Open Currency Position Risk and Value at Risk Analysis in Commercial Banks

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Abstract. In this article, Risk of Open Currency Position which the banks are most commited and Value at Risk method which is used to measure market risk are investigated. Variance - Covariance and Historical Simulation Methods used in calculating risk expense were thoroughly investigated and analyzed its effects on banks.

Key Words and Phrases: Open Currency Position, Currency Risk, Value at Risk, Normal Distribution, Variance - Covariance, Historical Simulation.

1. Open Currency Position Risk

If the bank has a disparity between the total balance sheet assets and the total of the balance sheet liabilities in one currency, then the bank's balance position in that currency is open. If the balance sheet assets in the currency exceed the total amount of the total liabilities, then the bank position will be long in that currency, in the contrary, if the balance sheet liabilities in the currency exceed the total amount of the total assets, then the bank position becomes short.

If the position of the bank in one currency is long, then the bank will suffer losses as a result of a decrese of exchange rate. On the contrary, if the position in one currency is short, then exchange rate of that currency will lead to the bank loss. If the position of the bank in any currency is open to the likelihood of an event that could lead to loss, then there would be a currency risk. This currency risk is called the Open Currency Position risk and this risk arises from an open position on the balance of the currency. Open Currency Position risk is one of the most exposed risks of banks.

2. Value at Risk Method

Banks open currency position either cumpulsorily or voluntarily in different currencies. Hence, banks are exposed to risks due to their open position. It is very important for banks to predict the effects of changes in exchange rates on the currency position within a certain period of time. The Bank should calculate to what extent it will expose its open position,

and hence to what extent the exposure to risk. The method used to measure the open currency position risk is called the Value at Risk Method. Value at Risk is the maximum exposure to probable loss of a certain amount during the valuation period. Exposure to Risk is a method that measures the maximum loss of volatility in the financial markets, i.e. fluctuations in volatility.

As we mentioned, a value at risk is an expected maximum loss with a certain confidence level in a certain period of time As it is seen from the definition, Value at Risk includes two factors, such as the Time Span and the Level of Confidence. The time interval is a period it takes to close the position. Degree of precision of curency posiotn risk depends on confidence level. Degree to which extend a real risk exposure is less than calculated Value at risk is determined by confidence level. Here, the normal distribution and the features of this distribution are important.

Normal distribution is such a distribution that is symmetrically average, and the average, median and mod are equal. These values are crossed at the same point as indicated by a curve. Mode is the most frequently number in a series. The median is the number in the middle of a sequence of numbers when it is put in order from smaller or larger in series. As noted above, the right and left sides of the intersection of the curve of the normal distribution are symmetric to each other. The normal distribution curve infinitly stretches to the left and right but does not cut the bottom line. Below is a schedule of normal distribution:
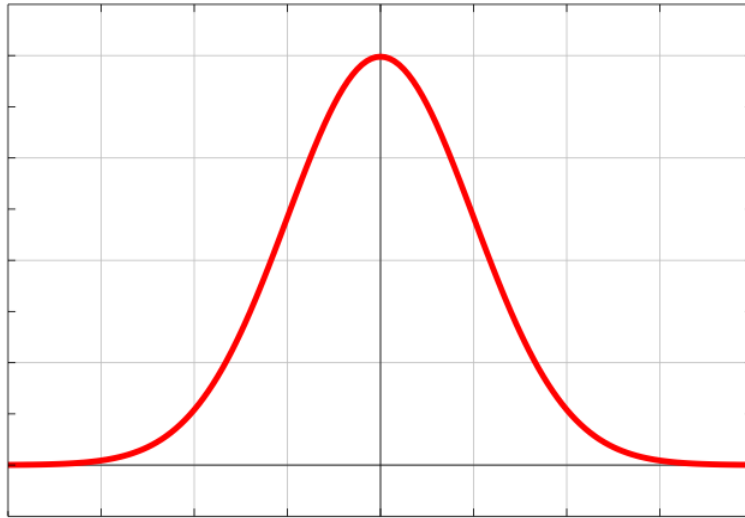
The standard deviation is taken at "0" at the hinge point of the normal distribution curve.
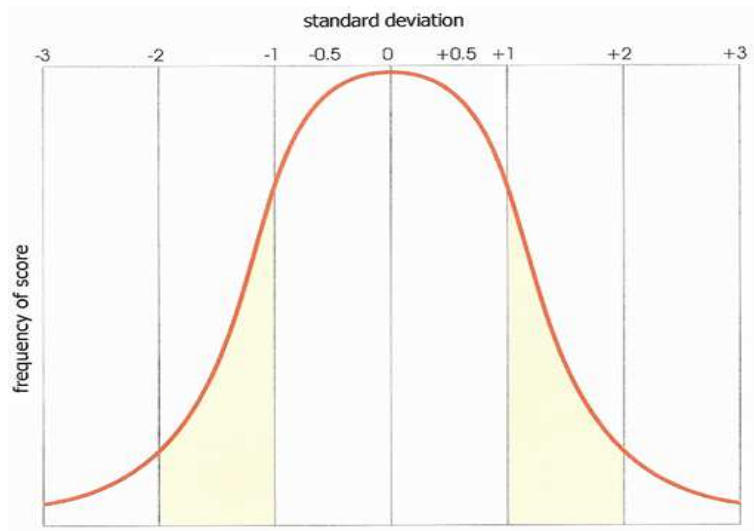
The standard distribution is such a distribution that the average value for that distribution is "0" and the variance is "1". 68%, 95% and 99% of values in normal distribution fall accordingly within (-1,+1), (-3,+3) and, (-2,+2) standard deviation:
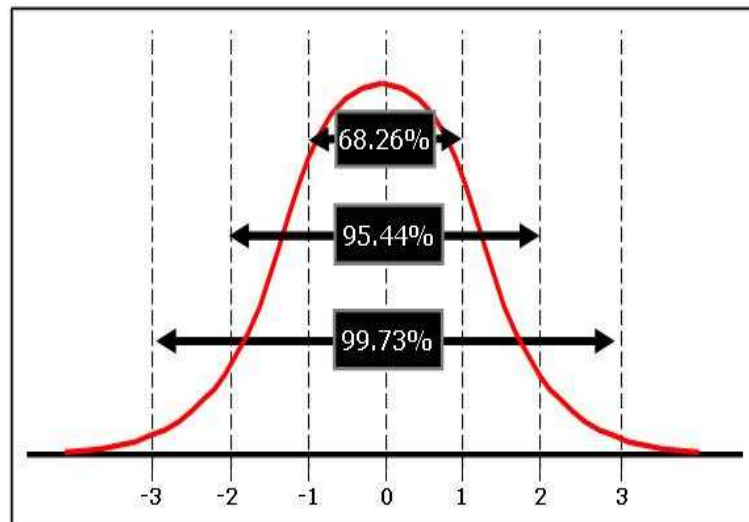
Different levels of confidence are selected for estimating Value at Risk. The volatility of the market should be taken into consideration when selecting the level of confidence. In emerging economies, financial markets are highly volatile, thus the level of confidence should be taken higher in these countries, as the financial markets are less volatile in developed countries, so the level of confidence should be lower. However, the 99% confidence level is selected as a standard. The Basel Committee recommends that the level of confidence should be chosen as high as possible. The higher the risk level, the higher the value at risk.

The methods for calculating the value at risk are divided into two classes, including parametric and nonparametric methods. The Variance-Covariance method is used in the parametric method, however the Historical Simulation method is in the non-parametric method. parametric methods depend on the degree of confidence under the hypothesis that revenue is normally distributed. In non-parametric method, income is not dependent on any parameter. In other words, revenue is not based on any hypothesis. We will stay on these two methods which are commonly used to measure value at risk.

3. Parametric method: Variance - Covariance method

This method determines the parameters affecting the currency position and calculates the maximum loss value from the fluctuations that occur at a certain level of confidence.

Let's assume that the bank's total assets are 3,750,000 EUR and total liabilities are 5,730,000 EUR. Euro currency position is open and short. The open position is -1,980,000 EUR. Therefore, there will be loss as a result of the increase in exchange rate of the Euro.

We need exchange rates of at least two months to calculate value at risk with parametric method. We obtain the latest two-month euro exchange rate on the Central Bank's website. In order to apply the Variance-Covariance method it is important that the distribution of the exchange rates ought to be normal. Otherwise, the value at risk will yield an erronous result. We'll use skewness and kurtosis to detect whether the distribution is a normal distribution. Skewness is a number that shows the symmetry of distribution. If skewness is equal to zero the distribution will be symmetric, if it is smaller than zero, ie negative numbers, the distribution will be right-handed and ultimately, if it is more than zero, that is, positive numbers, the distribution will be left-handed. The number of kurtosis is a value associated with the sharpness or the cavity of the distribution.If the kurtosis is 3, then the distribution will be a normal distribution, if the distribution is less than 3 then distribution will be spike and if it is greater than 3 then it will be concave. In order to calculate skewness, we can use SKEW in the Excel program and KURT to calculate kurtosis. If we calculate the skewness and kurtosis values, we get the following:

Date	Rate	Skewness	Kurtosis	Mode	Median	Average
03.09.2018	1.9729	-0.080875	-0.685801	1.972900	1.967050	1.965113
04.09.2018	1.9727					
05.09.2018	1.9712					
06.09.2018	1.9778					
07.09.2018	1.9770					
10.09.2018	1.9630					
11.09.2018	1.9722					
12.09.2018	1.9699					
13.09.2018	1.9762					

Date	Rate	Skewness	Kurtosis	Mode	Median	Average
14.09.2018	1.9883					
17.09.2018	1.9781					
18.09.2018	1.9876					
19.09.2018	1.9848					
20.09.2018	1.9852					
21.09.2018	2.0024					
24.09.2018	1.9967					
25.09.2018	1.9960					
26.09.2018	1.9996					
27.09.2018	1.9976					
28.09.2018	1.9799					
01.10.2018	1.9712					
02.10.2018	1.9668					
03.10.2018	1.9681					
04.10.2018	1.9494					
05.10.2018	1.9567					
08.10.2018	1.9571					
09.10.2018	1.9546					
10.10.2018	1.9561					
11.10.2018	1.9655					
12.10.2018	1.9729					
15.10.2018	1.9635					
16.10.2018	1.9673					
17.10.2018	1.9649					
18.10.2018	1.9550					
19.10.2018	1.9479					
22.10.2018	1.9570					
23.10.2018	1.9474					
24.10.2018	1.9496					
25.10.2018	1.9398					
26.10.2018	1.9325					
29.10.2018	1.9366					
30.10.2018	1.9348					
31.10.2018	1.9281					
01.11.2018	1.9284					
02.11.2018	1.9396					
05.11.2018	1.9353					

As you can see, skewness is -0.080875 and kurtosis -0.685801. Skewness is different from "0" and kurtois is "3". At the same time, we have noted that in normal distribution

the average, median and mod are equal. Here, all of the values are different from each other. Given all this, we can say that distribution is not a normal distribution. Nevertheless, we can normalize this distribution. We use the NORMDIST function in the Excel program. This function converts distribution to a normal distribution with a specified average value (standard average) and standard deviation. However, each distribution can not be converted to a normal distribution. In order to use the NORMDIST function, we need to calculate the average value and standard deviation values. To calculate the average, we sum up these amounts and divide them into their number. The average number is calculated by the following formula:

$$\overline{r} = \frac{\sum_{i=1}^{n} r_i}{n}$$

Where, n – number of values, r_i - values and $\overline{r}$- average of the values. After obtaining the mean, we need to calculate the variance to calculate the standard deviation. Variance is a statistical value that shows how far each of these exchange rates is from the average. To calculate the variance, we calculate the sum of the squares of the differences from average of all the rates and then divide their number to one minus. The following formula is used to calculate variance:

$$\sigma^2 = \frac{\sum_{i=1}^{n} \left(r_i - \overline{r}\right)^2}{n - 1}$$

Where, σ^2- the variance of these rates. Then we need to calculate the standard deviation. Standard deviation indicates a deviation of the estimated figure from from the mean of the set of values Standard deviation is the root of the variance and is calculated by the following formula:

$$\sigma = \sqrt{\frac{\sum_{i=1}^{n} \left(r_i - \overline{r}\right)^2}{n - 1}}$$

Where, σ- the standard deviation of given rates. The detailed description of the calculation is as follows:

Date	Rate	Average	Square of deviation	Variance	Standard deviation
03.09.2018	1.9729	1.965113	0.000061	0.000388	0.019710
04.09.2018	1.9727		0.000058		
05.09.2018	1.9712		0.000037		
06.09.2018	1.9778		0.000161		
07.09.2018	1.977		0.000141		
10.09.2018	1.963		0.000004		
11.09.2018	1.9722		0.000050		
12.09.2018	1.9699		0.000023		
13.09.2018	1.9762		0.000123		
14.09.2018	1.9883		0.000538		
17.09.2018	1.9781		0.000169		
18.09.2018	1.9876		0.000506		
19.09.2018	1.9848		0.000388		
20.09.2018	1.9852		0.000403		
21.09.2018	2.0024		0.001390		
24.09.2018	1.9967		0.000998		
25.09.2018	1.996		0.000954		
26.09.2018	1.9996		0.001189		
27.09.2018	1.9976		0.001055		
28.09.2018	1.9799		0.000219		
01.10.2018	1.9712		0.000037		
02.10.2018	1.9668		0.000003		
03.10.2018	1.9681		0.000009		
04.10.2018	1.9494		0.000247		
05.10.2018	1.9567		0.000071		
08.10.2018	1.9571		0.000064		
09.10.2018	1.9546		0.000111		
10.10.2018	1.9561		0.000081		
11.10.2018	1.9655		0.000000		
12.10.2018	1.9729		0.000061		
15.10.2018	1.9635		0.000003		
16.10.2018	1.9673		0.000005		
17.10.2018	1.9649		0.000000		

Date	Rate	Average	Square of deviation	Variance	Standard deviation
18.10.2018	1.955		0.000102		
19.10.2018	1.9479		0.000296		
22.10.2018	1.957		0.000066		
23.10.2018	1.9474		0.000314		
24.10.2018	1.9496		0.000241		
25.10.2018	1.9398		0.000641		
26.10.2018	1.9325		0.001064		
29.10.2018	1.9366		0.000813		
30.10.2018	1.9348		0.000919		
31.10.2018	1.9281		0.001370		
01.11.2018	1.9284		0.001348		
02.11.2018	1.9396		0.000651		
05.11.2018	1.9353		0.000889		

We can calculate variance and standard deviation by using Excel functions, VAR and STDEV. Let us Normalize distribution with NORMDIST function:

Rate	Normalization
1.9281	3.567192
1.9284	3.667930
1.9325	5.246246
1.9348	6.294925
1.9353	6.537772
1.9366	7.192703
1.9396	8.821054
1.9398	8.934681
1.9474	13.486201
1.9479	13.786019
1.9494	14.670538
1.9496	14.786353
1.9546	17.418853
1.955	17.600747
1.9561	18.073221
1.9567	18.312725
1.957	18.427399
1.9571	18.464853
1.963	19.907433

Rate	Normalization
1.9635	19.954187
1.9649	20.018521
1.9655	20.015891
1.9668	19.948059
1.9673	19.899468
1.9681	19.796030
1.9699	19.450303
1.9712	19.107172
1.9712	19.107172
1.9722	18.792848
1.9727	18.620038
1.9729	18.548090
1.9729	18.548090
1.9762	17.149081
1.977	16.756785
1.9778	16.347095
1.9781	16.189329
1.9799	15.201675
1.9848	12.289117
1.9852	12.045393
1.9876	10.591266
1.9883	10.173373
1.996	6.022602
1.9967	5.699944
1.9976	5.300748
1.9996	4.478074
2.0024	3.476943

The distribution table will be as follows:
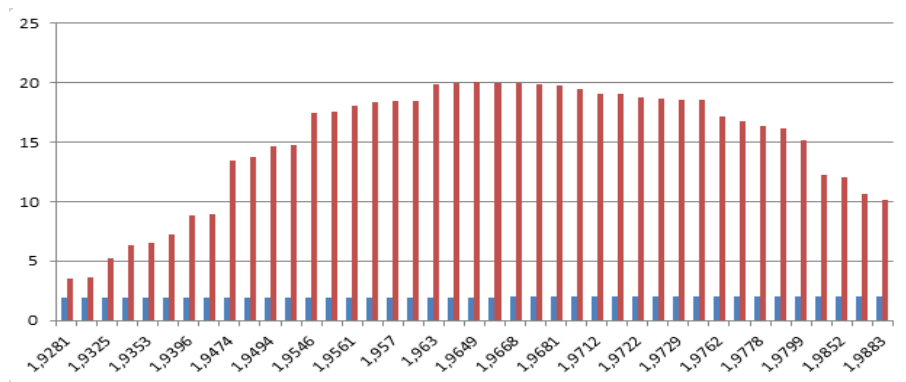
With The Variance-Covariance Method (VAR) The Value at Risk is calculated as follows:

$$VAR = Open\ Position * \sigma * \alpha$$

Where, σ – standard deviation, α – the level of assurance. Here, α is equal to 1,645, at 95% confidence level in normal distribution, as noted. Similarly, the value that corresponds to 99% confidence level in normal distribution is 2,326. In our case, the open position is -1,980,000 EUR and standard deviation is 0.019710. Therefore,

$$VAR95\% = 64196.55 \quad and \quad VAR99\% = 90772.75$$

The Value at Risk we obtained means that the maximum amount of our loss at 99% confidence level within 1 day will be AZN 90 772.75. The probability exceeding of our loss from this amount is 1%. If we multiply the calcaulated Value at Risk for 1 day by the square root of holding period we will get a value at risk for that period The formula will be:

$$VAR = Open\ position * \sigma * \alpha * \sqrt{t}$$

Where, t – time interval, or, in other words, a retention period.

4. Non-parametric method: Historical Simulation method

This method is based on the assumption that the history repeats itself. This method uses Historical Values to calculate Value at Risk. That is, we can calculate the amount of loss for tomorrow by using the prior days' rates and losses, assuming that tomorrow will be like the days we left behind. There will also be a level of confidence.

Suppose that the total assets of the Bank is 9,750,000 GBP and the total liabilities is 7,350,000 GBP. Pound currency position is open and long. The open position is 2,400,000 GBP. Therefore, there will be loss as a result of the decrease of the exchange rate of the Pound.

With a Historical Simulation Method, we need exchange rates for at least the last two months to calculate the value at risk. We obtain the latest two-month exchange rate currencies from the Central Bank's website. Then we calculate the daily fluctuations of these exchange rates. The following formula is used to calculate the change:

$$(rate_{current\ day} - rate_{the\ day\ before}) / rate_{the\ day\ before}$$

Then the open position is re-evaluated by multiplying to the change of these exchange rates. These re-evaluations are then sorted from large to small. After the rankings the total rows are multiplied by 95% or 99%. There are 45 rows in our example. If we multiply this figure to 95% or 99%, we'll get approximately 43 and 44 respectively. The amount

in row 43 with probability 95%, and the amount in row 44 with probability 99% are The Value at Risk. The detailed illustration of the calculation is as follows:

Date	Rate	Change	Impact	Ranking	Open position	Value at Risk (95%)
						-20201.66
03.09.2018	2.1980				2400000	
04.09.2018	2.1865	-0.523%	-12556.87	28795.16		Value at Risk (99%)
05.09.2018	2.1861	-0.018%	-439.06	25884.10		-22608.31
06.09.2018	2.1953	0.421%	10100.18	23178.90		
07.09.2018	2.1984	0.141%	3389.06	22331.57		
10.09.2018	2.1951	-0.150%	-3602.62	18663.53		
11.09.2018	2.2163	0.966%	23178.90	15288.02		
12.09.2018	2.2116	-0.212%	-5089.56	14071.80		
13.09.2018	2.2172	0.253%	6077.05	13381.90		
14.09.2018	2.2302	0.586%	14071.80	12606.06		
17.09.2018	2.2239	-0.282%	-6779.66	11263.58		
18.09.2018	2.2363	0.558%	13381.90	10234.31		
19.09.2018	2.2354	-0.040%	-965.88	10100.18		
20.09.2018	2.2354	0.000%	0.00	8782.47		
21.09.2018	2.2562	0.930%	22331.57	6077.05		
24.09.2018	2.2236	-1.445%	-34677.78	5705.83		
25.09.2018	2.2275	0.175%	4209.39	5229.47		
26.09.2018	2.2392	0.525%	12606.06	5047.88		
27.09.2018	2.2364	-0.125%	-3001.07	4209.39		
28.09.2018	2.2243	-0.541%	-12985.15	3389.06		
01.10.2018	2.2141	-0.459%	-11005.71	2882.82		
02.10.2018	2.2157	0.072%	1734.34	2643.05		
03.10.2018	2.2094	-0.284%	-6824.03	1734.34		

Date	Rate	Change	Impact	Ranking	Open position	Value at Risk (95%)
04.10.2018	2.1978	-0.525%	-12600.71	0.00		
05.10.2018	2.2118	0.637%	15288.02	-439.06		
08.10.2018	2.2290	0.778%	18663.53	-965.88		
09.10.2018	2.2278	-0.054%	-1292.06	-1292.06		
10.10.2018	2.2373	0.426%	10234.31	-2715.05		
11.10.2018	2.2478	0.469%	11263.58	-3001.07		
12.10.2018	2.2505	0.120%	2882.82	-3602.62		
15.10.2018	2.2293	-0.942%	-22608.31	-5060.27		
16.10.2018	2.2346	0.238%	5705.83	-5089.56		
17.10.2018	2.2393	0.210%	5047.88	-6779.66		
18.10.2018	2.2267	-0.563%	-13504.22	-6824.03		
19.10.2018	2.2135	-0.593%	-14227.33	-11005.71		
22.10.2018	2.2216	0.366%	8782.47	-12489.16		
23.10.2018	2.2029	-0.842%	-20201.66	-12556.87		
24.10.2018	2.2077	0.218%	5229.47	-12600.71		
25.10.2018	2.1907	-0.770%	-18480.77	-12985.15		
26.10.2018	2.1793	-0.520%	-12489.16	-13504.22		
29.10.2018	2.1817	0.110%	2643.05	-14227.33		
30.10.2018	2.1771	-0.211%	-5060.27	-18409.81		
31.10.2018	2.1604	-0.767%	-18409.81	-18480.77		
01.11.2018	2.1837	1.079%	25884.10	-20201.66		
02.11.2018	2.2099	1.200%	28795.16	-22608.31		
05.11.2018	2.2074	-0.113%	-2715.05	-34677.78		

As mentioned above, the Value at Risk that we have obtained likewise means that the maximum amount of loss we will have is 22 608.31 AZN at 99% confidence level within 1 day. The probability of the loss exceeding this amount is 1%.

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