How Effective Are Foreign Currency Futures Markets As Hedging Vehicles?

Jeong W. Lee

Abstract

In this paper, we investigate minimum risk hedges and hedging effectiveness measures for five currencies: Euro, Japanese yen, British pound, Swiss franc, and Canadian dollar. Analysis indicates the relative desirability of positions in futures contracts to minimize the risk of spot currency exposure. Among five currencies studied, Japanese yen proves the least hedging effectiveness across the time periods. Results also show hedging effectiveness increases with the investment horizon.

I. Introduction

Even with the economic sluggishness since the “Great Recession”, the daily trading volume of all foreign currencies has steadily increased to reach more than 4 trillion dollars. Undoubtedly, many speculators and hedgers utilize currency futures as alternatives to the forward exchange markets. While many studies report empirical evidence on the relationships between forward and spot foreign exchange markets, surprisingly there are not many works done on the use of foreign currency futures markets to test theories of exchange rate determination or as a practical means of hedging exchange rate movement.

The traditional method of determining the number of futures in a hedge is simply to measure the position in the underlying asset and to take an equal but opposite position in futures contracts. Now this method can be called a naïve approach. The first alternative to this approach was suggested by Ederington (1979) who defined a measure for the effectiveness of a hedge. Another one was proposed by Johnson and Walther (1984), who applied the “α-t” model of Fishburn (1977), and Howard and D’Antonio (1984, 1987). Some applied this idea to hedge a global portfolio. Thomas (1988) argued that international equity portfolios benefit from currency hedging. Perold and Shulman (1988) claimed that even after accounting for transaction costs due to hedging, currency hedging appeared to be the dominant strategy for a global fund manager. Using a hedge ratio of unity, they avoided the complexities of perfect hedge and total loss of control of the volatility. Cantaluppi (1994) found that currency hedging was beneficial but needed the integration of hedging and investment decisions. Glen and Jorion (1993) delved into the portfolio containing bonds for the search of improvement of the performance.

This study is designed to analyze hedging effectiveness and to determine the size of the minimum risk futures position for hedging each of five broadly traded currencies: Euro, Japanese yen, Swill franc, British pound, and Canadian dollar. This study is limited in scope to empirical analysis of single currency hedges. The strategy of minimizing currency risk with cocktails of spot currencies has been analyzed extensively in the literature. While theoretically holding a multiple currency portfolio of spot and futures positions may be desirable, practically managing such a portfolio requires centralized currency management facilities and experts. It also assumes stability or continued forecasting of cross-currency correlation relationships.

Jeong W. Lee, Ph.D. is Assistant Professor of Finance at the University of North Dakota, Grand Forks, ND 58202. Email: jeong.lee@business.und.edu.

A hedging usually carried out by buying (selling) a futures contract to initiate a hedge and closing out the position when the spot market transaction occurs by selling (buying) the contract in the futures market rather than taking delivery. Risk is reduced to the extent that the gain (loss) in the futures position offsets the loss (gain) on the spot position. Three types of analysis are conducted in this study. First, the minimum risk hedge ratio and associated hedging effectiveness are determined for each security assuming one week investment horizons. Summary statistics are presented for each currency. Second, since length of investment (hedging) horizons and time to delivery may affect the minimum risk hedge rates and hedging effectiveness, one, two and four week hedges are examined with contracts separated into three month periods representing time to delivery (ranging from closest to delivery (0-3 months) to that with 9-12 months remaining to delivery). The variation in the minimum risk hedge ratios and hedging effectiveness of contracts with different periods left to delivery over alternative investment horizons are analyzed. Third, while forward and future currency markets both provide similar hedging opportunities for contracts with equal time to delivery and investment horizons, differences in market characteristics may result in segmentations between markets. A currency by currency comparison of forward and futures markets in terms of hedging effectiveness is examined.

Analysis indicates the desirability of various size positions in futures contracts per unit of spot currency to obtain minimum risk hedges. Results also show edging effectiveness increases with the hedger's holding period and is sensitive to a contract's time to delivery. The next section contains a brief summary of pervious empirical results on foreign currency forward and futures markets and of the theoretical basis for the hedge ratios and the hedging effectiveness measures used in this study. A more detailed description of the data set is presented in Section III along with an analysis of the results. In the final section, conclusions are presented and areas of future work explored.

II. Measurement of Hedging Effectiveness

Using the basic assumptions and principles of portfolio theory, it can be shown that the optimal hedge ratio (HR*), and hedging effectiveness of a market or contract(s) is related to the covariance between the spot and futures prices changes and the variances of futures price changes. In this case, the hedge ratio implies the weight of futures position in the portfolio or proportion of the given spot positions (long or short) that is hedged. A positive (negative) HR* indicates a purchase (sale) of futures and is the solution of the following equation:

$$\text{Min} \quad Var(C_{Ht}) = Var\,(C_{st}) + X^2_f\, Var(C_{ft}) + 2X_jCov\,(C_{st}, C_{ft}) \qquad (1)$$

Subject to:

$$C^0_{Ht} = E\,(C_{st}) + X_fE(C_{ft}) \qquad (2)$$

Where

C_{st}, C_{ft} = the price change during period t of the spot and futures contracts,

C^0_{Ht} = the target changes in value during period of a portfolio invested in a fixed level of spot currency and a future contract in proportion X_f,

X_f= the proportion of the portfolio held in future contracts; X^*_f equals the optimal hedge ratio (HR*) with $X_f < 0$ representing a short position and $X_f > 0$ a long position.

Above equation is similar to the two asset portfolio variance model. But in this case the spot X_f is fixed at 1.0 and does not appear explicitly in the expression. Also risk and return are defined in terms of changes in value rather than return since the cost of setting up the position is effectively zero. Since the object of most hedging is to receive the maximum amount of price change risk reduction, the problem can be reduced to that of determining the minimum risk hedge ratio HR^*_m or simply the value of X_f at which the unconstrained objective function (1) reaches a minimum. The object of analysis is to measure hedging effectiveness for these risk minimizing hedges represented by a futures position in the proportion of HR*m. This minimum risk hedge ratio can be found by setting the partial derivative of the portfolio variance with respect to X_f equal to 0 and solving for X^*_f.

$$\frac{\partial \operatorname{Var}(C_{Ht})}{\partial X_f} = 2 X_f \operatorname{Var}(C_f) + 2 \operatorname{Cov}(C_s, C_f) = 0 \quad (3)$$

$$X^*_f = -\frac{\operatorname{Cov}(C_s, C_f)}{\operatorname{Var}(C_f)} = HR^*_m$$

The value of X^*_f is equivalent to the negative of the slope coefficient of a regression of spot price changes on futures price changes and is easily determined given a data set of such price changes. The measure of hedging effectiveness E^*_f for the minimum risk hedge is defined as the reduction in variance as a proportion of total variance that results from maintaining a hedged ($X_f \neq 0$) rather than unhedged position ($X_f = 0$). E^*_f reduces to the coefficient of determination for the regression of spot on futures' price changes:

$$E^*_f = -\frac{\operatorname{Cov}(C_s) - \operatorname{Var}(C_H)}{\operatorname{Var}(C_f)} = 1 - \frac{\operatorname{Var}(C_H)}{\operatorname{Var}(C_s)} \quad (4)$$

$$E^*_f = -\frac{\operatorname{Cov}(C_s, C_f)^2}{\operatorname{Var}(C_s)\operatorname{Var}(C_f)} = R^2$$

As the correlation between the spot and futures price increases, the effectiveness of futures contract for reducing the risk of a particular spot position increases. The unity R^2 implies we have achieved the perfect hedge.

III. Data Set and Results

Five major currencies, i.e., Euro, Japanese Yen, British Pound, Swiss Franc, and Canadian dollars were utilized in this study. Currency futures contracts call for delivery in March, June, September, and December. Therefore all 20 contracts were investigated. Futures price data were collected from the Wall Street Journal, and Investor's Business Daily using weekly Friday's closing prices of contract during the period March 2005 to December 2009 traded in the International Monetary Market of CME (Chicago Mercantile Exchange) Group. Closing prices of spot currencies on each Friday were collected from the Treasury Department.

Tables 1, 2, and 3 contain the results for each currency's futures contract of estimating minimum risk hedge ratio (HR*) and hedging effectiveness measures (E^*_f). Results support the hedging usefulness of the various futures currency markets. All hedge ratios exhibit significantly different from 1.0 at a significance level of 5 percent using a two-tailed *t*-test. Nonetheless, the hedge ratios were significantly less than one, meaning that a naïve one-for-one futures to spot hedge is not interpreted as the average proportional reduction in spot price change variance that could have been realized by hedging with the minimum risk hedge ratio (HR^*_f) over the period. For four currencies, Euro, Canadian Dollar, British Pound, Swiss Franc, their E^*_f levels are all over 80 percent for four weeks duration. The Japanese yen proves relatively the most difficult to hedge based on an average E^*_f over all data set. For hedges of duration of one, two, and four weeks, E^*_f values of Japanese yen are 23 percent, 30 percent, and 77 percent.

Table 1
Futures Hedging Effectiveness Result (2005-2009)
Hedging duration: one week

	Euro		Japanese Yen		Canadian Dollar		British Pound		Swiss Franc	
Months included	EF*	HR*	EF*	HR*	EF*	HR*	EF*	HR*	EF*	HR*
All	.542	.569	.231	.339	.329	.430	.452	.712	.521	.602
0-3	.683	.725	.228	.329	.319	.523	.429	.639	.492	.583
3-6	.739	.812	.195	.249	.298	.329	.626	.721	.735	.941
6-9	.357	.294	.297	.328	.420	.698	.392	.711	.453	.620
9-12	.713	.822	.193	.535	.221	.523	.814	.902	.557	.681

Table 2
Futures Hedging Effectiveness Result (2005-2009)
Hedging duration: two weeks

	Euro		Japanese Yen		Canadian Dollar		British Pound		Swiss Franc	
Months included	EF*	HR*	EF*	HR*	EF*	HR*	EF*	HR*	EF*	HR*
All	.818	.884	.304	.435	.829	.803	.821	.834	.762	.817
0- 3	.592	.810	.285	.329	.793	.813	.910	.932	.809	.829
3-6	.839	.792	.520	.609	.931	.892	.731	.871	.933	.987
6-9	.935	.988	.621	.554	.791	.710	.712	.611	.569	.702
9-12	.883	.902	.543	.402	.998	.973	.546	.597	.915	.913

Table 3
Futures Hedging Effectiveness Result (2005-2009)
Hedging duration: four weeks

	Euro		Japanese Yen		Canadian Dollar		British Pound		Swiss Franc	
Months included	EF*	HR*	EF*	HR*	EF*	HR*	EF*	HR*	EF*	HR*
All	.887	.933	.772	.797	.982	.998	.989	.997	.938	1.102
0-3	.819	.921	.820	.923	.938	.945	.987	.921	.910	.893
3-6	.839	.920	.728	.767	.938	.912	.901	.932	.992	1.032
6-9	.993	.924	.520	.709	.824	.792	.938	.798	.932	.915
9-12	.932	.948	.992	.763	.983	1.229	.992	.984	.992	1.182

The results also indicate that hedging effectiveness increases with the length of the investment horizon. For all currencies, and delivery periods, hedges of four weeks duration are twice effective as one week hedge positions. Overall all of five currencies show consistent high levels of hedging effectiveness. Japanese yen shows the least hedging effectiveness across the time periods. Even though findings reveal that hedging effectiveness increases with the length of the holding period, generally speaking, the contract closest to delivery tends to provide the most liquidity. Thus easy to hedge does not mean the best to hedge. Results also indicate the effect of time to delivery across the sample contracts.

IV. Conclusions

In this study, new set of analysis is done to the hedging potential of foreign currency futures. Brief hedging effectiveness measures and optimal hedge ratios are presented for a sample of weekly price observations on 20 futures contracts for five currencies. Most cases the futures markets are shown to have consistently high hedging effectiveness. Hedging performance is weakest when a hedge of short duration (one week) was required and increased when one moved to longer hedging horizons. The results show all five foreign futures for one week hedge duration and Japanese yen futures for all hedge durations are somewhat inferior as hedging tools although they provide significant reduction in risk exposure when compared to a completely unhedged position. Euro maintains the least variation of hedging effectiveness throughout lengths of duration among currencies studied. Even though hedging with the short duration is the least effective, hedgers should bear in mind that the short duration increases its usefulness because the nearby contract most likely is more liquid than longer-term contracts. But the study does not indicate the nearby contract as the best hedging instrument. Results show in many cases the contracts with nine to twelve months to delivery provide the best chance of risk reduction.

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