Universidad del CEMA

Master in Finance

Research Work

Advantages and Disadvantages of a Hedge for the Exchange-Rate Risk in the Spot FX Market and Futures Market

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Abstract

It is the purpose of this research work to compare the advantages and disadvantages of using the Spot Forex and Futures markets to hedge the exchange-rate risk, thus providing with the necessary tools to chose either for one or other market based on the characteristics of each hedging.

On the other hand, this work has the purpose of explaining the way the spot Forex market works, which is not often explained on the books, especially to hedge the exchange-rate risk. In general, academic books which discuss hedging for the exchange-rate risk limit themselves to deal with the Futures market, Forwards Contracts and Options.

The Gold Exchange and the Bretton Woods Agreement

In 1967, a Chicago bank refused a college professor by the name of Milton Friedman a loan in pound sterling because he had intended to use the funds to short the British currency. Friedman, who had perceived sterling to be priced too high against the dollar, wanted to sell the currency, then later buy it back to repay the bank after the currency declined, thus pocketing a quick profit. The bank's refusal to grant the loan was due to the Bretton Woods Agreement, established twenty years earlier, which fixed national currencies against the dollar, and set the dollar at a rate of $35 per ounce of gold.

The Bretton Woods Agreement, set up in 1944, aimed at installing international monetary stability by preventing money from fleeing across nations, and restricting speculation in the world currencies. Prior to the Agreement, the gold exchange standard--prevailing between 1876 and World War I--dominated the international economic system. Under the gold exchange, currencies gained a new phase of stability as they were backed by the price of gold. It abolished the age-old practice used by kings and rulers of arbitrarily debasing money and triggering inflation.

But the gold exchange standard didn't lack faults. As an economy strengthened, it would import heavily from abroad until it ran down its gold reserves required to back its money; consequently, the money supply would shrink, interest rates rose and economic activity slowed to the extent of recession. Ultimately, prices of goods had hit bottom, appearing attractive to other nations, who would rush into buying sprees that injected the economy with gold until it increased its money supply, and drive down interest rates and recreate wealth into the economy. Such boom-bust patterns prevailed throughout the gold standard until the outbreak of World War I interrupted trade flows and the free movement of gold.

After the Wars, the Bretton Woods Agreement was founded, where participating countries agreed to try and maintain the value of their currency with a narrow margin against the dollar and a corresponding rate of gold as needed. Countries were prohibited from devaluing their currencies to their trade advantage and were only allowed to do so for devaluations of less than 10%. Into the 1950s, the ever-expanding volume of international trade led to massive movements of capital generated by post-war construction. That destabilized foreign exchange rates as setup in Bretton Woods.

The Agreement was finally abandoned in 1971, and the US dollar would no longer be convertible into gold. By 1973, currencies of major industrialized nations floated more freely, as they were controlled mainly by the forces of supply and demand. Prices were floated daily, with volumes, speed and price volatility all increasing throughout the 1970s, giving rise to new financial instruments, market deregulation and trade liberalization.

In the 1980s, cross-border capital movements accelerated with the advent of computers and technology, extending market continuum through Asian, European and American time zones. Transactions in foreign exchange rocketed from about $70 billion a day in the 1980s, to more than $1.5 trillion a day two decades later.

The Explosion of the Euromarket

A major catalyst to the acceleration of Forex trading was the rapid development of the eurodollar market; where US dollars are deposited in banks outside the US. Similarly, Euromarkets are those where assets are deposited outside the currency of origin. The Eurodollar market first came into being in the 1950s when Russia's oil revenue-- all in dollars -- was deposited outside the US in fear of being frozen by US regulators. That gave rise to a vast offshore pool of dollars outside the control of US authorities. The US government imposed laws to restrict dollar lending to foreigners. Euromarkets were particularly attractive because they had far less regulations and offered higher yields. From the late 1980s onwards, US companies began to borrow offshore, finding Euromarkets a beneficial center for holding excess liquidity, providing short-term loans and financing imports and exports.

London was, and remains the principal offshore market. In the 1980s, it became the key center in the Eurodollar market when British banks began lending dollars as an alternative to pounds in order to maintain their leading position in global finance. London's convenient geographical location (operating during Asian and American markets) is also instrumental in preserving its dominance in the Euromarket.

What is Foreign Exchange

Foreign Exchange (FOREX) is the arena where a nation' s currency is exchanged for that of another. The foreign exchange market is the largest financial market in the world, with the equivalent of over $1.5 trillion changing hands daily; more than three times the aggregate amount of the US Equity and Treasury markets combined. Unlike

other financial markets, the Forex market has no physical location and no central exchange. It operates through a global network of banks, corporations and individuals trading one currency for another. The lack of a physical exchange enables the Forex market to operate on a 24-hour basis, spanning from one zone to another in all the major financial centers.

Traditionally, retail investors' only means of gaining access to the foreign exchange market was through banks that transacted large amounts of currencies for commercial and investment purposes. Trading volume has increased rapidly over time, especially after exchange rates were allowed to float freely in 1971. Combination of low margin and high leverage has changed the way the Interbank currency market operates. In this way, Forex has been opened to retail investors, giving them the professional tools and services needed to trade effectively in an independent atmosphere.

Who are the players in the Forex market?

The Forex market has been called Interbank market for a long time due to the fact it was traded by banks, including central banks, commercial banks and investment banks. As we have mentioned before, trading volume in this market has rapidly increased, due to, among other factors, the market players have increased throughout the time. Today, we can mention international large corporations, global money managers, international brokers, options and futures traders and speculators as players of this market.

Spot Forex Market vs. Equity Market

24-Hour Trading

Forex is a true 24-hour market. It opens every Sunday at 17:00hs (New York time) when the Eastern hemisphere's stock exchanges open and closes every Friday at 15:00hs (New York time) when the US stock exchanges are closed down. This trading operation time offers a major advantage over equities trading. Therefore, traders can always respond to breaking news immediately around the world, which have an effect on this market. Furthermore, unlike the prices at the equities market, the spot FX market does not have gaps between the closing and opening prices of a day during the trading week; we can only find gaps between the closing and opening prices of a new week.

Liquidity

The daily trading volume in the spot FX market is approximately 50x larger than that of the New York Stock Exchange; there are always brokers or dealers willing to buy or sell currencies in the FX markets. Traders in this market can always open or close positions at the market price, that is, there is always a counterparty willing to make an opposite transaction, thanks to this market liquidity.

Because of the lower trade volume, investors in the stock market are more vulnerable to liquidity risk, which results in a wider dealing spread or larger price movements in response to any relatively large transaction.

Profit Potential in both Rising and Falling Markets

When a trader opens a position in the FX market, what he is really doing is to go long in a currency and short in another one. For example: in the case a trader opens a long position in the EURUSD currency pair, what he is in fact doing is to be long in Euros and short in US dollars, or otherwise, he is buying Euros and selling US dollars.

When the reverse transaction is made in this market, that is, to be short in the EURUSD currency pair means exactly the same with regard to the required margins and type of transaction. Both trading operations, long and short positions in any currency pair are opened using margin accounts; this means that both trade operations are leveraged. While investing in equities is rather differently, since the short position is the only one who needs leverage and this is not always available.

Spot Forex Market vs. Futures Market

Leverage

Understanding leverage procedures at the spot Forex market is a key element of this research work.

The most important difference between the spot FX market and futures market lies in the leverage used. Consequences that this difference have on the analysis of a hedge for the exchange-rate risk are the main focus and approach of this research work.

All currency pairs are quoted against the US dollar as per the following convention:

Euro	EURUSD
British Pound	GBPUSD

Yen	USDJPY
Swiss Franc	USDCHF
Canadian Dollar	USDCAD

Contracts traded in the Forex market are of 100,000 units of the first currency pair's acronym. For example, when we are trading EURUSD, either buying or selling, we are doing each transaction for an amount equal to EUR 100,000, but when we are trading the Canadian Dollar we are doing this transaction for USD 100,000.

Minimum margin per contract in the FX market goes separately from the currency traded and it is an amount of USD 500 per each contract. This means that leverage will depend on the currency to be traded.

As an example, we will calculate leverage for the EURUSD currency pair. Let's suppose that the spot exchange-rate for the EURUSD currency pair is 1.2000. As we have explained above, in the case of transactions in the EURUSD currency pair, trades are made for the amounts of EUR100,000. Therefore, with 1 contract of USD 500, the investor is trading for the amount of EUR 100,000, which, at the spot Forex exchange rate, represents a transaction of EUR 100,000 * 1.2000 = USD 120,000. Then, leverage at the beginning of the transaction is 240:1; this means that the investor, with USD 500 has traded for an equivalent amount of USD 120,000.

In the Futures market, leverage on the Euro futures contract is as follows:

Data from the CME (Chicago Mercantile Exchange) Market as of December 15, 2003.		
	US dollars (USD)	Euros (EUR)
Initial Margin	USD 2,498	
Maintenance Margin	USD 1,850	
Trading Vol. / Contract		EUR 125,000

Therefore, we will have two kinds of leverage; one at the beginning of the transaction or initial and the other one will be the maintenance leverage.

Leverages were calculated using the data provided by the CME as of December 15, 2003 shown in the previous table.

In order to calculate the initial leverage, we will consider the initial margin account, thus:

L_i = Initial leverage.

L_i = Volume per futures contract multiplied by the exchange rate's spot price divided by the initial margin → EUR 125,000 * 1.2000 / USD 2,498 = 60

L_i = 60:1

In order to calculate the maintenance leverage, we will use the maintenance margin account, thus:

L_m = maintenance leverage.

L_m = Volume per futures contract multiplied by the exchange rate's spot price divided by the maintenance margin account → EUR 125,000 * 1.2000 / USD 1,850 = 81

L_m = 81:1

To sum up, leverage in the futures market as well as in the Forex market shall depend on the exchange rate's spot price. In the particular case of a spot price equal to 1.200, leverages for the futures market are L_i = 60:1 and L_m = 81:1 respectively, while leverage in the Forex market is 240:1

Consequences of such difference will be analyzed in the conclusions section of this research work.

Volume of Futures Contracts

As we have explained above, minimum traded contract in the futures market is EUR 125,000; this means that if an investor wishes to hedge an EUR 400,000 position, he/she has to buy a number of contracts equivalent to EUR 400,000 / EUR 125,000 = 3.2 contracts. Consequently, said investor shall have to choose whether to buy 3 or 4 futures contracts with the associated risks that this implies. Meanwhile, minimum trade contracts in the FX market are, in the case of the Euro, of EUR 100,000, thus existing the possibility to buy portions of one contract being multiple of EUR 10,000. That is, if an investor wishes to go either long or short of Euros for an amount of EUR 150,000, then he/she has to buy 1.5 contracts. Since the Forex market is more flexible with regard to the minimum contract volume, this implies that the risks to exactly hedge the position required are lower than those at the futures market.

Transaction Costs

It is hereby understood that transaction costs are the costs charged by brokers to buy or sell currencies in the market. Thus, Forex market has a competitive advantage over the equities and derivatives markets, since the only transaction cost charged is the spread.

Spread in the spot FX market shall exclusively depend on the broker. As an example, dealing spreads offered by brokers of this market are normally 5 pips (1 pip is 0.0001 cents of US dollar) for the strongest currencies. If we consider for example the Euro-US dollar currency pair, bid /ask prices, can respectively be as follows: EURUSD Bid 1.2250, Ask 1.2255. In general, the dealing spread is lower than the average dealing spread offered in the equities and futures markets, and this is due to this market's liquidity.

Both in the futures market and equities market, in addition to the dealing spread, brokers also charge a transaction cost for the purchase and sale of each contract that has been entered into. We herein mention the average transaction costs charged by brokers in the futures market: USD 7.75 per each contract and transaction, whether it is a purchase or a sale, plus Clearing and Exchange fees and those charged by the National Futures Association (NFA), which are USD 0.02 and USD 0.05 per each transaction and contract, respectively.

Expiration of Futures Contracts.

Expiration of contracts in the currency futures market is quarterly in the following months: March, June, September and December, and physical delivery takes place on the third Wednesday of each of the above-mentioned months.

On the contrary, in the spot FX market, currencies are purchased or sold at the spot price of that moment. In this way, if an investor wishes to hedge a currency position as of February 28, today he/she opens a position in the spot FX market and closes it up at its expiration date, meanwhile in the futures market such investor shall have to choose to enter into a futures contract with a pre-established expiration date, which maybe either March or December to hedge the position on February. This implies a basis risk due to the difference in the expiration dates between the futures contract's expiration and that one of the investor's obligation.

Policy on Margin Accounts.

There are two types of margin accounts in the currency futures market, the initial margin account and the maintenance margin account, while in the spot Forex market there is only the maintenance margin account.

Unlike the futures contract, which the investor arranges a future price, either to purchase or to sell a currency, in the spot FX market the current currency price is being traded.

Therefore, a very important difference existing between these two markets lies in the fact that in the spot FX market, overnight interests are charged or paid for open positions at the closing of each trading day. Said overnight interests are related to the short-term interest rates of the countries involved in the currency pairs that are being traded. It is worth noting that such interests are calculated over the traded volume and not over the amount of the margin account.

Example for the EURUSD currency pair:

An investor wants to buy EURUSD at the spot exchange rate of 1.2000, therefore what he is doing is buying EUR 100,000 and selling USD 120,000. Consequently, he/she will be paid with the European daily interest rates for the traded amount of EUR 100,000 and shall pay the American daily interest rate on account of USD 120,000.

Since Europe's short-term interest-rates are at present higher than those of the USA, such interest-rate spread on account of the traded volume will be deposited daily in this investor's margin account.

It is important to note that this calculation is made each day, that is, if during an open position the short-term interest-rates curves are inverted, i.e., USA's interest-rates go higher than Europe's, the investor shall have to pay daily overnight interests rates.

The overnight interest-rate calculation will depend, as we have explained before, on the effective short-term interest rates, and moreover, each broker offers bid/ask interest rates for each currency pairs. As an example of the above, the following table shows the daily overnight interest rates in US dollars offered by a Forex broker as at December 22, 2003 per each open position of 100,000 units:

Currency	Long	Short
EURUSD	$ 2.50	$ -7.50
USDJPY	$ 3.00	$ -8.00
GBPUSD	$ 9.00	$ -14.00
USDCHF	$ -	$ -5.00
AUDUSD	$ 6.50	$ -11.50
USDCAD	$ 2.00	$ -7.00

In the case the investor opens a long position on the EURUSD currency pair of a unit, i.e. EUR 100,000, he/she shall daily receive USD 2.5 in his/her margin account. On the other hand, in the case the position is short on the EURUSD currency pair, the broker will withdraw USD 7.5 each day from such investor's margin account.

In summary, the broker will pay interest rates to the investor over the traded volume if the investor is buying the currency of the country with higher short-term interest rates than the currency he/she is selling.

This difference existing on the payment of the overnight interest rates in the futures market will be discussed in the conclusions section of this research work.

Example of a Hedge for the Exchange Rate Risk

Since operations at the currency spot FX markets and futures contract have been understood together with its differences and similarities, we will now discuss an example a hedging for the exchange–rate risk.

Let's suppose that today is January 2 nd, 2003 and the USA-based company XXX has an obligation for the amount of EUR 10,400,000 with a European creditor, to be paid off on October 20, 2003. This company wants to hedge the exchange-rate risk, both rising and falling exchange rate fluctuations; therefore, the company would like to hedge the amount in US dollars that it shall have to pay off at the obligation's maturity date.

In order to purchase said hedge, the company decides to compare the advantages and disadvantages of hedging this risk through the currencies futures market versus the leveraged spot Forex market.

Data on prices of the EURUSD currency pair.

The analysis on the hedges will be made ex-post, therefore, the data which has been used are actual data provided by the Bloomberg source.

Spot and Futures Prices of the EURUSD currency pair

Chart 1 shows the fluctuation in the futures contracts' prices of the EURUSD currency pair to expire at December 2003 and the spot price between January 2, 2003 and October 20, 2003.

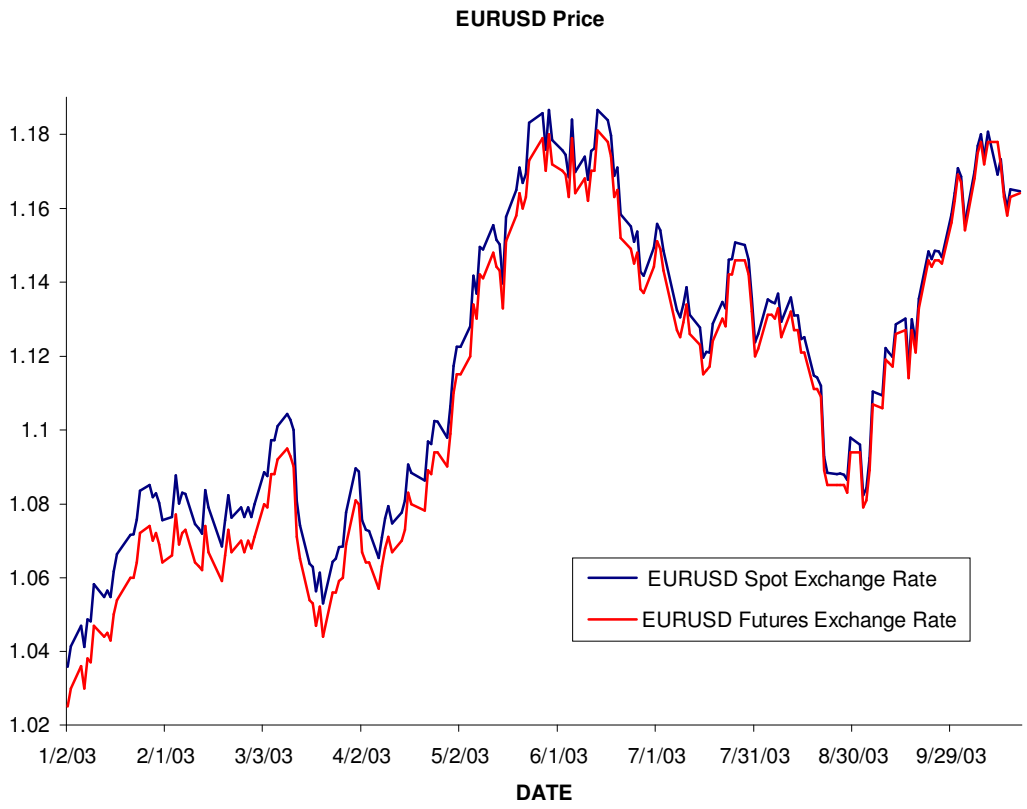


Chart 1: Bloomberg Source

The data on the spot FX market corresponds to the closing of each day and this happens every day at 15:00hs NY. This coincides with the opening of the next day's trading session, since, as we have mentioned before, the currency spot FX market remains open 24 hours a day. The reason why the spot FX market makes a rollover of positions at 15:00hs NY time is to calculate the open positions' overnight interest rates. In the case of the futures contract, the data provided is that one of that trading session's closing price.

In chart 2, it is shown a Bloomberg screen where the characteristics of the Euro futures contract used for hedging are shown. This data was obtained on November 4, 2003.

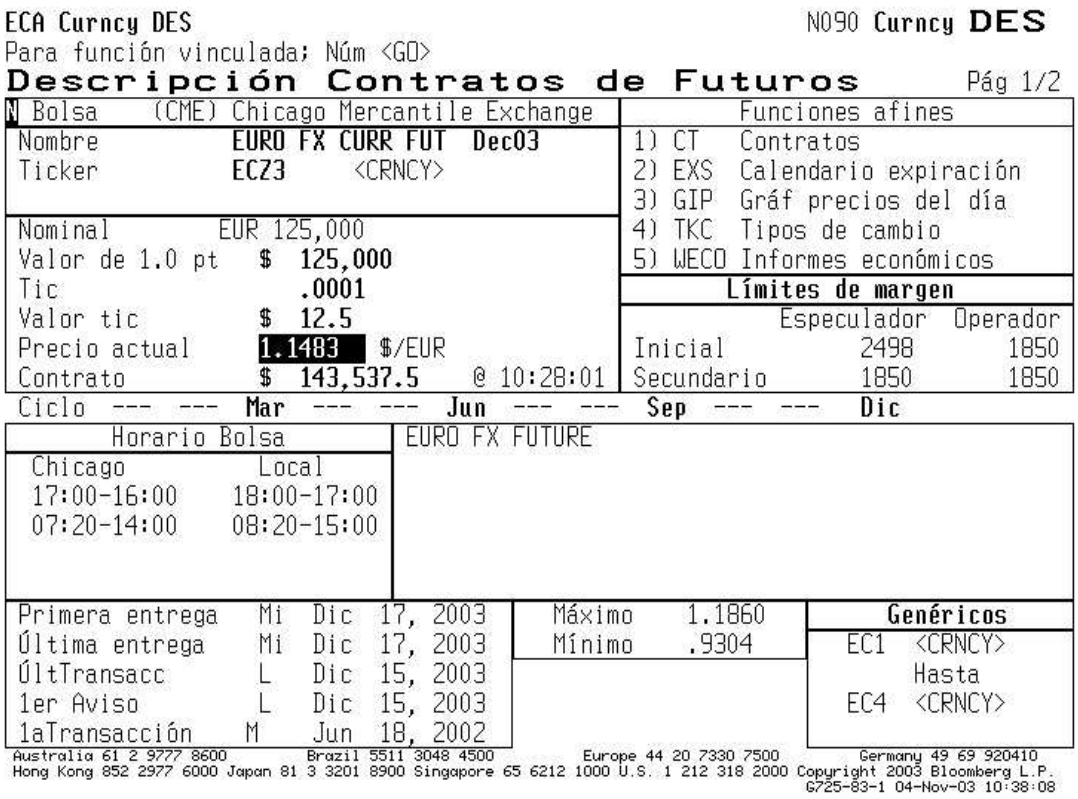


Chart 2: Bloomberg Source.

Hedge for the Exchange-rate Risk using the Spot FX Market

Calculation of the number of contracts to be purchased

The amount to be hedged is EUR 10,400,000, therefore it shall be necessary to buy an X number of contracts, which shall be closer to the Euros value of the hedge. As we have explained before, in the particular case of the EURUSD currency pair, each contract is entered into for the amount of EUR 100,000, thus the number of contracts will be as follows: EUR 10,400,000 / EUR 100,000 = 104 contracts. In this particular case, through the purchase of 104 contracts at the spot FX market, the company will purchase exactly the value in Euros of its future obligation.

Calculation of Funds for the margin account

Based on the number of contracts necessary for the hedging, which number is already known (104 contracts), the minimum number necessary to fund the margin account shall be:

USD 500 → 1 Contract

USD X → 104 Contracts

Then X = 104 contracts * USD 500 / 1 contract = USD 52,000

This means that the XXX company with an amount of USD 52,000 may purchase in the spot Forex market at the currency exchange rate of 1.0359 on January 2, 2003 an equivalent amount to EUR 10,400,000.

Since the company is buying Euros and selling US Dollars, if the currency exchange rate goes down, i.e. the US Dollar is being appreciated, the broker will require a margin call from the company. Then, it is at the company's discretion to fund the margin account with an amount higher than the maintenance margin of USD 52,000 in order to avoid quick and successive margin calls.

It is also at the company's discretion to withdraw funds from the margin account in the case the Euro is appreciated, that is to say, if the currency exchange rate goes up.

A very much-used criterion to manage the margin account is VaR (Value at Risk), which gives us the daily maximum loss based on the underlying assets' volatility. Consequently, using said calculation, the company may decide to maintain for example the margin account with the minimum maintenance margin of USD 52,000 plus the daily maximum loss calculated with the VaR method, and multiplied by x number of days necessary to give the company time to make the necessary money transfers to the broker and, therefore, to avoid to be required a margin call until the last day of the hedge.

Analysis of Losses and/or Gains.

Based on the above-mentioned data necessary to purchase a hedge, the purpose is to show how Losses/Gains of the margin account have developed in this market.

In chart 1, the exchange rate's daily evolution of the EURUSD currency pair was shown since January to October 2003. In view of this evolution, the XXX company's margin account in the broker will be changing. Losses or gains can be seen in chart 3 based on the spot exchange rate for the period covered by the hedge.

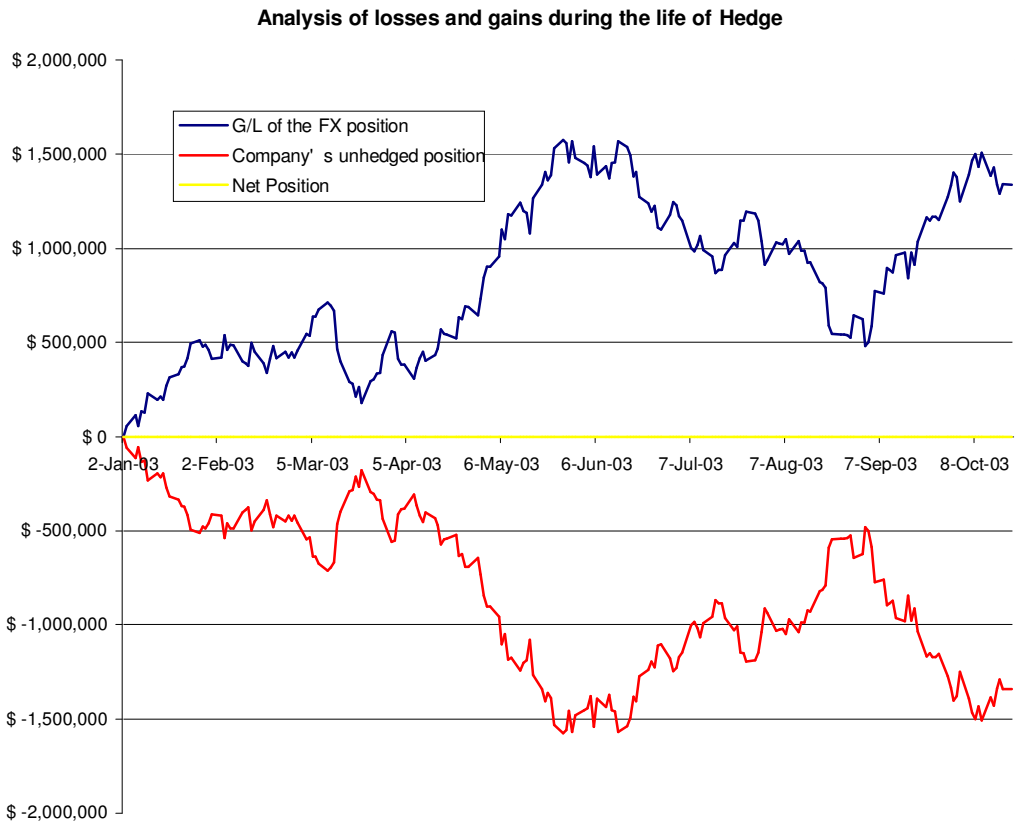


Chart 3:

It is important to note that the (y) axis amounts are expressed in US dollars. The blue line shows the Loss/Gain of the open position at the spot Forex market, without taking the overnight interest rates into account, meanwhile the red line shows the company exposure throughout the obligation term in the case it had decided not to be hedged. In other words, it is the company's unhedged position based on the spot exchange rate. As it was expected, the yellow line in the chart shows that the company's net loss or gain as the result of hedging its exposure to the exchange rate risk during the hedge period is being null; this is without considering the overnight interest rates.

In fact, this is not completely true, since we have to take into account the overnight interest rates charged or paid by the broker to the investor, as we have explained in the leverage section. In this case, the Euro zone's short-term interest rates were higher than those of the USA during the hedge period; therefore the company will receive overnight interest rates every day.

Outcome of Hedge at the obligation's maturity date

At the hedge expiration on October 20, the Euro spot price was 1.1646, therefore, the XXX company closes its position at the spot FX market and it may buy, for example, the Euros necessary to pay off its obligation at an exchange house.

The following table shows the data at the beginning and the end of the hedge.

Date	Spot Exchange Rate (EURUSD)	Debt in EUR	Debt in USD	Loss/Gain in FX Position	Overnight Interest rates	Net Position
2-Jan-03	1.0359	*	**	$ -	$ -	$ -
20-Oct-03	1.1646	€ 10,400,000	$ 12,111,840	$ 1,338,480	$ 75,920	$ 1,414,400

On January 2, the obligation assumed by the company of EUR 10,400,000, at the spot FX exchange rate of 1.0359, represented the amount in US dollars of EUR 10,400,000 x 1.0359 = **USD 10,773,360.**

On October 20, the company shall pay the obligation for the amount of EUR 10,400,000. To such purpose, the company closes out its position in the spot market, thus receiving the net position of USD 1,414,400. Since its obligation in US dollars as at October 20, is of EUR 10,400,000 x 1.1646 = **USD 12,111,840**, the company shall add to the Forex position an amount of US dollars equal to USD 12,111,840 – USD 1,414,400 = **USD 10,697,440** to purchase EUR 10,400,000, and in this way to pay off its obligation.

As we can see, this amount does not match with the USD 10,773,360, which represented the liability as at January 2, 2003 in USD 75,920, that corresponded to the interests received by the company. Thus, we can conclude that in this particular case, the company was benefited when it received such interests.

(*) (**) Since we do not exactly know the borrowing rates the company may obtain in USA or in Europe, we are not able to accurately calculate the company's liability of EUR 10,400,000, which represented in Euros as well as in US dollars as at October 20, 2003.

Hedge for the Exchange-rate Risk using the Futures Market

Calculation of the number of contracts to be purchased.

As we have mentioned before, the Euro minimum futures contracts are of EUR 125,000, the amount to be hedged is EUR 10,400,000; therefore the number of contracts required is EUR 10,400,000 / EUR 125,000 = 83.2 contracts.

Calculation of the Optimal Hedge Ratio (h)

The "h" hedge ratio shows us the optimal number of futures contracts necessary to hedge the exposure in a dynamic hedge. Define:

ΔS: change in spot price, S, during a period of time equal to the life of the hedge.

ΔF: change in futures price, F, during a period of time equal to the life of the hedge.

σ_S: standard deviation of ΔS.

σ_f: standard deviation of ΔF.

ρ: coefficient of correlation between ΔS and ΔF.

h: hedge ratio.

The change in the value of the hedger's position during the life of the hedge is:

$h \Delta F - \Delta S$, for a long hedge.

$\Delta S - h \Delta F$, when the hedger is long the asset and short the futures.

In either case the variance, v, of the change in value of the hedged position is given by:

$$v = \sigma_s^2 + h^2\sigma_f^2 - 2h\rho\sigma_s\sigma_f$$

so that

$$\Delta v/\Delta h = 2h\ \sigma_f^2 - 2\rho\sigma_s\sigma_f = 0$$

Setting this equal to zero, and noting that $\Delta v^2/\Delta h^2$ is positive, we see that the value of h that minimizes the variance is

$$h = \rho\ (\sigma_s / \sigma_f)$$

Coefficients so obtained as per the data of the example resulted in:

$\sigma_s = 0.0400$

$\sigma_f = 0.0423$

$\rho = 0.9980$

$h = 0.9439$

Now we have to multiply the number of contracts obtained at the beginning by the "h" optimal hedge ratio:

83.2 contracts * 0.9439 = 78.53 contracts.

The (h) ratio is used in the case of dynamic hedging, that is by calculating this ratio throughout the hedge period, we can decide whether to buy or sell contracts.

We will not use a dynamic hedge for the example analyzed in this research work, therefore, the company has to decide whether to buy between 83 and 84 contracts. In this research work, we will make the calculations with 83 contracts and then, we will analyze the consequences of not purchasing the exact number of contracts necessary to hedge such exact number.

It is important to note that the fact of deciding not to use a dynamic hedging and buying 83 futures contracts implies to purchase a hedge in Euros of: 83 Contracts * EUR 125,000 = EUR 10,375,000. Therefore, we have an exposure of EUR 10,400,000 – EUR 10,375,000 = **EUR 25,000**. The effects of this exposure in Euros, which is unnecessary to the company, will be discussed in the analysis of basis risk.

Calculation of Funds for the Margin Account.

Based on the number contracts necessary (83 contracts) to hedge the company's exposure, and on the minimum maintenance and initial margins of: USD 1,850 and USD 2,498 respectively per each contract, the company will have to fund the initial margin account with a minimum amount of:

USD 2,498 * 83 contracts = USD 207,334

And the company will also need to have a minimum amount during the hedge in agreement with the maintenance margin of:

USD 1,850 * 83 contracts = USD 153,550

As in the case of the hedge using the spot FX market, we leave at the company's discretion the management of the margin account, that is, to have certain amounts of funds in such account in excess of the maintenance margin in order to avoid margin calls.

Analysis of Losses and/or Gains.

The evolution of the futures price of the Euro as at December 2003 was shown in chart 1 during the hedge period. In view of this evolution, the company's margin account in the broker will be changing during the life of the hedge.

Chart 4 shows the losses or gains both of the open position in the futures market as well as the loss or gain that the company would have had in the case that it has decided not to hedge its exposure during its period.

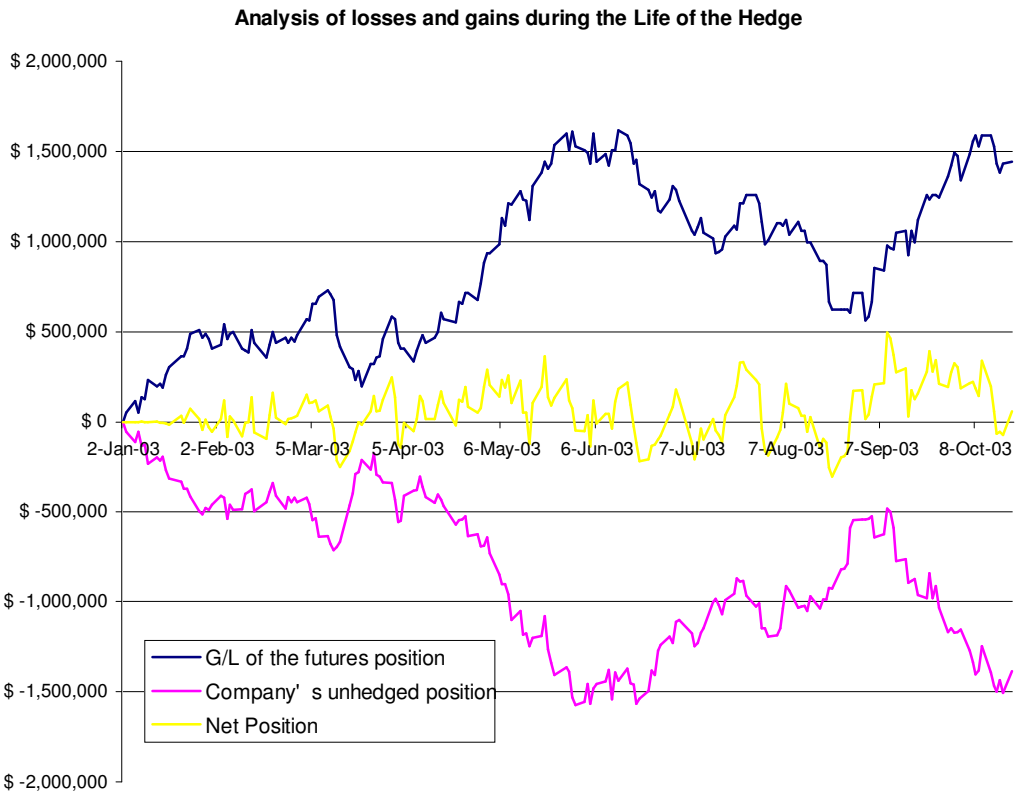


Chart 4

It is important to note that the (y) axis amounts are expressed in US dollars. The blue line shows the Loss/Gain of the open position at the futures market, meanwhile the red line shows the company exposure throughout the obligation term in the case that it had decided not to be hedged. In other words, it is the company's unhedged position based on the spot exchange-rate. The yellow line in the chart shows that the company's net loss or gain during the hedge period, unlike the spot FX market, is changing throughout the time, and this is due to the fact that the Euro futures contract price is different to the change shown by the spot exchange rate.

Outcome of the Hedge at the obligation's maturity date.

At the expiration of the hedge on October 20, the XXX company closes out its position at the futures market and buys the Euros necessary to pay off its obligation at an exchange house.

The following table shows the data at the beginning and the end of the hedge.

Date	Spot Exchange rate (EURUSD)	Futures Exchange Rate (EURUSD)	Debt amount in EUR	Debt amount in USD	Loss/Gain Futures Position
2-Jan-03	1.0359	$ 1.0250	*	**	$ -
20-Oct-03	1.1646	$ 1.1640	€ 10,400,000	$ 12,111,840	$ 1,442,125.00

On October 20, the company shall pay off the obligation for the amount of EUR 10,400,000. To such purpose, the company closes out its position in the futures market, thus receiving USD 1,442,125. Since its obligation in US dollars as at October 20, is of USD 12,111,840, the company shall add to the futures position an amount of US dollars equal to USD 12,111,840 – USD 1,442,125 = **USD 10,669,715** to purchase EUR 10,400,000, and in this way to pay off its obligation.

(*) (**) Like in the case of the spot FX market hedge, since we do not exactly know the borrowing rates the company may obtain in USA or in Europe, we are not able to accurately calculate which amount the company's obligation of EUR 10,400,000 as of January 2 represents in Euros and in US dollars as at October 20, 2003.

Analysis of Basis Risk

There are a number of reasons why hedging using futures contracts works less than perfectly in practice:

1. The asset to be hedged may not be exactly the same as the asset underlying the futures contract.
2. The futures contract's expiration date may be different to the hedge's expiration date.
3. The hedge amount may not coincide with the exact number of futures contracts.

In our case, we will only discuss the basis risks described in item 2 and 3 because the basis risk of item 1 is not applicable since there are currency futures contracts to hedge the exchange-rate (the Euro).

Definition of Basis Risk

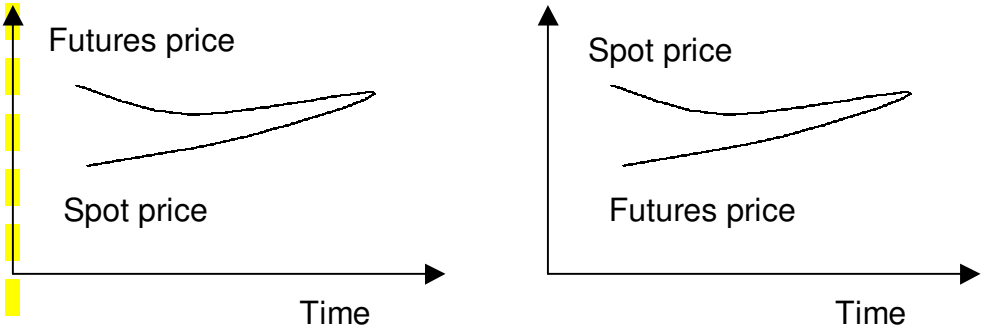
The basis risk in a futures contract hedging is defined as follows:

Basis = spot price of asset to be hedged – futures price of contract used

If the asset to be hedged and the asset underlying the futures contract are the same, the basis should be zero at the **expiration** of the futures contract.

However, during the hedge period, that is prior to expiration of the futures contract, the basis may be positive or negative.

The following charts show that at the expiration of the futures contract, the price of the futures contract is the same than the spot price. However, during the futures period, the basis risks are not necessarily zero.



This also can be shown in chart 1, where we can see that when the expiration of the futures contract is closer (Dec 2003), the futures price is closer to the currency spot price.

We can see that when the spot price increases by more than the futures price, the basis risk increases. This is referred to as a *strengthening of the basis.* When the futures price increases by more than the spot price, the basis risk declines. This is referred to as a *weakening of the basis.*

To examine the basis risk of our example, we will use the following notation:

S_1= EURUSD spot price as of January 2, 2003.

S_2= EURUSD spot price as of October 20, 2003.

F_1= Euro futures price as of January, 2 2003 with expiration date on Dec-2003.

F_2= Euro futures price as of October 20, 2003 with expiration date on Dec-2003.

b_1= basis as of January 2, 2003

b_2= basis as of October 20, 2003

From the definition of basis risk:

$b_1 = S_1 - F_1$.

$b_2 = S_2 - F_2$.

Basis risk due to the obligation's maturity date.

Since the maturity date of the company's obligation is on October 20, and it does not match the futures contract expiration date of December 2003, then, there is a basis risk which we calculate as follows:

S_1= 1.0359

S_2= 1.1646

F_1= 1.0250

F_2= 1.1640

In our example, we will calculate the basis risk with the data ex-post, while the hedge risk is actually associated with b_2 , which as of January 2, 2003 is unknown.

$b_1 = S_1 - F_1 = 1.0359 - 1.0250 = 0.0109$

$b_2 = S_2 - F_2 = 1.1646 - 1.1640 = 0.0006$

The company is hedging the exchange-rate risk with a long position of futures contracts in Euros. Therefore, we can say that the effective price paid out by the company in the futures hedge is given by:

$S_2 + F_1 - F_2 = F_1 + b_2 = 1.0250 + 0.0006 = 1.0256$

We note that due to the fact that the company had to sell the futures contracts prior to expiration, in this particular case, the company had a loss since it paid an additional amount of 0,0006 cents of US dollar per Euro.

The yellow line in chart 5 shows this basis risk in US dollars during the hedge period.

Basis risk due to the number of traded contracts.

A key factor affecting the basis risk is the choice of the futures contract to be used for hedging. This choice has two elements:

1. The choice of the asset underlying the futures contract
2. The choice of the futures contract 's expiration month

When the maturity date of the company's exposure does not exactly match the futures contract's expiration date, a contract with a later expiration month is generally chosen in these circumstances. This is because futures prices are in some instances quite erratic during the expiration month. In general, basis risk increases as the time difference between the hedge expiration and the futures contract's expiration month increases. However, in some situations the hedger may be inclined to use short-maturity futures contracts and roll them forward.

In our example, the company hedged its EUR 10,400,000 exposure with 83 contracts of EUR 125,000. Therefore, it only hedged an amount in Euros of EUR 125,000 * 83 contracts = EUR 10,375,000. The remaining EUR 25,000 is then exposed to the exchange-rate risk.

Without taking interest rates into account during the hedge period and considering that the spot exchange rate as of January 2 was 1.0359 and as of October 20 was

1.1646, the Euro was appreciated in (1.1646 – 1.0359)/1.0359 = 12.42%. The company was negatively affected by the unhedged EUR 25,000, due to the Euro appreciation.

Conclusions

After discussing an example of hedging for the exchange-rate risk in the spot FX market and futures market, and the associated basis risks, we will analyze the advantages and disadvantages of each market for this type of hedging.

Advantages of the Spot FX market over the Futures market.

Leverage.

On page 7, leverage was analyzed in both markets and it was shown that the spot FX market has greater leverage; therefore we can conclude that the hedger needs less money to hedge its exposure using this market.

In order to quantify this advantage with regard to the futures market, we will analyze leverages of maintenance margin accounts of both markets and in this way place them under the same conditions. We are not taking into account the initial margin account of futures contracts.

Following with the example discussed in this research work, in order to hedge EUR 10,400,000 in the futures market a minimum maintenance margin of USD 153,550 was needed. And the whole amount of the obligation was not hedged thereby existing a remaining unhedged EUR 25,000 due to the number of futures contracts traded. Meanwhile, a minimum maintenance margin of USD 52,000 was needed at the spot FX market to hedge the total amount of the obligation. That is to say, for the same hedging, due to a greater leverage needed at the spot FX market, it became that the futures market is more expensive by 295%.

We can also achieve at the same result when comparing the different leverages. As per the calculation obtained in the leverage analysis, the data of leverages for both markets are: 81:1 for the futures markets and 240:1 for the spot FX market.

Hedging during the life of the hedge

As we have seen in chart 3, in the spot FX market, the hedger is hedged of the exchange-rate risk during the period the position is open. While in the futures market, he only has 100% hedging at the expiration of the futures contract.

This spot FX market's advantage enables the hedger to cancel at any time his exposure to the exchange-rate risk and be 100% hedged.

However, in the futures market there will be some times when the hedger will be over hedged and in other times he will be under hedged, as it is shown by the yellow line in chart 4.

In the example discussed in this research work, the obligation's maturity date was October 20, 2003, but if by any reason, the debtor or the creditor decides to advance or delay said obligation's maturity date, provided always the amount is the same, the hedger will be hedged, by closing out his position in the spot FX market, on the obligation's new expiration date. In the futures market, on the contrary, in this case the hedger should roll the futures contract forward.

Basis Risk.

It was clearly stated in the basis risk analysis that the futures market is exposed to such risks, and depending on the hedge characteristics, that is, with regard to the obligation's amount and maturity date, the basis risk may have a great incidence on the outcome of the hedge. However, the spot Forex market is not exposed to this type of risks.

Transaction Costs.

In the section of the analysis of transaction costs, we could see that the spot Forex market has a competitive advantage over the futures market, since the only transaction cost charged is the currencies spread.

Therefore, likewise in the advantage of the basis risks above, and depending on the hedge characteristics with regard to the number of contracts and whether the latter is a dynamic hedge where futures contract are purchased and sold during the hedge period, transaction costs may play a significant role in the election of the market to be used for the hedging.

Advantages of the Futures Market over the Spot Forex Market.

Hedging of interest-rate risk.

When the futures market is used to hedge a currency exposure, not only the exchange rate risk is being hedged but also the interest-rate risk. That is to say, when a futures contract is entered into, the currency price is being hedged regardless of how interest-rates of the countries involved in the transaction fluctuate. Consequently, it may be

calculated the amount in the local currency that will be needed to hedge the exposure in a foreign currency at the futures contract's expiration date.

If in the example discussed in this research work, the company obligation's maturity date would have been on December 2003 likewise the futures contract's expiration date, we could have said ex-ante that the company, at the expiration date, will need an amount in US dollars equal to: EUR 10,400,000 * 1.0250 = USD 10,660,000 without regard to the interest –rates fluctuation.

On the other hand, in the spot Forex market, due to the overnight interest rates which was explained above in detail, the exchange-rate risk is the only risk being hedged, while the interest-rate risk is not. This means that we could not precisely foresee in advance at the obligation' maturity date how much money will be necessary to hedge said obligation, since this will depend on interest-rates, being this a variable benefit or not for the hedging based on its characteristics.

Therefore, we could infer that, depending on the hedging characteristics, the futures market may be more beneficial for long-term exchange-rate risk hedges.

Organized Market vs. Over-the-counter Market (OTC)

The futures market is an organized market whereas the spot Forex market is an OTC market. Although quantifying the risk in an OTC market is extremely difficult, we could infer that the futures market is more secure than or that is less exposed to the market risk exposure. Therefore, choosing a broker to trade in the spot Forex market plays an essential role in the decision to minimize the risk involved in an OTC market.

Maybe many of the above-mentioned advantages of the spot Forex market vs. the futures market are explained in terms of market risk.

Final Conclusion

After discussing the characteristics of an exchange-rate risk hedge, and once we have analyzed the advantages and disadvantages of the spot Forex and futures markets, it is the purpose of this research work to provide with the necessary tools to chose what market is more suitable to be used for hedging this risk.

As an example, we will mention a particular case where the spot Forex market is more convenient than the futures market.

Let's imagine that a company has a short-term currency exposure and said exposure is changing in volume dynamically whether each day or per week. In this case, we

can see that the spot Forex market is more suitable than the futures market due to the greater leverage, lower transaction costs and the advantage of avoiding basis risks.

The fact that the currency exposure changes dynamically makes the volume of the open position in the spot Forex market change along with the exposure fluctuations. Therefore, transaction costs associated with this type of hedging use to be very significant, thus the advantages of the spot Forex market are clearly evidenced.

The spot FX market's greater leverage vs. the futures market implies less money to hedge the company's exposure.

On the other hand, the fact of being a short-term hedge, the negative effect of the overnight interest rates is attenuated by said short-term period of hedge; and this could favor the hedger in the event the spot Forex position receives such overnight interest rates, if such is the case.

Comments

1. All registered US Futures Commission Merchants (FCM) and members of the National Futures Association (NFA) involved in foreign exchange trading will begin requiring a minimum margin of 1% for all forex transactions as from December 1, 2003. This requirement will be implemented by all FCMs as a result of the National Futures Association's new rule (BYLAW 306). For further details about this rule, please access the NFA's website at the following link http://www.nfa.futures.org/compliance/forexRuleAmendments.asp

   This new rule has an effect on the spot Forex market's margin account, since as we have discussed in this research work, the spot market's fixed minimum margin was USD 500 per each contract of 100,000 units. As from December 1, 2003, all brokers registered in US will calculate the minimum margin as follows:

1 contract of USD/JPY	1 contract of EUR/USD	1 contract of GBP/USD
1% of USD 100,000 = USD 1,000	1% of EUR 100,000 = EUR 1,000, which is USD 1,200*	1% of GBP 100,000 = GBP 1,000, which is USD 1,700**

* Calculated at the spot rate of EURUSD = 1.2000

** Calculated at the spot rate of GBPUSD = 1.7000

It is important to note that although this rule is effective as from December 1, 2003, it only comprises all entities registered in USA. Because of this reason, calculation of this work was not modified since there are still numerous brokers around the world who are still requiring a margin of USD 500 per each contract of 100,000.

It is worth noting that due to this new rule being effective, in the case the investor decides to use a broker member of the NFA, he/she should deposit more funds in the margin account of the spot market than the amount calculated in this research work. Although, there still is the advantage of the spot Forex market's greater leverage than the futures market, the latter would be minor.