TRANSACTION EXPOSURE AND VALUE AT RISK: A PRACTICAL APPLICATION FOR MNCs[1]

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ABSTRACT

This research paper measures the "value at risk" for an MNC transacting business in five specific foreign currencies for a recent time period. These foreign currencies include the British pound, the Euro, the Swiss franc, the Japanese yen and the Canadian dollar. The values at risk for each possible two-currency portfolio (vis-à-vis the U.S. dollar) are computed and evaluated. The effects of each currency's volatility as well as the correlations between the currency movements are examined. These findings should inform MNCs about the degree of transaction risk faced and provide key insight into decisions for managing this risk.

INTRODUCTION

Because multinational corporations (MNCs) conduct business in a variety of currencies, they are exposed to exchange rate risk on a continuing basis. One form of exchange rate risk is "transaction exposure." This is the risk that the MNC's cash flows will be affected by exchange rate changes. Both receivables and payables denominated in foreign currencies contribute to this risk.

"Value at risk" is a probabilistic approach to measuring downside risk (i.e., the maximum loss) that is likely to occur within a specific time frame at a particular level of confidence. Multinational corporations may utilize this model to assess the transaction risk associated with net cash flows denominated in one or more foreign currencies.

To understand exactly how this approach to measuring transaction risk can be applied, this research paper employs daily data from February 12, 2007 through March 30, 2007 (a total of thirty consecutive observations) to evaluate the value at risk for a variety of two-currency portfolio models involving the following currencies: the Swiss franc, the British pound, the Euro, the Canadian dollar, and the Japanese yen. The value at risk is determined for each combination of currencies for this particular time period (i.e., a total of ten combinations), at the 95-percent confidence level.

Optimally, this risk should be viewed on a consolidated basis; that is, across all the firm's divisions and across all countries. The transaction exposure associated with payables denominated in one particular currency (in any division) will be offset, in whole or in part, by any receivables denominated in that same currency. However, any positive (or negative) net cash flow in a particular currency will subject the MNC to transaction exposure due to potential fluctuations in exchange rates.

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In certain circumstances, an MNC may decide not to hedge its transaction exposure. In other circumstances, the MNC may decide to hedge this risk using one or more techniques including a forward hedge, a money market hedge, a futures hedge, a currency option hedge, or some other technique. But in order to make these decisions (i.e., to hedge or not to hedge) in an optimal fashion, the corporation needs an objective assessment of exactly how much risk it faces. Value at risk is one particular approach to assessing risk that has become increasing popular since the middle of the 1990s. While the value at risk approach has wide applicability, it is increasingly used by MNCs to assess transaction exposure. Articles about this approach to measuring risk are now common in the literature.

As noted above, value at risk technique is a probabilistic approach to measuring downside risk (i.e., the maximum loss) that is likely to occur within a specific time frame at a particular level of confidence. A business may utilize this approach to assess the transaction risk associated with net cash flows denominated in one (or each) particular currency. In this case, the downside risk (maximum loss) is a function of the standard deviation in the percentage changes of the particular exchange rate, the (dollar) value of the net cash flow itself, and the desired confidence level. The "value at risk" (the maximum loss) is positively associated with each of these three variables.

In addition, an MNC may utilize this basic approach to assess the riskiness of the net cash flows associated with the variety currencies in which it transacts business. This use of the model, which measures the transaction risk associated with the net cash flows associated with an entire "portfolio" of currencies, is particularly valuable for MNCs that transact business in multiple currencies on a routine basis. Based on standard portfolio theory, the transaction risk (i.e., the maximum loss) in this latter case is a function of the proportions of the total portfolio in each currency, the standard deviations of the percentage changes in each exchange rate, the correlation coefficients of the percentage changes of the relevant exchange rates, the (dollar) value of the net cash flows, and the desired confidence level. [See Madura, 2008, for a clear and concise description of the basic value at risk approach to measuring transaction risk.]

Of course, a portfolio of currencies whose values are highly volatile vis-à-vis the dollar (i.e., the standard deviations in percentages changes in the dollar exchange rates are high) will have a high level of transaction risk, ceteris paribus. Portfolios of currencies that possess positive and high correlation coefficients will also face more "value at risk," other things equal. On the other hand, portfolios of currencies that have low (or even negative) correlation coefficients will have less value at risk due to internal (or natural) diversification effects.

Value at risk is sensitive to the particular time period being considered. For example, if a particular exchange rate varies more over a month than over a week, or if the anticipated net cash flow denominated in a particular currency is greater for the next month than the next week, then the value at risk (i.e., the maximum loss) will be greater for the next month than the next week, given the same level of confidence. Because MNCs can predict their net cash flows with far more accuracy over relatively shorter periods of time, the value at risk model is most often used for predicting the maximum loss over relatively short periods of time. However, it may be that an MNC would find it useful to predict the value at risk for multiple time periods.

REVIEW OF LITERATURE

The usage of value at risk (VAR) as a management tool gained popularity in the second half of the 1990s as the Securities and Exchange Commission required that publicly held corporations quantify and disclose their market risk associated with volatility in foreign currency exchange rates, interest rates, commodity prices, and additional risk factors. (See Thiem and Ruiz-Zaiko,

1998) Another factor which promoted the usage of VAR was the Basle II Capital Accord (1997). (See Sacks, 1997) An article by Platt (2007) provides an excellent discussion of the increased use of value at risk resulting from globalization.

While the expression "value at risk" is widely used, the expression does not refer to one particular methodology (or approach) to quantifying risk. Rather it refers to a family of related approaches including: 1) the variance-covariance approach, 2) historical simulation, and 3) the use of Monte-Carlo simulations. Janabi (2006) provides an excellent primer on the variance-covariance method to measuring value at risk. The article by Glasserman, Heidleberger, and Shahabuddin (2002) discusses the use of Monte Carlo simulations to estimate value at risk.

The following articles provide good overviews of VAR or empirical tests of the different approaches: Carrada-Bravo, Hosseini, and Fernandez (2006), Tardivo (2002), Stambach (1996), Hendricks (1996), Angelidis and Degiannakis (2005), Chong (2004) and Gramlich (2002).

Despite the widespread usage of the value at risk methodology, the potential shortcomings of this approach to measuring downside risk are fairly well known. One of these shortcomings is the possibility that the assumption the variable (or variables) in question is normally distributed is incorrect. Articles that explore the implications of nonnormal distributions, including fat tails and how to employ VAR in these cases (sometimes referred to as "extreme value theory"), include Neftci (2000), Hull and White (1998), Bekiros (2008), Novak, Dalla, and Giraitis (2007), Yamai and Yoshiba (2005), Ferreira (2005), Castellano and Giacometti (2001), Taylor (2000), Mittnik and Paolella (2000), Kaut, Vladimirou, Wallace, and Zenios (2007), and Ghaoui, Oks, and Oustry (2003).

Another potential vulnerability of the VAR approach is that the ability to forecast volatility deteriorates as the time horizon lengthens. Relevant articles include Christoffersen and Diebold (2000), Fernandez (2005), and Chiu, Lee, and Hung (2005).

Despite the potential weaknesses of the VAR approach to measuring risk, the article by Jorion (2002) presents evidence the "VAR disclosures [by commercial banks] are informative in that they predict the variability of trading revenues."

RESULTS AND INTERPRETATIONS

The standard deviations (of the daily percentage changes) for each exchange rate (i.e., vis-à-vis the U.S. dollar) were computed for the time period under consideration. The results are shown in Table 1, below.

Table 1 -- Standard Deviations

U.S. dollar/Swiss franc	0.471
U.S. dollar/British pound	0.302
U.S. dollar/Euro	0.347
U.S. dollar/Canadian dollar	0.450
U.S. dollar/Japanese yen	0.725

Because the variability in the U.S. dollar/Japanese yen exchange rate was relatively large (as shown above), one can infer that receivables or payables denominated in Japanese yen would contribute more to transaction risk than receivables or payables denominated in other currencies, ceteris paribus. Alternatively, due to the relatively low volatility in the U.S. dollar/British pound exchange rate, receivables or payables denominated in British pounds would cause less transaction risk than receivables or payables denominated in other currencies, ceteris paribus. By comparison, transactions denominated in Euros, Swiss franc or Canadian dollars would create an intermediate amount of transaction risk for the MNC (ceteris paribus).

Of course, the total transaction risk of a portfolio of currencies will also depend on the correlation coefficients between the movements in the currencies. Table 2, below, represents the correlation coefficients for the time period considered.

Table 2—Correlation Coefficients

	Swiss franc	British pound	Euro	Can. dollar	Japanese yen
Swiss franc	1	0.139485	0.66777	0.027042	-0.348722
British pound		1	0.21865	0.440179	0.211755
Euro			1	0.308446	-0.13542
Can. dollar				1	-0.010833
Japanese yen					1

As can be seen in the above data, seven of the ten two-currency portfolios have positive correlation coefficients, while three of the two-currency combinations are negatively correlated. These statistics have a direct bearing on value at risk.

For example, because the correlation coefficient for the U.S. dollar/Swiss franc exchange rate and the U.S. dollar/Euro exchange rate (i.e., between the percentage changes in these exchange rates) is relatively high (at 0.6677), an MNC with net cash flows in these two currencies will face more value at risk (i.e., a greater maximum loss) than if it transacted business denominated in the other currencies, ceteris paribus. Alternatively, because the correlation coefficient for the U.S. dollar/Swiss franc exchange rate and the U.S. dollar/Japanese yen exchange rates is negative (at -0.348722), an MNC doing business denominated in these currencies might be expected to face less value at risk due to the internal diversification.

However, comparing the standard deviations of the two, two-currency portfolios mentioned in the above paragraph is revealing. One might anticipate that because the U.S. dollar/Japanese yen exchange rate is so much more volatile than the U.S. dollar/Euro exchange rate (i.e., in terms of the percentage changes), a two-currency model including the Japanese yen would result in significantly more risk than a two-currency model including the Euro.

However, when comparing the relative risks of a portfolio including the Swiss franc and the Japanese yen to a portfolio including the Swiss franc and the Euro, the transactions risks are, in fact, very similar. Specifically, while the standard deviation of the former portfolio (including the

Japanese yen) is 0.357, the standard deviation of the latter portfolio (including the Euro) is slightly higher at 0.374. [This assumes that the proportions of the net cash flows in each currency are equal; i.e., assuming a 50/50 split.] See Table 3.

The explanation for this seeming anomaly, of course, is that the correlation coefficient between the Swiss franc and the Japanese yen is negative, whereas the correlation coefficient between the Swiss franc and the Euro is strongly positive. In effect, the portfolio with the Swiss franc and the Japanese yen achieves a significant degree of internal diversification due to the negative correlation in the percentage changes in these two exchange rates. This natural diversification is, apparently, more than enough to offset the fact that the U.S. dollar/Japanese yen exchange rate exhibits significant volatility.

The two standard deviations noted above can be used to determine the actual dollar value of the maximum one-day loss to the MNC for each of these two, two-currency portfolios, at a particular confidence level. Specifically, assuming these probability distributions are normally distributed, the 95-percent confidence interval for these portfolios can be determined by multiplying each standard deviation by 1.65. For example, there is a 5-percent chance that the loss experienced on the portfolio including Swiss francs and Euros will be greater than 0.617 percent of the net cash flows over the next day (i.e., 0.374 x 1.65). Accordingly, the maximum one-day loss on a portfolio of $1,000,000 of net cash flows in the portfolio containing Swiss francs and Euros is $6,170.

The comparable figure for the portfolio including Swiss francs and Japanese yen is slightly less at $5,891. Obviously, the greater the (dollar value) of the net cash flow, the greater the value at risk, in absolute amount.

Broadening out the analysis, the maximum one-day loss for each of the ten, two-currency portfolios can be determined based on the standard deviations of the relevant portfolios shown in Table 3, below.

Table 3 – Risks (Standard Deviations) of Two-Currency Portfolios

	Swiss franc	British pound	Euro	Can. dollar	Japanese yen
Swiss franc		0.29708	0.374327	0.329932	0.35699
British pound			0.25381	0.321409	0.421467
Euro				0.323534	0.380269
Can. dollar					0.424633
Japanese yen					

At the 95-percent confidence level, the maximum one-day loss (in terms of percent) for each of the above two-currency portfolios is shown in Table 4, below.

Table 4 – Maximum One-Day Loss of Two-Currency Portfolios

	Swiss franc	British pound	Euro	Can. Dollar	Japanese yen
Swiss franc		-0.490182	-0.61764	-0.544389	-0.589034
British pound			-0.418787	-0.530325	-0.69542
Euro				-0.533832	-0.627444
Can. dollar					-0.700645
Japanese yen					

Based on Tables 3 and Table 4, above, it is clear that an MNC with net cash flows denominated in Canadian dollars and Japanese yen (i.e., vis-à-vis the U.S. dollar) faces more transaction risk than an MNC with net cash flows denominated in any other two-currency portfolio. A two-currency denominated in British pounds and Japanese yen also faces a relatively high degree of transaction risk. [These particular two-currency portfolios have standard deviations of 0.425 and 0.421, respectively.] The two-currency portfolios with the least transaction risk are the portfolios with net cash flows denominated in 1) British pounds and Euros and 2) Swiss francs and British pounds. [The standard deviations of these portfolios are, respectively, 0.254 and 0.297.] The remaining two-currency portfolios result in an intermediate level of transaction risk.

LIMITATIONS AND FUTURE RESEARCH

A principal advantage of the value at risk approach to measuring transaction exposure is its simplicity. MNCs can utilize this approach to risk management at a relatively low cost in terms of both time and effort, assuming the data are available. In addition, this approach to quantifying transaction risk is, at a conceptual level, relatively straightforward.

Nonetheless, the value at risk approach has shortcomings. One potential shortcoming is the implicit assumption that the variables in question are normally distributed. While the assumption of normality makes value at risk easier to employ, it has been observed that the distributions of some variables (especially asset prices) may have “fat tails” and, as a result, the likelihood of extreme events may be underestimated.

Another potential weakness is that the ability to forecast generally deteriorates as the time horizon lengthens. On a related note, if the variability in a particular exchange rate changes over time, or if the correlations between exchange rate movements change over time, the value at risk for one particular time period may not accurately reflect the value at risk for another time period. Subsequent studies may shed light on the temporal stability of these relationships.

Despite these limitations, the authors believe this analysis is both revealing and instructive for MNCs concerned about the amount of transaction risk to which they are exposed. The value at risk approach and results provided by this study should help firms measure and manage the risk of conducting business on a world-wide basis.

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