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SYSTEM DYNAMICS APPROACH TO MODELLING THE MARKET RISK OF BANKS

Market risk is the possibility of losses for an investor due to factors that affect the overall performance of the financial markets in which he or she is involved. It arises from the changes in market prices of financial and physical assets that are on the balance sheet of the bank due to changes in foreign exchange rates, interest rates or other factors. Market risk is a systematic risk and cannot be eliminated due to diversification; an investor can only mitigate this type of risk by hedging a portfolio. Market risk does not arise for individual instruments, but it realizes when adverse events influence on the most assets in the market. To avoid the negative impact of the market risk the hedging is used, a specific procedure of the special instruments purchase (swaps, options, forward contracts, etc.) which decrease losses in case the risk is realized for securities.

There are eight main sources of risk that affect the general market: interest rate, equity, foreign exchange, commodity, margin, shape, holding period, and basis risk. Interest rate risk is the risk that arises for bond owners from fluctuating interest rates. Equity risk, the risk that stock or stock indices (e.g. Euro Stoxx 50, etc.) prices or their implied volatility will change. Foreign exchange risk, the risk that foreign exchange rates (e.g. EUR/USD, EUR/GBP, etc.) or their implied volatility will change. Commodity risk, the risk that commodity prices (e.g. corn, crude oil) or their implied volatility will change. Margining risk results from uncertain future cash outflows due to margin calls covering adverse value changes of a given position. Shape risk in finance is a type of basis risk when hedging a load profile with standard hedging products having a lower granularity. Holding period risk is a financial risk that a firm's sales quote giving a potential retail client a certain time to sign the offer for a commodity, will actually be a financial disadvantage for the offering firm since the market prices on the wholesale market has changed. Basis risk in finance is the risk associated with imperfect hedging.

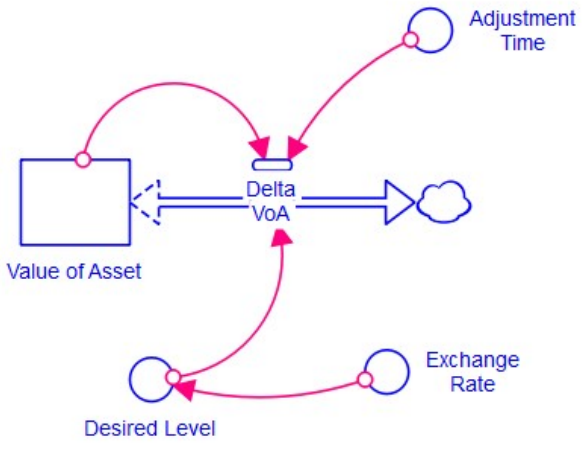

Figure 1. **The simplified view of the Market Risk model**

In this paper, I will more specifically examine the foreign exchange risk. Foreign exchange risk is the present or potential risk for asset prices, which arises from unfavorable fluctuations of foreign exchange rates. The model can be built for one financial asset that may suffer in the future due to changes in the exchange rate, in order to find out what changes it will take: positive or negative. Value of asset is a stock. Delta VoA represents all changes in this stock. Whether this risk will appear or not depends on some risk factor – exchange rate in this case. However, this asset price reacts to changes with a delay. Important features of the system dynamics models are both the possibility to reflect this delay in the reaction and the ability to test the sensitivity of the response. This is useful in assessing market risk and in assessing Value at Risk (VaR) .

The sensitivity analysis is used to determine how sensitive the model is to changes in the values of the model parameters and changes in the structure of the model. Sensitivity analysis helps to increase confidence in the model by studying the uncertainties that are often associated with the parameters in the models. Many parameters in the systems dynamic's models have values that are very difficult or even impossible to measure with high accuracy in the real world, and also most of the values of the parameters change in the real world.

The sensitivity analysis allows for determining which level of accuracy is required for the parameter to make the model useful and valid. The sensitivity analysis may also indicate which parameter values are reasonable for use in the model. If the model behaves as expected from real observations, this gives some evidence that the values of the parameters reflect, at least a bit the "real world". This analysis also helps to understand the dynamics of the system. Experimenting with a wide range of values, one can understand the behavior of the system in extreme situations. If you find out that the behavior of the system significantly changes the value of the parameter, you can determine the point of the reference element in the model - a parameter, a specific value that can significantly affect the behavior of the system. This sensitivity analysis will further help simulate the reaction with variable parameters, help estimate possible losses, etc.

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