Investment Strategies for Foreign Currency Option of An OBU – Application of AHP

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Abstract: In response to dramatic fluctuation of financial environment, increased pressure resulted from market competitiveness and escalated degree of risk, the demand for hedging increase. In general, the financial derivatives for hedging include forward-based and option-based derivatives. The option is a convertible contract. The option market can be separated into organized exchange and over-the-counter (OTC) markets. The options for organized exchange may include interest rate, foreign currency, stock index options and options on futures. The trend has signified the option is one of the most popular hedging instruments. The offshore banking unit (OBU) is a branch of commercial bank that only accepts abroad deposit. However, its loans are limited to some designated investment items. In the regard, the primary objective of the study is to investigate investment strategies of trading currency options to facilitate the OBU with a hedging derivatives. Some popular trading rules are available for options. To measure the relative importance of the complicated influential factors under the objective of maximizing profit with embedded risk, the AHP (Analytical Hierarchy Process), which were proposed by Saaty, is applied to obtain the weights. The weights may then be used to determine the appropriate investment strategy. The candidate strategies may incorporate long call, long put, straddle, strangle, and so on.

Keywords: Currency Options, Analytic Hierarchy Process, OBU

1. Introduction

Stock index and stock index futures written options have been a major breakthrough in this securitization process, enabling economic agents to speculate or completely eliminate the market or systematic risk exposure of an equity portfolio. Further, we know that in today portfolio management, the market "is not limited by national boundaries both theoretical and practical evidence supporting the notion that international diversification" pays. Indeed, as long as domestic

markets remain only partially integrated and experience heterogeneous evolution patterns, any investor can benefit from spreading his assets over different baskets (countries), thereby improving his .performance through country-specific risk premiums. Unfortunately, although the goal of investing across countries is to reduce the global market risk exposure of a portfolio, it simultaneously leads to an additional uncertainty factor, namely foreign currency risk exposure. Indeed, an American investor investing in Swiss equity, Japanese convertible bonds, and British Gilts may suffer a negative rate of return on his investment simply because these foreign currencies depreciated against the dollar while the global market performance of these assets--in local currencies--was insufficient to compensate for the currencies' depreciation. Hence, foreign currency risk exposure plays an essential role in international portfolio management strategies since it provides an additional factor on which portfolio managers or investors can speculate--by choosing to invest in countries whose currency is expected to increase or at least remain stable against their reference currency--or about which they should and hence seek protection. Moreover, if we consider the fact that currency risk is actually· affecting a much broader category of economic agents--consumers, producers, traders, etc.--there is no doubt that financial instruments enabling to hedge an exporter long or an importer short position in a foreign currency fulfill a key economic function under today flexible exchange rates regime. Hence, currency options provide a safe way of protecting internationally diversified portfolios against potential adverse exchange rate movements and therefore enable portfolio managers to stay in or enter equity markets despite the fairly weak and/or volatile nature of their currencies.

In the presentation, the financial environment of an OBU (Offshore Banking Unit) is initially introduced. Concept of the cross exchange rate in physicals is then brought out. Based on the fundamental concept, pricing and volatility factors of currency options is the next topic. Hence, an OBU will have its financial management on currency options by the proposed three stage process. A case study with Reuter's real-time data is then exhibited to illustrate the proposed process. In the end, we make certain conclusion and suggestions.

2. Financial Environment of An OBU (Offshore Banking Unit)

The Offshore Banking Act was promulgated on December 1983 by the government in Taiwan,the Republic of China. According to the Act, both domestic and foreign banks are authorized to set up offshore banking branches or offshore banking units(OBU) within the territorial confines of the Republic of China. Nineteen domestic banks and nineteen foreign banks have set up OBUs up to the end of the year 1993 since China International Commercial Banks was authorized to set up OBU in June 1984.Of all OBUs, total amount of capitals were accumulated to thirty billions U.S. dollars, of which 89% of capitals come from financial institutions; 75% of transaction are with financial institutions as well; 78% of asset duration are within six months; and 89% of debt duration are within six months.

In the Republic of China, an OBU is confined to branch level. To facilitate managing foreign exchange, OBU's domestic transaction is separated from the foreign transaction. Transaction media is limited to non-New Taiwan dollars. In general, an OBU may be limited to accept foreign exchange deposits from individuals, legal entities or government agencies without the territory of the Republic of China. Besides, an OBU may conduct only the following types of financial operations: managing funds on international financial markets, including options, futures on interest rate and other financial derivatives, booking and managing foreign currency' loan, engaging in foreign currency trading and rimittance. An OBU may raise fund on international financial markets and loan to clients within the territory of the Republic of China.

Other advantages to an OBU include: (1) it is not subject to all related restrictions prescribed in the status for Foreign Exchange Regulation, the Interest Rate Regulation Act, the Banking Act and the Central Bank of China Act. (2) An OBU is also exempt from deposit reserve requirement, business tax on their business receipts, stamp duties. (3) Except privilege fee of 800 thousands New Taiwan Dollars, income of an OBU is exempt from corporate income tax.

3. Transaction on Cross Rate in Foreign Exchange Market

Foreign exchange is basically a short run financial transaction. It's major characteristics is the currency exchange from one to another. An OBU may engage in foreign exchange market as an intermediary for customers, or to arbitrage for profit, or to leveling position to avoid risk.Ideally, currency exchange can be exercised among any two kinds of currencies; e.g. Japan yen exchanged for German mark; or Swiss france exchanged for sterling. These kinds of cross exchanges between any two of non-US dollars currencies can be exercised in the following two manners: (1) exchange directly between two non-US dollar currencies through trader's quoting, or (2) exchange indirectly between the two non-U.S. dollar currencies through U.S. dollars. In consideration of arbitrage on prevailing currency market, a manager of currency exchange of an OBU is accustomed to using Reuter's real time system to simulate cross exchanges among currencies. Based on the results of simulation, a manager may choose appropriate exercise strategies. Therefore, the study simulates cross currency exchange according to the following design:

1). An OBU may trade in currency market continually through Reuter's real-time system conceptually. However, few OBU prefers engaging in arbitrage with real time transaction data. A recent study by Rhee and Chang (1992) collected data every 35 minutes for one month. In the study, data are collected every 10 minutes from Reuter's real time system during the time period of February 1, 1994 to March 31, 1994. Total amount of records are 5,760.

2). In consideration of time and cost, the study collects six price items for three kinds of currencies, i.e. *DEMb* and *DEMa* for exchange German mark to U.S. dollars, *JPYa* and *JPYb* for buying and selling prices to exchange Japan yen

to U.S. dollars, and *DEMJPYb* and *DEMJPYa* for buying and selling·prices to exchange Japan yen to German mark.

3). In case of price spread in currency market, an OBU may engage in currency arbitrage with two-point (or locational) arbitrage or three-point (or triangular) arbitrage. Two-point arbitrage indicates direct trading between German mark and Japan yen if there exists price discrepancy between countries or regions. Three-point arbitrage, on the other hand, indicates trading two kinds of non-U.S. dollars with U.S. dollars individually at the same time. However, in practice, an OBU engages in currency arbitrage with any combination of the two modes. The benchmarks for evaluating those combinations are stated in equations (1)-(4), as shown below:

$$\pi_1 = S1 \cdot \frac{DM}{S} \cdot \frac{Y}{DM} \cdot \frac{S}{Y} - S1 = S1 \cdot (DEMb \cdot DEMJPYb) / JPYa - S1 \tag{1}$$

$$\pi_2 = S1 \cdot \frac{Y}{S} \cdot \frac{DM}{Y} \cdot \frac{S}{DM} - S1 = S1 \cdot (JPYb / DEMJPYa / DEMa) - S1 \tag{2}$$

$$\pi_3 = DEMJPYa - Max\left[JPYb/_{DEMb} \cdot JPYa/_{DEMa} \cdot JPYa/_{DEMb} - (DEMJPYa - DEMJPYb) \right] \tag{3}$$

$$\pi_4 = Min\left[JPYa/_{DEMa} \cdot JPYb/_{DEMb} \cdot JPYa/_{DEMb} - (DEMJPYa - DEMJPYb) \right] \tag{4}$$

4. Pricing and Volatility Factors of Currency Options

Currency option is a financial derivative that trades on foreign exchange market and option holder may buy or sell currencies at the prescribed prices from contractors or counterparties in a given time period. Option pricing models can be resorted to those proposed by Black-Scholes[3] and Cox-Ross-Rubinstein[7]. The major factors that influence option pricing may include currency price (S), exercise price (X), domestic riskless interest rate (r_d), foreign riskless interest rate (r_f), time to expiration (T), and underlying currency price volatility (σ).

Generally-adopted formulas to measure price variation of currency options may include absolute level or relative ratio of price variation or delta (Δ), rate of variation or convexity or gamma (Γ), time variation or theta (Θ), fluctuational amplitude or vega (Λ), and exposure to change in volatility of price or rho (K), as exhibited in the first and second column of Table 1. In the same table, column 3 to 5 show the relationship between algebraic sign of the aforementioned factors and variational direction of option price.

Table 1 Price Fluctuational Indices of Currency Options

Measure	Function	Negative	Zero	Positive
Δ	Exposure to directional price change $\Delta = \dfrac{Dollar\ change\ in\ position\ value}{Dollar\ change\ in\ underlying\ currency}$	Bearisk. Position benefits from price decline.	Neutral. No change in value for a small price change.	Bullish. Position benefits from price increases.
Γ	Exposure to price instability ; "non-directional price change". $\Gamma = \dfrac{Change\ in\ position\ delta}{Dollar\ change\ in\ underlying\ currency}$	Position benefits from price stability.	Position is unaffected by price stability.	Position benefits from price instability.
Θ	Exposure to time decay $\Theta = \dfrac{Dollar\ change\ in\ position\ value}{Decrease\ in\ time\ to\ expiration}$	Position value declines with the passage of time.	Position in unaffected by the passage of time.	Position benefits from the passage of time.
Λ	Leverage of position price elasticity $\Lambda = \dfrac{Percentage\ change\ in\ position\ value}{Percentage\ change\ in\ underlying\ currency}$	Bearish. Position benefits from price declines.	Neutral . No change in value for a small price change.	Bullish. Position benefits from price increases.
K	Exposure to change in volatility of price $K = \dfrac{Dollar\ change\ in\ position\ value}{One\ percent\ change\ in\ volatility}$	Position benefits from a drop in volatility.	Position is unaffected by change in volatility.	Position benefits from an increase in volatility.

5. OBU's Investment Strategies on Currency Options

The difference of risk expectation on currency options between traders generates transaction to pursure profit and/or reduce capital costs. The major objective of an OBU's engaging in currency options on trading exchange is to avoid risk in prevailing currency exchange market. In general, strategies to transact on currency options may include long call, long put, straddle, strangle, condor, butterfly, vertical spread, time spread, back spread and conversion. In Table 2, implementation ways for transacting on currency options in response to coefficients of price fluctuation are summarized in columns 2 to 4.

Table 2 Investment Strategies on Foreign Currency Options

Strategy	Implementation	Delta	Gamma	Theta
Long Call	Purchase long call option	Positive	Positive	Negative
Long Put	Purchase long put option	Negative	Positive	Negative
Straddle	Purchase call and put, both with the same exercise price and time to expiration	Neutral	Positive	Negative
Strangle	Purchase call and put, each equally out of the money, and each with the same time to expiration	Neutral	Positive	Negative
Condor	Purchase call and put, each equally out of the money, and write a call and a put, each further out of the money than the call and put that were purchase. All options have the same time to expiration	Neutral	Positive	Positive
Butterfly	Write two at-the-money calls, one in the money, and the other equally far out of the money	Neutral	Negative	Positive
Vertical Spread	Buy one call, and write another call with a higher exercise price. Both options have the same time to expiration	Positive	Neutral	Neutral
Time Spread	Write one call and buy another call with a longer time to expiration. Both options have the same exercise price	Neutral	Negative	Positive
Back Spread	Buy one call and write another call with a longer time to expiration. Both options have the same exercise price	Neutral	Positive	Negative
Conversion	Buy the currency option, write a call, and buy a put. The options have the same time to expiration and the same exercise price	Neutral	Neutral	Neutral

Of the major operations of an OBU, possession of currency options to avoid risk of cross rate in prevailing market is the most common operation. In the study, investment strategies regarding operation on cross rate in combination with currency options are the major stress. Three major steps could be identified in the study. First, operations on cross rates are examined based on the proposed equitions (1) to (4), i.e. π_1, π_2, π_3 and π_4. In the second step, an OBU's manager check out the evaluation results with prescribed profit level. The OBU's manager would consider operate on currency options to hedge risk in case the computed result lower than prescribed profit level. The last step, the OBU's manager would exercise or give up the option according to the following criteria: (1) spread between currency price and exercise price, (2) spread between domestic and foreign riskless interest rates, (3) time to expiration, (4) volatility of currency prices, (5) delta, (6)

gamma, (7) theta, (8) vega, and (9) rho. In general, investment strategies of currency options, e.g. call or put, may have the relationship with the nine indices as shown in table3.

Table 3 Relationship Between Investment Strategies of Currency Options and Influence Factors.

Currency Option Level						Currency Option Volatility					
	S	X	σ	T	r_d	r_f	Δ	Γ	Θ	Λ	rho_d	rho_f
Call	+	-	+	+	+	+	+	+	-	+	+	-
Put	-	+	+	+	-	-	-	+	-	+	-	+

+ indicates positive, i.e., option price gets higher, in case the value of the factor gets larger
- indicates negative, i.e., option price gets lower, in case the value of the factor gets larger

However, to apply to practical operation and theoretical compromise among factors, Saaty's AHP (analytical hierarchy process) is asked to serve as the tool to obtain relative weights among factors. In Figure 1, the research framework is illustrated as a hierarchy structure.
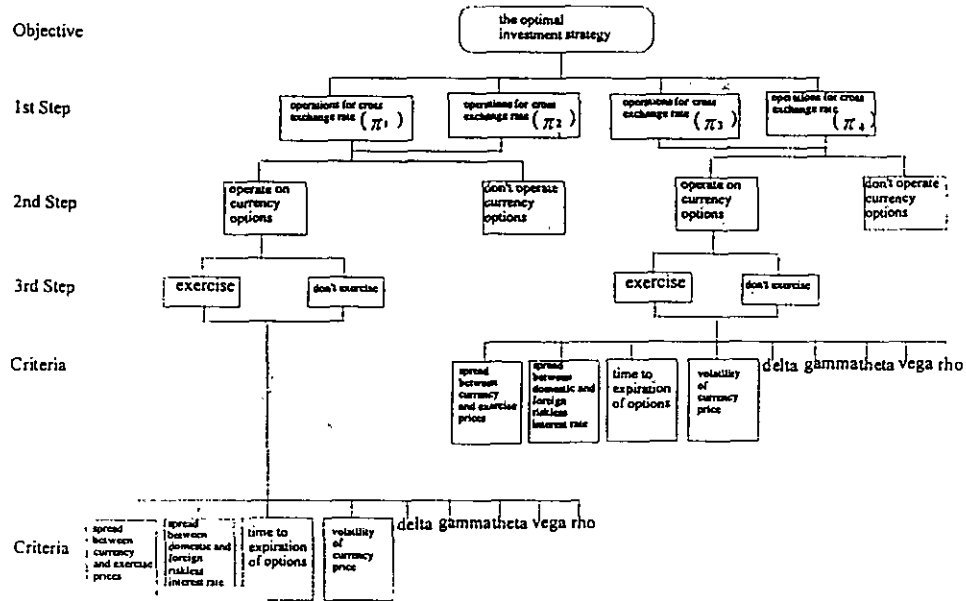

Figure 1 Hierarchy Structure for OBU's Investment Strategies on Cross Rate and Currency Options

Based on the data provided by Philadephia Exchange, benchmark for each of evaluation criteria is shown in Table 4.

Table 4 Benchmark for Evaluation Criteria

Evaluation Criteria	Call Benchmark	Put Benchmark
Spread between currency and exercise prices	0.01(C1)	-0.01(P1)
Spread between domestic and foreign riskless interest rates	0.035(C2)	0.035(P2)
Time to expiration of options	0.2959(C3)	0.2959(P3)
Volatility of currency price	0.1109(C4)	0.1109(P4)
Delta	0.7(C5)	-0.7(P5)
Gamma	0(C6)	0(P6)
Theta	-0.5(C7)	0.5(P7)
Vega	0.5(C8)	-0.5(P8)
Rho_d	0.2(C9)	-0.2(P9)
Rho_f	-0.2(C10)	0.2(P10)

In case profit of cross exchange lower than benchmark level in spot market, an OBU manager is to operate on currency options in option market to hedge risk.

Hence, we simulate transaction on currency options as the following steps:
1). An AHP software is chosen to establish hierarchy structure, compute weights, setup criteria and build alternatives.

2). Relevant data for currency options in Philadephia Exchange , such as currency price, exercise price, domestic riskless interest rate, foreign riskless interest rate, and time to expiration for options, can be retrieved from Reuter's real-time system. Currency volatility is calculated by transaction price of prevailing currency during the interval. Concerning the coefficient of price fluctuation, it can be computed by the formula shown in Table 1.

3).Compare actual profitability of currency options with benchmark to determine if to exercise options.

6. Case Study

In the case study, seven criteria are chosen. They are spread between currency price and exercise price, spread between domestic and foreign riskless interest rates, time to expiration, volatility of currency price, delta, theta and vega. Employing the AHP software, computed weights are shown in Table 5.

Table 5 Computed Weights for The Case Study

Criteria	Weights
Spread between currency and exercise prices	0.166157(W1)
Spread between domestic and foreign riskless interest rates	0.146383(W2)
Time to expiration of options	0.154403(W3)
Volatility of currency price	0.161735(W4)
Delta	0.141648(W5)
Theta	0.124770(W6)
Vega	0.104903(W7)

Based on the equations (5) and (6), the minimum/maximum of call/put indicator as well as the numbers computed by the data collected from spot market can be computed. When the computed numbers for spot market are greater/smaller than the call/put indicator, we exercise the options.

$$Call\ Indicator = (C1) \cdot (W1) + (C2) \cdot (W2) + (C3) \cdot (W3) + (C4) \cdot (W4) + (C5) \cdot (W5) - (C7) \cdot (W6) + (C8) \cdot (W7) \tag{5}$$

$$Put\ Indicator = (P1) \cdot (W1) - (P2) \cdot (W2) + (P3) \cdot (W3) + (P4) \cdot (W4) - (P5) \cdot (W5) - (P7) \cdot (W6) + (P8) \cdot (W7) \tag{6}$$

7. Conclusion and Suggestion

In the study, we propose a systematic algorithm to bridge traditional financial management that make references to various indicators individually to operate on currency options. A manager may update the weights of evaluation criteria by repeating consulting AHP after a certain time period. Therefore, the proposed method may keep abreast with rapid changing financial environment.

Of our experience, the proposed process is simple to implement and acceptable to practioners. It incorporates not only the conventional mathmatical formulas but also the newly developed decision method.

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