can be called as the "Direct Hedging", as the risk associated with a currency can be hedged with one of the derivative instruments available on that currency. Hedging, in the case of the long run policies, is design for to stabilise the returns not to enhance the returns; a firm or an investor should think of currency hedging as having zero expected return (Thomas, 1989; Prolid & Schulman, 1988)⁴⁸.

⁴⁷ Campbell Harvey, *Predictable Risk and Returns in Emerging Markets*, NBER, Working Paper No:4621, 1994.

⁴⁸ Lee R. Thomas, *The Performance of Currency-Hedged Bonds*, Financial Analysts Journal, May-June, 1989, p. 25-31.

Andrea F. Prolid, & Evan C. Schulman, *The free Lunch In Currency Hedging: Implications for Investment Policy and Performance Standards*, Financial Analysts Journal, May-June, 1988, p. 45-50.

However, the problem the emerging markets is that they do not have an effective financial market for direct hedging. In most of the emerging markets, the forward contracts are illiquid and as are traded in huge amount, they are not efficient in many cases. On the other hand, the futures and the options markets are limited or absent at all. Also, the exchange rate controls and the regulations restrict the transactions in the financial markets.

Since currencies for which no organised derivative markets exists are by and large currencies of countries with poorly developed capital markets, alternative hedging methods such as borrowing or lending in those currencies are either limited or not available, making cross hedging a rather unique way of managing risk exposure to those currencies.⁴⁹

In such cases, the absence of the efficient derivatives markets, the investors and firms may use derivative instruments on other assets that are traded at different markets whose prices are correlated with the foreign exchange rate. This is called “Cross Hedging”. For example, an investor who is subject to a currency risk, as a result of its long position in Turkish Lira, may want a protection against currency fluctuations. As the major derivatives market is not effective and even non existent in Turkish economy, the spot currency risk position can be covered by a futures contract on other currency in other developed financial markets, like the German Mark or the Canadian Dollar futures.

Cross-hedging entails the use of a futures contract in an asset to reduce the risk related to a cash position in another asset that differs materially in location, type, grade or maturity date. Three factors determine the measured effectiveness of cross-hedges:

1. The true correlation between assets;
2. The accuracy of estimates of the risk-minimising hedge ratio;

⁴⁹ Udo Broll, Kit P. Wong, Itzhak Zilcha, *Multiple Currencies and Hedging*, *Economica*, 1999, vol. 66; p. 421.

3. The stability of the true hedge ratio over time.⁵⁰

Although, the cross-hedging practices are mainly applied with the utilisation of the future contracts, the option contracts can also be used.

In the following sections, the illustration of the currency futures cross-hedging and its effectiveness on the portfolio will be investigated. The single and multiple cross-hedging practices for Turkish Lira with world's major currency futures will be examined.

6.1 LITERATURE REVIEW

The main procedure applied in hedging with futures and cross hedging steamed from the Markowitz (1952)⁵¹ mean-variance methodology. The mean-variance methodology was applied to futures by some studies like Johnson (1960)⁵² and Ederington (1979)⁵³. The hedging with futures contracts and testing effectiveness of the direct hedging with futures were applied by the Grammatikos & Saunders (1983)⁵⁴ and Eaker & Grant (1987)⁵⁵. However, the theoretical development of the cross-hedging applications started with the Anderson and Danthine (1981)⁵⁶, who extended the single hedge models to a multivariate case. Following Anderson and Danthine, several studies are devoted to the implementation of the cross-hedging methodology and examining the performance of cross hedging in reducing the foreign exchange risk.

⁵⁰ Mark R. Eaker & Dwight D. Grant, *Cross Hedging of Foreign Currency Risk*, Journal of International Money and Finance, vol. 6, 1987, p. 6.

⁵¹ Harry Markowitz, *Portfolio Selection*, Journal of Finance, 1960, March, vol. 7, no. 1, p. 77- 91.

⁵² Leland L. Johnson, *The Theory of Hedging and Speculation in Commodity Futures*, Review of Economic Studies, vol. 27, 1960, p. 139-151.

⁵³ Louis H. Ederington, *The Hedging Performance of the New Futures Markets*, Journal of Finance, 1979, March, vol. 34, no.1, p.157-170.

⁵⁴ Theoharry Grammatikos, & Antohony Saundres, *Stability and the Hedging Performance of Foreign Currency Futures*, Journal of Futures Markets, vol. 3, no. 3, 1983, p. 296-305.

⁵⁵ Eaker & Grant, Op. Cit., p. 85- 105.

The cross-hedges are mainly established through the usage of the currency futures on major currencies. DeMaskey (1997)⁵⁷ investigated the effectiveness of the cross hedging of the minor European and Asian with five leading currency future contracts. The study is carried on the testing the effectiveness of the in-sample and out-of-sample hedging effectiveness. Another study carried by DeMaskey and Aggarwal (1997)⁵⁸ states that currency risks in Asian emerging markets can be effectively cross hedged using futures and options in developed country currencies such as (especially) the Japanese yen. With the same manner, Eaker and Grant (1987)⁵⁹ showed that the cross hedging was effective in hedging currency risks. However, they also presented that the cross hedges were not effective as the direct hedging activities. Instead of the currency future contracts, Eaker and Grant used the gold futures contracts to hedge the same currency risk position. However, the cross hedges implemented by using gold future contracts were found to be ineffective.

Braga, Martin and Meilke (1989)⁶⁰ investigated the hedging effectiveness of the Deutsche mark futures on the Italian Lira/ US Dollar exchange rate. This study showed that the exchange rate risk of Italian lira/ US dollar can be cross-hedged with using the Deutsche mark futures.

On the other hand, some studies illustrated the performance of the commodity futures on the cross hedging of the foreign exchange rate risk. Benet (1990)⁶¹ used commodity futures contracts, which were chosen according to the “primary export commodity” hypothesis, to construct cross hedges against unanticipated movements of thirteen minor

⁵⁶ Ronald W. Anderson & Jean P. Danthine, *Hedging and Joint Production: Theory and Illustrations*, Journal of Finance, 1980, May, vol. 35, no.5, p. 487-498.

⁵⁷ Andrea L. DeMaskey, *Single and Multiple Cross Hedging with Currency Futures*, Multinational Finance Journal, 1997, vol.1, no.1, p. 23-46.

⁵⁸ Raj & DeMaskey, Op Cit., p. 88-95.

⁵⁹ Eaker & Grant, Loc. Cit.

⁶⁰ Francesco S. Braga, Larry J. Martin, Karl D. Meilke, *Cross Hedging the Italian Lira/US Dollar Exchange Rate with Deutsche Mark Futures*, The Journal of Futures Markets, 1989, vol. 9, no.2, p.87-99.

⁶¹ Bruce A. Benet, *Commodity Futures Cross Hedging of Foreign Exchange Exposure*, The Journal of Futures Markets, 1990, vol.10, no.3, p. 287-306,

currencies. And the results showed that export commodity futures were equally effective and even more stable, in comparison with the currency futures contracts.

Mun and Morgan (1997)⁶² investigated the effectiveness of cross hedging from the point of deposit money banks. Their study shows that how effectively the foreign currency asset and liability positions held by the depository banks of the five emerging Asian countries can be hedged by using five currency futures. The study presents that the minimum variance cross hedge with either single currency futures contracts or multiple currency futures contracts gives better results than the unhedged position for all of the sample countries.

Some academicians look the cross hedging from the point of exporting firm. Broll and Eckwert (1999)⁶³ stated that a firm could reduce its income risk by engaging in a hedging activity with assets that are correlated with to the foreign exchange rate. Their finding is that the hedging decision and the production decision can not be separated as the assets in a firm's portfolio is correlated with the exchange rate.

6.2 DATA AND METHODOLOGY

There is one data set used for constructing the cross hedges and test the efficiency of the cross hedges. The data set covers period from December 31, 1981 to December 29, 2000. The data is composed of monthly spot prices of US dollar per Turkish Lira and the monthly future prices of Deutsche marks, British pound, Swiss francs, Japanese yen and the Canadian dollars traded on Chicago Mercantile Exchange. The currency futures contract specifications of CME is given in Appendix I at the end of the text. The monthly spot prices for the TL/US dollar is obtained from the web site of the Central

⁶² Kyung-Chun Mun & George E. Morgan, *Cross Hedging Foreign Exchange Rate Risk: The Case of Deposit Money Banks in Emerging Asian Countries*, Pacific-Basin Finance Journal, 1997, vol. 5, p. 215-230.

⁶³ Udo Broll & Bernhard Eckwert, *Export and Indirect Hedging of Foreign Currency Risk*, The Japanese Economic Review, 1999, vol5, no.3, p. 356-362.

Bank of Turkey.⁶⁴ On the other hand, the monthly futures price data are obtained from the “Grainmarketresearch” web site.⁶⁵ The data present the spot prices of TL/US dollars as of the last day of the month; with the same manner, the future prices are all settlement prices in US dollars as of the last day of the month.

As the futures contracts have four delivery months in a year: March, June, September and December; there will be three holding periods for each of the futures contracts until the expiry date. There will be 12 months holding periods for each year in the sample.⁶⁶ So, for the data set there are 228 observations for each of the futures contract during 19 years.

In the case of foreign investments, investors have basically two strategies for the return on the foreign currency. The first one is to wait until the end of the investment period and convert the foreign currency based return to the domestic currency. On the other hand, the second strategy is to hedge the current investments against the unexpected exchange rate movements. Hedging decision depends on the availability and the efficiency of the derivatives market. If such market exist direct hedging strategies are applied. The effectiveness of the direct hedging strategies were proved by the studies of the Grammatikos & Saunders (1983)⁶⁷ and Eaker & Grant (1987)⁶⁸ However, as noted earlier the availability of the effective derivative markets is limited in some countries. So, investor has to construct cross hedge the investment with available financial derivatives abroad against the exchange rate risk.

The implementation of the cross hedge with futures contracts is generally based on the mean-variance objective function of the hedger.⁶⁹

⁶⁴ <http://www.tcmb.gov.tr>

⁶⁵ <http://www.grainmarketresearch.com>

⁶⁶ As suggested by Eaker & Grant (1987) and DeMaskey (1997).

⁶⁷ Grammatikos & Saundres, Loc. Cit.

⁶⁸ Eaker & Grant, Loc. Cit.

$$\begin{aligned} \text{Min}_{\beta_i, \beta_j} \text{Var}(C_{Ht}) = & \text{Var}(C_{st}) + \sum \beta_i^2 \text{Var}(C_{fit}) + 2 \sum \beta_i \text{cov}(C_{st}, C_{fit}) \\ & + 2 \sum \sum \beta_i \beta_j \text{cov}(C_{fit}, C_{fit}) \end{aligned}$$

which is subject to:

$$C_{0Ht} = E(C_{st}) + \sum \beta_i E(C_{fit})$$

where;

C_{st}, C_{fit} = the price change during period t of the spot and i^{th} futures contracts, respectively;

C_{0Ht} = the target expected change in value during period t of a portfolio invested in a fixed level of spot currency and n futures contracts, each in proportion β_i .

β_i = the proportion of integer number of contracts. Thus β_i would equal the hedge ratio with $\beta_i < 0$ representing a short position and $\beta_i > 0$ representing a long futures position.⁷⁰

The equation presented above will lead to the foundation of optimal or least-risk hedge ratios, β^* . The optimal hedge ratios can be derived by an multivariate ordinary least square (OLS) regression of a single spot position on a single or multiple futures positions, as implemented by Ederington (1979) and Anderson & Danthine (1981). The general form of the empirical cross hedging regression equation is as follows:

$$C_{st} = a + \beta_1 C_{fit} + \beta_2 C_{fit} + \dots + \beta_n C_{fit} + u$$

The multivariate OLS regression gives the optimal hedge ratios β^* , which are obtained from the estimates of β_i . The estimation of optimal hedge ratios, β^* , are calculated by regression of the first differences of spot prices on the first differences of the futures prices. That is, the model adopted in this study is logarithmic. In another saying, the returns of the spot and futures prices are used in the calculations of the optimal hedge ratios. The aim of utilising price differences and than taking logarithm of these

⁶⁹ See Benet (1990) and DeMaskey (1997).

differences is to overcome the potential problems of autocorrelation and unit root problem.

The R^2 , the correlation of determination, found by the OLS regression, represents the optimal hedge ratio effectiveness in the sample sub-periods. The correlation of determination is calculated for each sub-period. However, as the optimal hedge ratios can not be calculated before the end of the period, the calculated effectiveness of optimal hedge ratios are only the measures of potential hedging effectiveness. The real measure of the hedging effectiveness is calculated by implementation of the prior sub-periods optimal hedge ratios to the following sub-periods. For example, first period's optimal hedge ratios will be implemented to the second period; and the second period's optimal hedge ratios will be implemented to the third period; and so on. The degree of effectiveness of the prior sub-period effectiveness is denoted by e .

The whole data set is divided into two sub-periods. The first sub-periods starts from December 31, 1981 and ends at June 6, 1991; the second period covers the data from July 31, 1991 to December 29, 2000. In each sub-period the number of observations are 114. The sub-periods are determined in accordance with the adequate sample size for statistical purposes, as Benet (1990) suggested.

The hedging strategy described above called a *naive strategy* as it uses past period's optimal hedging ratios for the next period. The period that the optimal hedging ratios are gathered is called the estimation period or in-the sample or *ex-post* period. These *ex-post* estimated ratios are implemented in the hedging period, which is also called out-of-sample or *ex-ante*. This strategy is applied with the assumption that the relation between the spot prices and the futures prices are stable over time. However, the estimated optimal hedge ratios may be instable for whole period; so an effective optimal hedge ratio can be in effective in the next period. The reason for this instability is mostly

⁷⁰ Benet, Op. Cit., p.289.

related with the structural changes in the exchange rate regimes; or same international agreements on the exchange rates, like the Plaza Agreement in 1987 and Louvre Accord in 1987. If such instability exists among the optimal hedge ratios, the naive strategy will present unsatisfactory results. So, the test for the intertemporal stability of the optimal hedge ratios is necessary. The stability tests are handled by using the dummy variables as Gujarati (1978)⁷¹ suggested in the form of:

$$C_{st} = \alpha + \beta_i \sum C_{fit} + \gamma_1 \sum D_1 C_{fit}$$

where,

C_{st} = the different in spot price during period t ,

C_{fit} = the difference in the prices of the i^{th} futures contract during period t ,

$D_1 = 1$ for the period December 31, 1981 to June 6, 1991; and 0 if not,

The symbol γ_1 represents the coefficients that show if any structural shifts occurred during the period of the test. On the other hand, the symbol β_i denote the optimal hedge ratio during the related period. The definition of D_1 is made for the dummy test that will be using in the “full data” period. And as stated earlier, for the statistical purposes, the “full data” set is divided into two sub-periods. So there is only one dummy variable is defined to find out if any structural changes occurred during the period.

However, the global financial market may directly effect the exchange rate market, the structural changes in the global financial markets should be modified to the test. There are two main structural changes in the world that directly effects the exchange rates, as stated by Demaskey (1997), the Plaza Agreement in September 1985 and the Louvre Accord in February 1987⁷². Hence, now there are three sub-periods in the “full data”

⁷¹ Gujarati, Damondar; *Basic Econometrics*; McGraw-Hill; New York; 1978

⁷² The Plaza Agreement: The Group of Ten members meet at the Plaza Hotel in New York to sign an international cooperative agreement to control the volatility of worl currency markets and to establish currency target zones.

set. The stability test will be repeated again for the sub-periods. Now the equation for the stability test will be as follows:

$$C_{st} = \alpha + \beta_1 \sum C_{fit} + \gamma_1 \sum D_1 C_{fit} + \gamma_2 \sum D_2 C_{fit} + \varepsilon$$

where

C_{st} = the different in spot price during period t ,

C_{fit} = the difference in the prices of the i^{th} futures contract during period t ,

$D_1 = 1$ for the period December 31, 1981 to August 31, 1985; and 0 if not,

$D_2 = 1$ for the period September 31, 1985 to December 31, 1987; and 0 if not.

6.3 EMPIRICAL RESULTS

With the utilisation of the data and the methodology presented below several statistics were gathered. These statistics were interpreted in the subsequent sections.

The empirical results are presented in three parts:

- i. The Test for Correlation: Presents the correlation in between the Turkish lira and the selected CME traded future contract prices.
- ii. Hedging and Efficiency: Presents the results of the OLS estimation process and the estimates of the optimal hedge ratios and their subsequent efficiency.
- iii. Test for Stability: Presents results of the test for checking if those estimated hedge ratios are stable over time.

The Louve Accord: the Group of Six member state that they will “intensify” economic policy coordination to promote global growth and reduce external imbalances; members agree that current exchange rates are “consistent with underlying economic fundamentals”. (Source: Eiteman; Stonehill; Moffett; Multinational Business Finance; Addison-Wesley Publishing Company; 7th Edition; 1995; p. 36.

6.3.1 Test for Correlation

The existence of a correlation between the spot position and the futures contracts is the first pre-requisite for construction of a cross hedge. Below tables presents the correlation matrix for Turkish Lira and the selected futures contracts. The Table 23 presents the correlation in the variables during the coverage of the data set.

Table 23 Correlation Matrix

	TL	DM	BP	SFR	YEN	CAD
TL	1.0000	0.3394	0.1735	0.3132	0.1484	0.1569
DEM	0.3394	1.0000	0.7023	0.9313	0.5956	0.0967
GBP	0.1735	0.7023	1.0000	0.6797	0.4432	0.2123
CHF	0.3132	0.9313	0.6797	1.0000	0.6359	0.0652
JPY	0.1484	0.5956	0.4432	0.6359	1.0000	0.0969
CAD	0.1569	0.0967	0.2123	0.0652	0.0969	1.0000

The shaded areas on the tables present the correlation of TL with the corresponding futures contract. For the “full data” set, the most strong correlated futures contract with TL is the Deutsche mark futures contract. The following, the Swiss franc futures contract is second most correlated contract; and the rank for the remaining from most strong correlation to least is British sterling futures, Canadian dollars futures and the Japan yen futures respectively. The correlations between the Turkish lira and the selected futures contracts are all positive, which is consistent with the suggestions of the Benet (1990)⁷³ and DeMaskey (1987)⁷⁴

The positive correlation between the Turkish lira and the selected futures contracts is determined. However, the determination of the correlation between the variables is not sufficient for constructing a cross hedge in between. Anderson & Danthine (1981)⁷⁵

⁷³ Benet, Op Cit., 288.

⁷⁴ DeMaskey, Op Cit., p. 24.

⁷⁵ Anderson & Danthine, Op. C.t., p. 1188.

stated that the cross hedges are in order whenever the cash/futures correlation is a constant different than zero.

Below, Table 24 represents the correlation test statistics. From the Table 23, which represents the test results for “full data” set, it can be seen that the correlations between the futures contracts and the Turkish lira is different than zero at 5 per cent level. If any of correlation of Turkish lira and futures contract is not different than zero at 5 per cent level that futures contract can not be used for the cross hedging purposes.

Table 24 Test for Correlation

	STATISTIC	T-TEST
TL-DEM	5.4248	1.9600
TL-GBP	2.6484	1.9600
TL-CHF	4.9577	1.9600
TL-JPY	2.2554	1.9600
TL-CAD	2.3877	1.9600

6.3.2 Hedging and Efficiency (R^2)

The cross hedging effectiveness of the Turkish Lira with the selected futures contracts are presented in the Table 25 and Table 26. As stated earlier the effectiveness is measured according to the OLS regression of the returns of the spot Turkish Lira against the returns of the selected futures contracts. Each of the return is calculated against US dollars.

The foundations presented in the tables are restricted with the significant coefficients and the highest R^2 cross hedges for comparison purposes. The other non-significant coefficients will not be presented in the tables. The reason for this is that the non-significant coefficients do not have an important effect in the foreign exchange risk reduction. This will be clearer in examining the tables. The whole of the foundations will be presented in the Appendix II.

The symbol β^* represents the optimal hedge ratio for the specific futures contracts for the specific time period. Likewise, the R^2 reported for each period denotes the optimal in-the-sample cross hedging effectiveness. As stated earlier, the optimal hedge ratios can not be estimated prior to the end of the periods; so the priory calculated hedge ratios could be used for hedging. Hence, the symbol e denotes the out-of-sample hedging effectiveness of the cross hedge, the effectiveness of the previous hedge ratio in the following sub-period (which is also called ex-post hedging effectiveness)

Table 25 Single Cross Hedges

		PERIOD I	PERIOD II
DEM	β^*	0,398	0,316
	R^2	0,412	0,043
	e		0,262
GBP	β^*	0,274	0,068
	R^2	0,196	0,002
	e		0,207
CHF	β^*	0,351	0,274
	R^2	0,349	0,040
	e		0,240
JPY	β^*	0,217	0,070
	R^2	0,122	0,003
	e		0,229
CAD	β^*	0,254	0,480
	R^2	0,019	0,022
	e		0,216

The Table 25 represents the hedging effectiveness for the data set for the single cross hedges. The first period effectiveness of the single cross hedges varies between the futures contracts, however the effectiveness is valid for each of them. For the first period (in-the-sample), the most effective hedging result is obtained by using the Deutsche mark futures contracts, the hedging effectiveness, R^2 , is 0.412 with a hedge ratio of, β^* , 0.398; and the Swiss francs futures contracts is the second most effective with 0.349 with a hedge ratio of, β^* , 0.351; for the first period. These results are

meaningful, as these futures contracts are the most correlated ones with the Turkish lira. For the other futures contracts the cross-hedging effectiveness is range from 0.156 for British pounds and 0.19 for the Japanese yen futures contracts.

Table 26 Multiple Cross Hedges

		PERIOD I	PERIOD II
DEM	β^*	0,535	0,338
JPY		-0,184	-0,044
	R^2	0,450	0,044
	e		0,272
CHF	β^*	0,482	0,307
JPY		-0,175	-0,061
	R^2	0,380	0,042
	e		0,261
DEM	β^*	0,451	0,418
CHF		0,103	0,388
JPY		-0,205	0,133
	R^2	0,454	0,044
	e		0,275
DEM	β^*	0,465	0,382
GBP		-0,033	0,264
CHF		0,122	0,117
JPY		0,203	-0,061
	R^2	0,455	0,059
	e		0,330

The Table 26 represents the hedging effectiveness of the cross hedges constructed by multiple futures contracts. The first period effectiveness of the multiple cross hedges are higher than the single cross hedges, these results are consistent with the findings of the DeMaskey (1997) and the Eaker & Grant (1987). The most effective hedges are attained by the usage of the combination of four futures contracts (Deutsche mar, British pound, Swiss francs and the Japanese yen futures contracts) and the combination of three futures contracts (Deutsche mark, Swiss franc and Japanese yen futures contracts) the R^2 s are 0.455 and 0.454 respectively. However, these two combinations are not significant at 5% level, so the combination size does not have a statistical significant

effect on the effectiveness of the hedge. Which means that to construct a much more effective hedge, there is no need to use more than two futures contracts. The combination of the Deutsche mark – Japanese yen and Swiss franc-Japanese yen futures contracts have 0.450 and 0.380 R^2 respectively, which are also statically significant at 5% level.

On the other hand, the second period effectiveness is much less than the first period for both of the single and multiple hedges as can be seen from Table 25 and Table 26. The most effective contract is the Deutsche mark futures and the second one is Swiss franc futures contract, the R^2 s are 0.043 and 0.040, and the optimal hedge ratios are 0.316 and 0.274 respectively for the single hedges. For the multiple hedges the effectiveness of the combinations slightly different from each other varies in a range of 0.42 and 0.59. These in-the-sample hedging effectiveness results for the second period are so small that the foreign exchange risk can not be eliminated with the estimated optimal hedge ratios in any of the futures contracts. However, if the first periods' hedge ratios are implemented in the second period, the hedging effectiveness dramatically increases, which is shown by e . For example for the Deutsche mark futures contract while the hedging effectiveness, R^2 , is 0.43, the out-of-sample hedging effectiveness, e , is 0.262. With the same manner the effectiveness of Swiss franc futures contract increases from 0.040, R^2 , to 0.240, e . For the multiple futures hedging effectiveness the result is the same for every combinations. For the statistically significant multiple hedges (Deutsche mark-Japanese yen and Swiss franc-Japanese yen) the hedging effectiveness, R^2 s, increase from 0.044 and 0.042, to 0.272 and 0.261 out-of-sample hedging effectiveness, e .

The OLS test implemented above have one vital result, that is the estimation period, in-the-sample, optimal hedge ratios are effective in reducing the foreign exchange risk on the hedging period, out-of-sample. In another saying, the estimated optimal hedge ratios in the first period are effective when they are implemented in the second period.

However, there is question to be answered: why the effectiveness of the estimated second period's optimal hedge ratios are so little? The Table 25 and Table 26 presents that there is a great difference in the hedging effectiveness, R^2 , between two periods. For example, while Deutsche mark futures hedge has an effectiveness of, R^2 , 0.412 in the first period; its effectiveness degree decreases to 0.043 in the second period. The answer to this question is that the effectiveness of the estimated optimal hedge ratios, R^2 s, are depend on the relation between the return on Turkish lira and the selected futures contracts. If any unusual changes occurred in one of the variables, the ability of the optimal hedge ratio effectiveness in reducing foreign exchange risk is limited. If the second period data is investigated, it is seen that there are three unusual data exists. These data are the ones that correspond to the 1994 financial crisis realised in the Turkish financial system. These data are January 31, March 31 and the April 29, in which the returns on the Turkish lira calculated in US dollars are -0.17, -0.19 and -0.41 respectively. The effect of the 1994 financial crisis on the data and the relation between the variables is clearer when the variances in the return of Turkish lira for the second period is calculated with and without these three data. The variance of the second period is 0.002 including the unusual data, and 0.0005 when the unusual data is excluded. The conclusion is that the effect of the 1994 crisis is vital on the cross-hedging effectiveness.

6.3.3 Test for Stability

The above tables through Table 23 and Table 26 the optimal hedge ratio estimates and their corresponding effectiveness are presented. As noted in the earlier, three factors determine the measured effectiveness of cross-hedges:

1. The true correlation between assets;
2. The accuracy of estimates of the risk-minimising hedge ratio;
3. The stability of the true hedge ratio over time.

The first two is satisfied in the previous sections; for the last step the hedge ratio stability between the period will be investigated.

The stability of the hedge ratios between the periods is important as the relationship estimated in one period may be change and the effectiveness of the hedges based on these estimates may be limited. The possible reasons of the instability may be some structural shifts in the foreign currency market as a whole or some country specific policy changes may effect the validity of the relation between the periods. The stability of the hedge ratios are tested with using two different time scale. The first test presents if any instability exists between the periods priory defined. And the recond test is handled according to the DeMaskey's (1990) suggestions.

$$C_{st} = \alpha + \beta_i \sum C_{fit} + \gamma_1 \sum D_1 C_{fit}$$

where

C_{st} = the different in spot price during period t ,

C_{fit} = the difference in the prices of the i^{th} futures contract during period t ,

$D_1 = 1$ for the period December 31, 1981 to June 6, 1991; and 0 if not,

Stability test is done as follows; as the null-hypothesis is $\gamma = 0$, that means that coefficient of the dummy variables are not statistically significant. In another saying, there are no significant shifts in the optimal hedge ratios between the sub-periods. Tests are done at 5% significance level.

In Table 27 first row of the table presents the estimated γ coefficient of the regression equation, second row is the significance of the test statistics. The rejection criteria is if the second row, significance of the test statistics, is less than 0.05 the null hypothesis can not be rejected. That means the optimal hedge ratios are stable between the periods. The foundations in the Table 27 and Table 28 present stability tests for the single and

multiple hedges. As can be seen from these tables, all significance test statistics are less than 0.05 and the null hypothesis can not be rejected. Which is that the estimated relation between the periods is stable over time.

Table 27 Stability Test for Single Cross Hedges

	TURKISH LIRA	
	γ_1	R^2
DEM	0,0082 0,559	0,117
GBP	0,192 0,214	0,037
CHF	0,083 0,006	0,100
JPY	0,174 0,186	0,030
CAD	-0,284 0,440	0,027

The second stability test is handled to see if the international structural shifts have a great effect on the relation between the periods. In this test the data is divided into three sub-periods, December 31, 1981 to August 31, 1985; September 31, 1985 to December 31, 1987; and from January 31, 1987 to December 29, 2000. Tests is handled using the equation below:

$$C_{st} = \alpha + \beta_i \sum C_{fit} + \gamma_1 \sum_i D_1 C_{fit} + \gamma_2 \sum_i D_2 C_{fit} + \varepsilon$$

where

C_{st} = the different in spot price during period t ,

C_{fit} = the difference in the prices of the i^{th} futures contract during period t ,

$D_1 = 1$ for the period December 31, 1981 to August 31, 1985; and 0 if not,

$D_2 = 1$ for the period September 31, 1985 to December 31, 1987; and 0 if not.

Table 28 Stability Test for Multiple Hedges

	TURKISH LIRA	
	γ_1	R^2
DEM	0,169	0,123
JPY	0,349	
	-0,0096	
	0,559	
CHF	0,142	0,105
JPY	0,425	
	-0,006	
	0,732	
DEM	0,190	0,124
	0,635	
CHF	-0,001	
JPY	0,978	
	-0,102	
	0,560	
DEM	0,0064	0,136
	0,877	
GBP	0,201	
	0,328	
CHF	-0,00003	
	0,999	
JPY	-0,0091	
	0,601	

Stability test is done as follows; as suggested by DeMaskey (1997) the null-hypothesis is $\gamma_1 = \gamma_2 = 0$, that means that coefficient of the dummy variables are not statistically significant. In another saying, there are no significant shifts in the optimal hedge ratios between the sub-periods. Tests are done at 5% significance level.

In Table 29 and Table 30 first two rows of the table presents the estimated γ coefficients of the regression equation, third row is the significance of the test statistics. The rejection criteria is if the second row, significance of the test statistics, is less than 0.05 the null hypothesis can not be rejected. That means the optimal hedge ratios are stable between the periods.

Table 29 Stability Test for Single Cross Hedges for Three Periods

	TURKISH LİRA		
	γ_1	γ_2	R^2
DEM	-0,0013 0,937	0,303 0,158	0,124
GBP	0,0037 0,829	0,164 0,589	0,031
CHF	-0,0056 0,732	0,269 0,195	0,106
JPY	0,127 0,510	0,324 0,126	0,033
CAD	0,280 0,545	-0,0042 0,954	0,026

Table 30 Stability Test for Multiple Cross Hedges for Three Periods

	TURKISH LİRA		
	γ_1	γ_2	R^2
DEM	-0,00078 0,974	0,0046 0,210	0,130
JPY	-0,00054 0,983	-0,151 0,648	
CHF	-0,126 0,596	0,506 0,212	0,114
JPY	0,144 0,674	-0,243 0,544	
DEM	0,241 0,566	0,680 0,418	0,132
CHF	-0,288 0,486	-0,268 0,782	
JPY	0,0043 0,873	-0,103 0,806	
DEM	0,181 0,690	0,550 0,519	0,132
GBP	0,107 0,679	-0,0009 0,978	
CHF	-0,284 0,504	-0,151 0,881	
JPY	0,0017 0,952	-0,145 0,733	

Consistent with the first stability test, the second stability test presents that the relation between the periods do not have a structural shifts during test period. All the all significance test statistics are less than 0.05 and the null hypothesis can not be rejected.



7. CONCLUSION

The thesis presented here, purposes to present the major foreign exchange derivatives instruments to manage or control the foreign exchange risk and their possible usage for international investors and firms. The main focus is placed on the foreign exchange rate risk management with usage of the foreign exchange futures while there is no futures exists in the financial system.

The risk management process for any entity starts with the identification of the risk born by the entity's operations. After identification of the risks, the second process is the measurement of the risk, which is what degree the entity is subject to risk. Hence, the last step is to manage the risk, if it is necessary. The management of risk entails to investigation of the possible risk management tools and selection of the best available alternative. This last step is important for the decision-makers because the selected alternative of the risk management tool has to provide a value to the entity in risk reduction.

The introduction of the freely flexible exchange rate system in 1970s, increased the volatility of the foreign exchange rates in the world financial markets. Following the recent trend of the financial markets towards to the globalisation of the world economy, which causes the integration of the financial markets, increased effects of the volatility in the foreign exchange markets. The integration is not just by means of trade or investments, but also by means of risks. Because the realised crisis in one part of the world can effect the other part easily. So, globalisation means freely flow of funds, capital, human force and also risk. Thus the exchange rate risk formed one of the major risks for international investors and international firms. The need for protection against

volatility in the exchange rates born the need for managing foreign exchange risk, and hence the need for foreign exchange derivative instruments.

The existence of the derivative instruments eases the management of the foreign exchange risk at some extent. However, while the derivatives markets are well developed in many industrialised countries, the availability of the derivative instruments is limited in most of the developing countries, availability in the sense of existence and efficiency. So the management of the foreign exchange risk for the foreign investors in those countries is limited. At this point, the possibility of the cross-hedging alternatives is to be investigated. Cross hedging can be defined as the utilisation of one or more futures contracts or options for hedging a cash position that is not directly deliverable under the terms of the futures contract. It is a technique to reduce risk when direct hedging of a cash position is inefficient or impossible, as in the case of many developing country's' markets currencies, where markets for forward and futures contracts and for options are either non-existent or inadequate

It is well known that the foreign exchange market in Turkey is not stable and the value of the Turkish Lira continuously is tried to be controlled by the governments. In the cases where the high inflation is realised and the possibility of devaluation exists, the ability of forecasts to estimate the futures exchange rates is a hard process and even impossible. Hence, the importing firms and the foreign investors are systematically subject to high risk of exchange rate in Turkey.

The study investigates if it is possible to manage Turkish Lira exchange rate risk and reduce the risk by using cross hedges traded in different countries. The study showed that the Turkish Lira exchange rate risk could be manageable and also reducible when the cross hedging is implemented. The cross hedging of Turkish Lira risk is, at some extent, as effective as any other cross hedges implement by other studies shown in the cross hedging literature.

However, some currencies, especially the European currencies, have definitely high cross hedging effectiveness than cross hedging effectiveness in Turkish Lira. The reasoning of this could be bound to the several reasons. As stated, the effectiveness of the cross hedging is highly effected by the correlation between the spot position currency and the hedging currency. That is if one wishes to construct a cross hedge the Turkish Lira risk with Deutsche Mark futures, there must be a strong relation between the spot price of the Turkish Lira and futures price of Deutsche Marks. The existence such relation depends on the integration and interrelation between those markets. As the European Union manages the relation in European countries, there is high integration and interrelation in between. This statement explains why European currencies, like Italian Lira, Spanish Peseta etc. have higher cross hedging effectiveness when they are hedged with European currencies. The same statement could be placed when the Far East countries are investigated. The cross hedging is more effective when those currencies are cross-hedged with the Japanese Yen futures. The weight of Japanese economy in the region and the high relation of other countries with Japanese financial markets lead high cross hedging effectiveness for those currencies.

The results of the analysis implemented in the study depends on the exclusion of the costs of construction of a cross hedge, the requirements of the futures contracts transactions, like the effects of margin requirements and any other procedures in using futures contracts, as it is in most of the studies in the literature. However, this exclusions do not have a vital effect on the usefulness of the study, because the main aim is to present an alternative path for exchange rate risk controlling in Turkey for international investors. Hence the basic conclusion is that the cross hedges are effective for managing Turkish Lira exchange rate risk and reduce the risk by using cross hedges.

Although, the cross hedging is effective, its effectiveness could not be compared to those hedge implemented by direct instruments for all currencies. As the literature on hedging with derivative instruments shows while the cross-hedging effectiveness is approximately in between 70% and 50%, the effectiveness of the direct hedges is in

between 95% and 90%. This reality presents the need for derivative markets in all financial systems. However, it has to be noted that existence is not solely a solution, these markets have also be liquid for efficiency.

Hence, as the predicability of the future prices is very important for stabilisation of the financial markets; Turkey, as a developing country trying to attract foreign investments, has to develop financial markets in which the future prices could be predicted. As the role of derivatives markets in determining reference prices can not be ignored, the need for such derivatives markets is significant in Turkish financial system. The construction of such market must be focus on the risk reduction factor in financial markets especially in foreign exchange market.



APPENDIX I CME CURRENCY FUTURES CONTRACT SPECIFICATIONS

Product & Trading Unit	Point Description	Contract Listings	Strike Price Intervals	Product Codes	Trading Venues				Minimum Fluctuation	
					Name	Hours	Listed	Strike	Price Limits	Tick
BRITISH POUND FUTURES 62,500 pounds sterling (British pounds)	1 point = \$.0001 per pound sterling = \$.625 per contract	Six months in the March Quarterly Cycle Mar, Jun, Sep, Dec.	N/a	Clearing=BP Ticker=BP GLOBEX2=6B AON=LP	FLOOR	7:20 a.m.-2:00 p.m. LTD	All listed series	n/a	No limits	0.0002=\$12.50
					GLBX2	Mon/Thurs 4:30 p.m.-4:00 p.m.; Sun & Hol 5:30 p.m.-4:00 p.m.	All listed series plus 3 calendar spreads	n/a	No limits	0.0002=\$12.50
										0.0001=\$6.25

Product & Trading Unit	Point Description	Contract Listings	Strike Price Intervals	Product Codes	Trading Venues				Minimum Fluctuation	
					Name	Hours	Listed	Strike	Price Limits	Tick
DEUTSCHE MARK FUTURES 125,000 Deutsche marks	1 point = \$.0001 per Deutsche mark = \$12.50 per contract	Delisting 12/17/2001 with the expiration of Dec. 2001. Three months in the March Quarterly Cycle. Mar, Jun, Sep, Dec.	n/a	Clearing=D1 Ticker=DM	GLBX2	Mon/Thurs 4:30 p.m.-4:00 p.m. Sun and Hol 5:30 p.m.-4:00 p.m. LTD	First three March Quarterly Months	n/a	No limits	0.0001=\$12.50
										0.00005=\$6.25

Product & Trading Unit	Point Description	Contract Listings	Strike Price Intervals	Product Codes	Trading Venues					Minimum Fluctuation	
					Name	Hours	Listed	Strike	Price Limits	Type	Tick
JAPANESE YEN FUTURES 12,500,000 Japanese yen	1 point = \$.000001 per Japanese yen = \$12.50 per contract	Six months in the March Quarterly Cycle, Mar, Jun, Sep, Dec. S	n/a	Clearing=J1 Ticker=JY GLOBEX2=6J AON=LJ	FLOOR	7:20 a.m.-2:00 p.m. LTD	All listed series	n/a	No limits	Regular	0.000001=\$12.50
										Calendar Spread	0.0000005=\$6.25
										All or None	0.0000005=\$6.25
					GLBX2	Mon/Thurs 4:30 p.m.-4:00 p.m. Sun & Hol 5:30 p.m.-4:00 p.m.	All listed series plus 3 calendar spreads	n/a	No limits	Regular	0.000001=\$12.50
										Calendar Spread	0.0000005=\$6.25

Product & Trading Unit	Point Description	Contract Listings	Strike Price Intervals	Product Codes	Trading Venues					Minimum Fluctuation	
					Name	Hours	Listed	Strike	Price Limits	Type	Tick
SWISS FRANC FUTURES 125,000 Swiss francs	1 point = \$.0001 per Swiss franc = \$12.50 per contract	Six months in the March Quarterly cycle, Mar, Jun Sep, Dec.	n/a	Clearing=E1 Ticker=SF GLOBEX2=6S AON=LS	FLOOR	7:20 a.m.-2:00 p.m. LTD	All listed series	n/a	No limits	Regular	0.0001=\$12.50
										Calendar Spread	0.00005=\$6.25
										All or None	0.00005=\$6.25
					GLBX2	Mon/Thurs 4:30 p.m.-4:00 p.m. Sun & Hol 5:30 p.m.-4:00 p.m.	All listed series plus 3 calendar spreads	n/a	No limits	Regular	0.0001=\$12.50

Product & Trading Unit	Point Description	Contract Listings	Strike Price Intervals	Product Codes	Trading Venues					Minimum Fluctuation	
					Name	Hours	Listed	Strike	Price Limits	Type	Tick
CANADIAN DOLLAR FUTURES	1 point = \$.0001 per Canadian dollar = \$10.00 per contract	Six months in the March Quarterly Cycle, Mar, Jun, Sep, Dec.	n/a	Clearing=C1 Ticker=CD GLOBEX2=6C AON=LK	FLOOR	7:20 a.m. - 2:00 p.m. LTD	All listed series	n/a	No limits	Regular	0.0001=\$10.00
										Calendar Spread	0.00005=\$5.00
										All or None	0.00005=\$5.00
100,000 Canadian dollars					GLBX2	Mon/Thurs 4:30 p.m.-4:00 p.m. Sun & Hol 5:30 p.m.-4:00 p.m.	All listed series plus 3 calendar spreads	n/a	No limits	Regular	0.0001=\$10.00
										Calendar Spread	0.00005=\$5.00

APPENDIX II ENTIRE FINDINGS OF OLS REGRESSION

1. HEDGING WITH SINGLE CONTRACT

		PERIOD I	PERIOD II
DEM	β^*	0,398	0,316
	R^2	0,412	0,043
	e		0,262
GBP	β^*	0,274	0,068
	R^2	0,196	0,002
	e		0,207
CHF	β^*	0,351	0,274
	R^2	0,349	0,040
	e		0,240
JPY	β^*	0,217	0,070
	R^2	0,122	0,003
	e		0,229
CAD	β^*	0,254	0,480
	R^2	0,019	0,022
	e		0,216

2. HEDGING WITH TWO MULTIPLE CONTRACTS

		PERIOD I	PERIOD II
DEM	β	0,5350	0,3380
JPY		-0.1840	-0.0440
	R2	0,4500	0,0440
	e		0,2720
CHF	β	0,4820	0,3070
JPY		-0.0175	-0.0610
	R2	0,3800	0,0420
	e		0,2610
DEM	β	0.4310	0.4700
GBP		-0.0440	-0.2600
	R2	0.4140	0.0570
	e		0.2636
DEM	β	0.4130	0.2460
SFR		-0.0163	0.0660
	R2	0.4120	0.0430
	e		0.2618
DEM	β	0.3990	0.3270
CAD		-0.0160	0.5110
	R2	0.4120	0.0680
	e		0.2617

		PERIOD I	PERIOD II
GBP	β	0.0139	-0.2080
SFR		0.3420	0.3790
	R2	0.3490	0.0500
	e		0.2402
GBP	β	0.2060	0.0480
JPY		0.0790	0.0610
	R2	0.2060	0.0040
	e		0.2186
GBP	β	0.2720	0.0330
CAD		0.0220	0.4700
	R2	0.1960	0.0230
	e		0.2077
SFR	β	0.3490	0.3070
CAD		0.0370	-0.0610
	R2	0.3490	0.0420
	e		0.2412
JPY	β	0.2090	0.0590
CAD		0.1700	0.4700
	R2	0.1300	0.0250
	e		0.2237

3. HEDGING WITH TRIBLE CONTRACTS

		PERIOD I	PERIOD II
DEM	β	0,4510	0,4180
CHF		0,1030	0,3880
JPY		-0.2050	0,1330
	R2	0,4540	0,0440
	e		0,2750
DEM	β	0.4330	0.3990
GBP		-0.0440	-0.2600
SFR		-0.0020	0.0670
	R2	0.4140	0.0570
	e		0.2636
DEM	β	0.5510	0.4980
GBP		-0.0230	-0.2630
JPY		-0.1810	-0.0500
	R2	0.4510	0.0580
	e		0.2725
DEM	β	0.4150	0.2050
SFR		-0.0160	0.1170
CAD		-0.0170	0.5180
	R2	0.4170	0.0690
	e		0.2681
SFR	β	0.4800	0.3370
JPY		-0.1740	-0.0870
CAD		0.0250	0.5480
	R2	0.3810	0.0700
	e		0.2621

		PERIOD I	PERIOD II
GBP	β	0.0107	-0.3060
SFR		0.3420	0.4470
CAD		0.0320	-0.6380
	R2	0.3500	0.0870
	e		
DEM	β	0.5390	0.0150
JPY		-0.1850	0.0560
CAD		-0.0370	0.4670
	R2	0.4510	0.0250
	e		0.2721
GBP	β	0.0270	0.2280
SFR		0.4650	0.1100
JPY		-0.1770	-0.0540
	R2	0.3810	0.0440
	e		0.2616
GBP	β	0.2230	0.3590
JPY		0.0800	-0.0630
CAD		0.0320	0.5240
	R2	0.2070	0.0700
	e		0.2197
DEM	β	0.4310	0.5420
GBP		-0.4400	-0.3570
CAD		-0.0005	0.6320
	R2	0.4140	0.0940
	e		0.2636

4. HEDGING WITH FOUR CONTRACTS

		PERIOD I	PERIOD II
DEM	β	0,4650	0,3820
GBP		-0.0330	0,2640
CHF		0,1220	0,1170
JPY		0,2030	-0.0610
	R2	0,4550	0,0590
	e		0,3300
DEM	β	0.5520	0.5870
GBP		-0.0210	-0.3650
JPY		-0.1810	-0.0770
CAD		-0.0290	0.6500
	R2	0.4510	0.0970
	e		0.3201
DEM	β	0.4550	0.1770
CHF		0.1030	0.1840
JPY		-0.2060	-0.0840
CAD		-0.0360	0.5390
	R2	0.4540	0.0720
	e		0.3302

		PERIOD I	PERIOD II
GBP	β	0.0260	-0.3220
CHF		0.4640	0.5130
JPY		-0.1770	-0.1080
CAD		0.0130	0.6700
	R2	0.3810	0.0930
	e		0.3152
DEM	β	0.4330	0.4070
GBP		-0.0440	-0.3590
CHF		-0.0020	0.1300
CAD		-0.0070	0.6400
	R2	0.4140	0.0950
	e		0.3188

5. HEDGING WITH FIVE CONTRACTS

		PERIOD I	PERIOD II
DEM	β	0.4670	0.3790
GBP		-0.0300	-0.3700
CHF		0.1110	0.2110
JPY		-0.2030	-0.0980
CAD		-0.0240	0.6690
	R2	0.4550	0.0420
	e		0.3309

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