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Exchange rate dynamics and Forex hedging strategies

Abstract

In the world of globalization, most business enterprises operate in more than one country, receiving foreign currency for exports and paying foreign currency for imports, and this exposes them to foreign exchange risk. Each entity and/or individual that has exposure to foreign exchange rate risk will have specific foreign exchange hedging needs; on the other hand, the effectiveness of different hedging techniques depends on the specific purposes they serve.

The present study extends the analysis of Dash et al. (2008) in comparing the performance of four different Forex hedging strategies, approaching the problem from the point of view of exchange rate dynamics, using a model for exchange rate movements. Based on the results of the simulation of this model, the hedging strategies which yielded the highest returns and the lowest variability of returns were identified.

The results of the study suggest that when cash inflows only are to be hedged, options hedging using out-of-the-money currency put options yields best results; when cash outflows only are to be hedged, options hedging using out-of-the-money currency call options yields best results, and when both cash inflows and outflows are to be hedged, options hedging using out-of-the-money currency put options for inflows and out-of-the-money currency call options for outflows yields best results. Finally, the results of the study show that it is always risky to remain unhedged against foreign exchange rate fluctuations.

These strategies can be used by business enterprises that have significant exposure to foreign exchange rate volatility.

Keywords: exchange rate dynamics, foreign exchange hedging strategies, simulation.
JEL Classification: F31, G15.

Introduction

There have been several significant changes in the international economic and political landscape, the most notable of which is the global meltdown and recession, which have led to uncertainty regarding the direction of foreign exchange rate movements. This uncertainty has led to high volatility in foreign exchange rates, and the need to hedge against foreign exchange risk and/or interest rate risk, while, at the same time, effectively ensuring a secure future financial position.

In the world of globalization, most business enterprises operate in more than one country, receiving foreign currency for exports and paying foreign currency for imports, and this exposes them to foreign exchange risk. Each entity and/or individual that has exposure to foreign exchange rate risk will have specific foreign exchange hedging needs; on the other hand, the effectiveness of different hedging techniques depends on the specific purposes they serve. This study examines the effectiveness of four important hedging techniques in different situations.

1. Literature review

There have been several recent studies on foreign exchange risk management which have focused on managing foreign exchange risk while doing business in developing countries.

Jesswein et al. (1995) studied the usage pattern of foreign exchange management strategies by American firms. They find that the popularity of the simpler, first-generation product (forward currency contracts) has not been overtaken by the sophisticated new entrants, and that the adoption of innovative foreign exchange risk management products is not as common as expected.

Albuquerque (1999) characterized optimal currency hedging for a loss-averse firm. He found that, surprisingly, when transactions costs are identical, forward contracts dominate put options as hedges of downside risk. Even though there are no fixed costs of implementing a hedging program there is a range of inaction in which it is optimal for the firm not to hedge. The dynamic hedge ratio is non-monotonic in the exchange rate. Albuquerque (2007) extended this analysis using three models of hedging: (1) a firm that chooses its hedging policy in the presence of bankruptcy costs; (2) an all equity firm that faces a convex tax schedule; and (3) a firm whose manager is subject to loss aversion. In all these models, again, he found that forwards dominate options as hedges of downside risk.

Hautsch and Inkmann (2003) presented a framework for deriving a vector of optimal hedge ratios against the currency exchange risk associated to a portfolio with multiple currency holdings. Optimality refers to a mean-variance objective function with a time-varying risk parameter. They proposed a data-driven choice of this parameter, which is suggested from the functional form of the first order conditions for a Sharpe ratio maximization criterion.

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Lioui and Poncet (2005) argued that when forward contracts are used, incurred profits or losses that accrue to the investor's wealth at each instant are locked-in in the forward position up to the contract maturity. Thus discounting these gains or losses back at the current date brings about an interest rate risk. Therefore the investor's hedging strategy itself generates an additional risk, which in turn induces the need for additional hedging.

Yazid and Muda (2006) studied the usage pattern of foreign exchange management strategies in multinational corporations. They found that multinationals are involved in foreign exchange risk management primarily because they sought to minimize operational overall cash flows, which are affected by currency volatility. Also, the majority of multinationals centralize their risk management activities and at the same time impose greater control by frequent reporting on derivative activities. It is likely that huge financial losses related to derivative trading in the past led to top management being extra cautious.

Dash et al. (2008) suggested that, for currency outflows, hedging with currency options contracts would yield the highest mean returns, irrespective of the movement of the exchange rate. On the other hand, for currency inflows, hedging with forward currency contracts would yield the highest mean returns for a decreasing trend in the exchange rate, cross currency hedging would yield the highest mean returns for a cyclic fluctuation in the exchange rate, however, for an increasing trend in the exchange rate, no single hedging strategy would yield the highest mean returns. They also concluded that it would be an added advantage for one to use a combination of strategies to manage foreign exchange exposure.

The present study has extends the analysis of Dash et al. (2008) in comparing the performance of different hedging strategies. However, unlike the approach in Dash et al. (2008), which essentially involved back-testing the hedging strategies, the present study has approached the problem from the point of view of exchange rate dynamics, using a model for exchange rate movements.

Walmsley (1996) discussed the enormous changes which have occurred during the past few years in foreign exchange markets and the impact they would be expected to have on the nature of international business. He proposed a non-linear model for exchange rate dynamics, based on a long-run equilibrium level and shocks, with mean-reversion.

Still (2009) discusses crowd dynamics and chaotics in the Forex market. He linked Walmsley's exchange rate dynamics model with the logistic function, and examined the chaotic properties of the model.

2. Data and methodology

The present study extends the analysis of Dash et al. (2008) in comparing the performance of four different hedging strategies, approaching the problem from the point of view of exchange rate dynamics, using a model for exchange rate movements. Based on the results of the simulation of this model, the hedging strategies which yielded the highest returns and the lowest variability of returns could be identified.

The model used in the study to simulate the exchange rate dynamics was adapted from Walmsley (1996). According to this model, the change in the exchange rate is proportional to the gap between the exchange rate in the previous period and the long-run equilibrium exchange rate; that is, $\Delta S_t = \theta(S' - S_{t-1})$. The long-run equilibrium exchange rate (denoted by S') is determined by such factors as relative money supply, output capacity, and so on, and can be assumed to be constant for the short run. The parameter θ, which measures the speed with which the system returns to equilibrium, is assumed to be related to S_t such that $\theta = \alpha S_t$, with $\alpha > 0$. Introducing a normally-distributed random shock term, the model used for the simulation can be expressed as: $S_t = \frac{S_{t-1} + \varepsilon_{t-1}}{\left[1 - \alpha(S' - S_{t-1})\right]}$. This simulation model was validated with the exchange rates of different currency pairs for the period of ten years.

The data for the study consisted of the closing USD/INR and GBP/INR exchange rates for the ten year period April 1, 1999-March 31, 2009. The reference date for the study was April 25, 2009. The spot USD/INR and spot GBP/INR exchange rates on the reference date were INR 49.8900/$ and INR 73.0000/GBP, respectively[1]. The one-month MIBOR and one-month LIBOR on the reference date were 4.5900% and 0.4400% p.a., respectively[2]. The Indian and U.S. inflation rates on the reference date were 0.2600% and -0.3836% p.a., respectively[3]. The Indian and U.S. risk-free interest rates (T-bill rates) on the reference date were taken as 6.1240% and 2.9600% p.a., respectively. Finally, the volatility of the USD/INR exchange rate on the reference date was found to be 6.6875% p.a. This data are used to determine the forward rate and option premium.

The analysis was carried out with a fixed series of cash flows, expected to be received at fixed time points within a six-month interval. The results are based on two hundred and fifty simulation runs of the above model.

[1] www.rbi.org, www.exchangerates.com.
[2] www.bankrates.com.
[3] www.inflationdata.com.

2.1. Comparative analysis of hedging strategies for USD inflows for six months. The first sample on which the different hedging strategies were applied was a series of cash inflows, as shown in the table below. The results of the simulation are shown in Table 1.

Table 1. Descriptive statistics of the simulation for USD inflows only

Series of cash inflows										
Date	10-May	24-May	5-Jun	10-Jun	25-Jun	2-Jul	15-Jul	15-Aug	27-Aug	15-Sep
Cash inflows	$10,000	$25,000	$17,500	$18,500	$50,000	$40,000	$55,000	$13,000	$25,000	$10,000
Descriptive statistics										
	Mean cash inflow				Std. dev.			C.V.		
Cross-currency hedging	INR 13,248,900.93				INR 558,183.01			4.21%		
Options hedging (2% above par)	INR 13,222,285.98				INR 98,327.20			0.74%		
Options hedging (at par)	INR 13,198,616.36				INR 174,206.45			1.32%		
Options hedging (2% below par)	INR 13,176,509.87				INR 247,600.88			1.88%		
Forward hedging	INR 13,172,184.96				INR 0.00			0.00%		
Without hedging	INR 13,148,035.17				INR 323,164.04			2.46%		

It was found that cross-currency hedging yielded the highest mean value of cash flows, followed by options hedging at 2% above par, options hedging at par, options hedging at 2% below par, forward hedging, and lastly without hedging. Paired-samples *t*-tests indicated that there was no significant difference between cross-currency hedging and options hedging at 2% above par, and that these strategies yielded significantly higher mean value of cash flows than the other strategies. It was found that forward hedging yielded significantly lower mean value of cash flows than options hedging. Finally, it was found that the unhedged position yielded significantly lower mean value of cash flows than the other strategies. In terms of volatility, it was found that forward hedging and options hedging had lower variability than the unhedged position, while it was found that cross-currency hedging had higher variability than the unhedged position. Thus, when an enterprise is exposed to cash inflows only, it is preferable to go for options hedging at 2% above par.

2.2. Comparative analysis of hedging strategies for USD outflows for six months. The next sample on which the different hedging strategies were applied was a series of cash inflows, as shown in the table below. The results of the simulation are shown in Table 2.

Table 2. Descriptive statistics of the simulation for USD outflows only

Series of cash inflows										
Date	10-May	24-May	5-Jun	10-Jun	25-Jun	2-Jul	15-Jul	15-Aug	27-Aug	15-Sep
Cash inflows	$10,000	$25,000	$17,500	$18,500	$50,000	$40,000	$55,000	$13,000	$25,000	$10,000
Descriptive statistics										
	Mean cash inflow				Std. dev.			C.V.		
Options hedging (2% below par)	(INR 12,466,075.25)				INR 256,560.91			-2.06%		
Options hedging (at par)	(INR 12,812,540.66)				INR 180,772.94			-1.41%		
Options hedging (2% above par)	(INR 13,017,654.47)				INR 256,560.91			-1.97%		
Without hedging	(INR 13,148,035.17)				INR 325,128.60			-2.47%		
Forward hedging	(INR 13,172,184.96)				INR 0.00			0.00%		
Cross-currency hedging	(INR 13,399,834.98)				INR 507,832.61			-3.79%		

It was found that options hedging at 2% below par yielded the highest mean value of cash flows, followed by options hedging at par, options hedging at 2% above par, without hedging, forward hedging, and lastly cross-currency hedging. Paired-samples *t*-tests indicated that options hedging at 2% below par yielded significantly higher mean value of cash flows than options hedging at par, which in turn yielded significantly higher mean value of cash flows than options hedging at 2% above par, and that the option hedging strategies yielded significantly higher mean value of cash flows than the other strategies. It was found that forward hedging and cross-currency hedging yielded significantly lower mean value of cash flows than without hedging. In terms of volatility, it was found that options hedging had lower variability than the unhedged position, while it was found that cross-currency hedging had higher variability than the unhedged position. Thus, when an enterprise is exposed to cash outflows only, it is preferable to go for options hedging at 2% below par.

2.3. Comparative analysis of hedging strategies for USD inflows/outflows for six months. The third sample on which the different hedging strategies were tested was a series of cash inflows, as shown in the table below. The results of the simulation are shown in Table 3.

Table 3. Descriptive statistics of the simulation for USD inflows and outflows

Series of cash inflows/outflows										
Date	10-May	24-May	5-Jun	10-Jun	25-Jun	2-Jul	15-Jul	15-Aug	27-Aug	15-Sep
Cash inflows	$10,000	($25,000)	$17,500	$18,500	($50,000)	($40,000)	$55,000	$13,000	$25,000	($10,000)
Descriptive statistics										
		Mean cash inflow			Std. dev.			C.V.		
Options hedging (2% below par)		INR 997,692.32			INR 113,568.06			11.38%		
Options hedging (at par)		INR 847,592.72			INR 79,189.55			9.34%		
Options hedging (2% above par)		INR 775,220.92			INR 93,659.20			12.08%		
Forward hedging		INR 698,644.16			INR 0.00			0.00%		
Cross-currency hedging		INR 692,740.11			INR 106,414.73			15.36%		
Without hedging		INR 662,522.25			INR 66,782.52			10.08%		

It was found that options hedging at 2% below par yielded the highest mean value of cash flows, followed by options hedging at par, options hedging at 2% above par, forward hedging, cross-currency hedging, and lastly without hedging. Paired-samples *t*-tests indicated that options hedging at 2% below par yielded significantly higher mean value of cash flows than options hedging at par, which in turn yielded significantly higher mean value of cash flows than options hedging at 2% above par, and that the option hedging strategies yielded significantly higher mean value of cash flows than the other strategies. It was found that there was no significant difference in the mean value of cash flows under forward hedging and cross-currency hedging. Finally, it was found that the unhedged position yielded significantly lower mean value of cash flows than the other strategies. In terms of volatility, it was found that options hedging had similar variability as compared with the unhedged position, while it was found that cross-currency hedging had higher variability than the unhedged position. Thus, when an enterprise is exposed to both cash inflows and outflows, it is preferable to go for options hedging at 2% below par.

Discussion and conclusion

The results of the study indicate that when cash inflows only are to be hedged, options hedging at 2% above par (i.e. using out-of-the-money currency put options) would yield best results; when cash outflows only are to be hedged, options hedging at 2% below par (i.e. using out-of-the-money currency call options) would yield best results; when both cash inflows and outflows are to be hedged, options hedging at 2% below par (i.e. using out-of-the-money currency put options for inflows and out-of-the-money currency call options for outflows) would yield best results. In particular, the results of the study show that it is always risky to remain unhedged against foreign exchange rate fluctuations.

Of course, much would depend on the risk-tolerance of the concerned firm. If a firm is absolutely risk-intolerant, forwards would be the most appropriate hedging instrument. In such a case, one should analyze inflation rates and interest rates to make sure that the forward rates are properly priced, both to construct better hedges and to take advantage of any mispricing. On the other hand, if the firm is able to take risk and wants better returns, it could hedge cash inflows by cross currency hedging. Again, the outcome of cross-currency hedging depends critically on the choice of third currency. Further research should examine the conditions under which different currencies would yield better results in cross-currency hedging.

From the results of the study, hedging with out-of-the-money currency options contracts was found to result in the highest mean returns, irrespective of the movement of the exchange rate. This seems to contradict the results of Albuquerque (1999, 2007) and the results of Dash et al. (2008).

There were some mild limitations inherent in the study. The data for the study was for the period of ten years only, which may not be comprehensive enough to come at a conclusion. Further, the study used a simple non-linear model for exchange rate dynamics; more complex models would improve upon the results of the present study. Finally, a small sample (only two hundred and fifty simulation runs) was taken for the study. A more longer-series study, with more currencies (such as the Euro), would give better results.

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