# Value at risk in the presence of a tender

Stephane Knauf and Emmanuel Acar of Citibank Foreign Exchange define the hedge ratio minimising the risk in a tender situation.

An assumption most companies make implicitly when measuring the size of their foreign exchange (FX) risks is one of cashflow certainty. This, however, can turn out to be a very strong statement if you consider the FX risk incurred when tendering to market, when entering a takeover bid process, or more simply when hedging anticipated cashflows.

This situation could even be extended to cases where your FX exposure depends on a different asset class, such as commodity-related risks (usually representing US$-denominated flows) for companies not using the dollar as their functional currency.

If we take the basic example of a foreign currency-denominated tender to market, currency risk will appear as soon as a price offer is made but only materialise in the case of success. Hedging that kind of exposure, or measuring the FX risk related to it, cannot be done using traditional methods because one crucial parameter would be missing: the estimated probability of success.

In this article, we will aim to define the hedge ratio minimising the risk in a tender situation as a function of market conditions (such as interest rate differential and volatility) and the probability of success. We will also give a concrete example showing how to further reduce the quantity of risk not 'hedgeable' through forwards.

### *Value at risk*

Value at risk (VaR) is a single number estimate of how much a company can lose due to the price volatility of the instrument it holds, such as an unhedged future currency payable or receivable. VaR is usually reported at the 95% level of confidence, meaning that there is only a 5% chance that the portfolio will fall by more than the VaR. The historical method uses the distribution of past cashflow returns to infer future risks. VaR can always be expressed as a co-efficient of proportionality to the underlying currency's market volatility and that is the convention adopted in this article.

> Companies are frequently exposed to floating or contingent exposures and modelling this uncertainty is pre-requisite

If we look at a company being exposed to the sterling against dollar exchange rate and the underlying currency market's volatility is 10%, a VaR of -1.5 will mean there is only a 5% chance that the cashflow will fall by more than the -15% (=-1.5*10%).

### *In the presence of a tender*

To illustrate the notion of tender, let's use the example of a British exporter tendering for a US$-denominated contract at the end of each month during the period February 1990 to November 2000. A final answer is expected in one month's time and the estimated chances of success are of probability p (1-p probability of failure). We then measured the VaR of the uncertain cashflow as a function of the monthly hedge ratio and the tender's probability over the total period. Once again, the VaR number is expressed as a proportionality co-efficient to the currency market's volatility, which was equal to for the period under study to 10%. Given the relative shortness of our data sample (130 months), we decided to repeat the entire process 500 times for each tender's probability.

*Figure 1* reports the average value at risk among the 500 comparable simulations. At one extreme, where the probability of success is high, forward contracts will linearly reduce VaR as a function of hedge ratio. At the other extreme an exposure which is not going to materialise (probability equal to zero) increases the VaR proportionally to the hedge ratio.

A more realistic situation occurs when the probability of the tender is neither one nor zero. In the case of maximum tender's uncertainty (p=50%), forwards will not be able to remove totally the risk attached to an uncertain cashflow. To understand why it is the case and what the factors are (interest rate differential, spot's drift…), we now turn our attention to modelling.

### *Expected value at risk*

Our goal is to quantify risk using simple modelling rather than past returns. We assume that the changes in the spot exchange rate follow a normal distribution with zero drift. In this case, the VaR of a known unhedged exposure will be proportional to the underlying currency market's volatility and the proportionality co-efficient is equal to –1.645 at the 95% confidence level. It can be shown that the hedge ratio which minimises the value at risk is almost equal to the probability of the tender happening. In other words, if there is an 80% chance that a transaction occurs, it is recommended to hedge about 80% of the transaction via Forwards. Differences with *Figure 1* appear for one main reason: the sterling depreciated against the dollar from 1.6758 at the end of February 1990 to 1.4259 at the end of November 2000, therefore violating the zero drift assumption. Many of these parameters, including others such as fat tails, can be

FIGURE 1

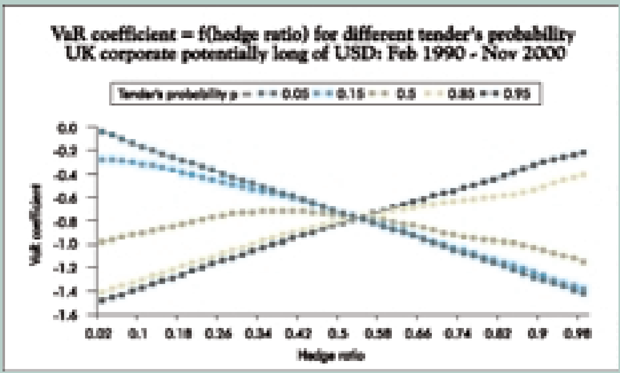



FIGURE 2

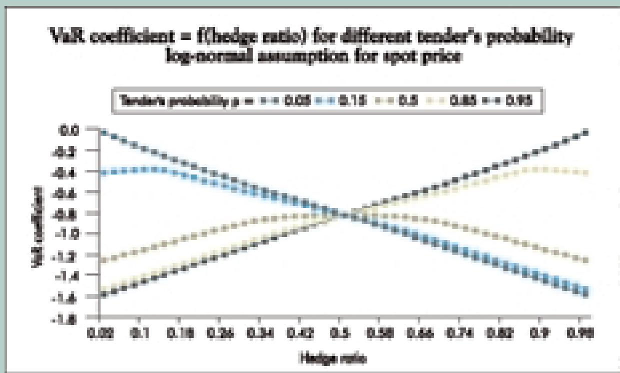
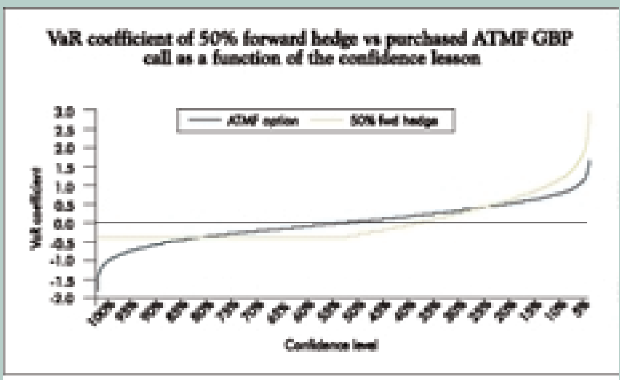



FIGURE 3




included to improve the modelling process.

In both cases, either past returns or modelling, Forwards will not be able to remove entirley the risk attached to an uncertain cashflow. Unhedgeable risk will be maximum when the tender's probability is equal to 50%. Options can potentially assist with the reduction in this situation.

***Forward looking***

Take the example of a British exporter tendering for a dollar-denominated contract with estimated chance of success being 50%. The tools selected in the simulations are the forward hedge, the purchase of sterling calls (ATMF, 40 Delta and 30 Delta) and the sale of out of the money options (15 and 20 Delta sterling calls and sterling puts).

To establish the best hedging mix, we first build any possible structure using the above tools and letting their relative weight vary by increments of 20% (from zero to 100%) inside a given portfolio. This gives us a total of more than 23,000 structures tested. A 4,000-iteration Monte Carlo process is used to calculate the VaR of the different hedging mixes. The strategy retained is the one minimising the VaR.

The strategy in question is the purchase of the ATMF sterling call for the full face value of the tender. Consequently, the minimum risk of –0.81 reached by using forwards only can be pushed down to –0.40. This however is achieved by paying a premium of –0.40 immediately. It could be argued that the marginal value of premium investment is therefore uninteresting, but we should bear in mind that by purchasing the ATMF option, the maximum risk incurred is the premium paid (that is, –0.40), this is regardless of the outcome of the tender or the spot drift over the period (*Figure 3*).

Although we regard the latter strategy as the correct way to benchmark tender situations from a risk perspective, it is not intuitive to make the premium investment for an ATMF strike and for the full amount when the probability of success lies around 50%.

Adding constraints on the premium can help refine the approach by balancing premium investment and acceptable risk level.

***Cashflow modelling***

This approach does not limit itself to binomially distributed exposures, but could be applied as soon as it is possible to model your cashflows. A good example is provided by the car industry where the sale of a car can be assimilated to a 'mini' tender to market. If we admit, for the purpose of simplification, that you won't buy a car X because your neighbour has just bought one and that your decision is more driven by technological features, size or personal taste than price, a car maker can correctly make the assumption that the size of its receivables for a given export market is normally distributed (the sum of binomial distributions tend toward normality if the former are independent).

Once the distribution has been established, you can determine the expected amount and hedge it forward. Alternatively, an option structure will be more suited to cover any incremental exposure. For example, you may decide to establish some form of protection for the expected amount plus one standard deviation, as beyond this point there is only a 16% chance of occurrence.

In summary, we can only underline the fact that companies are frequently exposed to floating or contingent exposures and that modelling this uncertainty is pre-requisite to any reliable risk management. Integrating this parameter into global risk measurements will definitely influence the way most companies choose their benchmarks. ■

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