**Transaction Exposure Based on VaR**

Value-at-risk (VaR) measures the probability of a specific exchange rate movement over a specific period of time.

VaR is based on the assumption that exchange-rate movements are normally distributed and that the standard deviation of those movements is constant over time. While it is not possible to verify that these assumptions are always correct, it is a helpful and convenient way to assess the probability of an exchange rate movement that you might want to hedge against.

**Example**:

You work for a French company that is scheduled to be paid in dollars for a large contract. You will be receiving the dollars one month from now and at that time you must convert the dollars to euros. Of course, you are concerned that if the dollar/euro exchange rate moves in an unfavorable direction over the next month, you will end up with fewer euros than you would like.

Based on a thorough analysis, your best guess is that the euro will be worth $1.15 in one month. If it ends up being slightly different from that, you will be ok, but if the euro ends up being worth $1.20 or more, this is unacceptable. You would want to hedge your position if you felt that there was more than a 5 percent chance that this could happen.

One way to look at this is to estimate the probability of the exchange rate being greater than 1.20 $/€. If that probability is greater than 5%, you want to hedge.

The other way to look at it is to find out what the exchange rate is which has exactly a 5% chance of being there in one month and compare that rate to 1.20 $/€. Either way, we need to start with the assumption that movements in the $/€ XR are normally distributed and that in one month, the mean (expected) value is 1.15.

Note that if we had no specific expectation, we could use today’s spot rate, the one-month forward rate, or a rate calculated from PPP to come up with an expected rate.

We now need to find an estimate of the standard deviation of these XR changes. For that, we can get past data from a number of different sources. One of them is

<https://www.ofx.com/en-us/forex-news/historical-exchange-rates/>

Note that this particular tool gives us the monthly averages of the exchange rate between whatever two currencies we select. The data goes back to January 1999 for the euro. For other currencies it goes back to January 1990. Select the currency that you are pricing (the one in the denominator) on the left-hand side and the other currency (the one in the numerator) on the right-hand side. Set the frequency as daily, monthly or yearly (we are using monthly in this example). For a reporting period, feel free to select a period longer than what you think you need – you can always delete some of the data once you have it in excel. In our example, we will get five years of monthly changes (60 monthly changes) with the last full month ending on July 31, 2018. Since it takes two months of rates to get one change, we need 61 months of rates – so the first month we need is the month ending July 31, 2013. Then simply click on “Retrieve Data”. Once the average rates appear, you will want to copy them and the dates to an excel spreadsheet. Note that you can choose how many decimal places your data shows.

You will want to find the monthly changes in the exchange rate. Changes can be calculated based on monthly compounding or continuous compounding. You should know how to do either. The monthly compounded change can be found by dividing the later XR by the former XR and subtracting 1.00. The continuously compounded change can be found by taking the natural log of the latter XR divided by the former XR. On the sample spreadsheet, I have done it both ways.

When deciding how large you want your sample to be, there is no clear-cut rule. Remember that you are trying to forecast the range of exchange rates one month from now by estimating the standard deviation of XR changes. So the question is: what time period (going backwards from today) do you feel will give you the most reliable estimate of the volatility of exchange rates going forward over a short time-period? You might feel that a larger sample is more reliable and thus choose to use all the data that you can get. Alternatively, you might decide that the past five years (or whatever you choose) will give you a better estimate. In our example, I have used the most recent 60 months of XR changes.

Find the estimate of the standard deviation of the XR changes (note that these 60 months are only a sample of the population of exchange rate changes). Since this is the estimate of the standard deviation of the XR *change*, we must multiply that change by our expected exchange rate in one month (1.15 in our example) to find the standard deviation of the exchange rate itself.

You now want to determine the probability that next month’s XR will be greater than 1.20$/€. You can do this with the NORM.DIST function in Excel. We assume that the set of possible exchange rates one month from now are contained in a normal distribution with our expected exchange rate (1.15 in this example) being the mean and the standard deviation of the exchange rate that we just calculated as the standard deviation. 1.20 will be the value of X, and of course we want the cumulative value of the area under the curve. The formula result will be the probability that the XR will be less than 1.20 one month from now, so we must subtract that value from 1.0 (the total area under the curve) to find the probability that the XR will be more than 1.20. If that probability is more than the 5 percent given in the example, you would want to hedge.