

## DESCRIPTION FOR THE GENERAL PUBLIC (IN ENGLISH)

Both macroeconomic and financial phenomena feature short- and as long-term relationships simultaneously. Therefore it appears most relevant to model them jointly, with a prospect of such an approach resulting in better, more accurate statistical inferences upon the phenomena not only over the sample period, but also upon in future evolution. Constraining statistical model to account for only either short- or long-term relations can severely diminish its predictive abilities.

Due to their characteristics, macroeconomic time series are most frequently modelled by means of vector autoregression with error correction mechanism and with constant conditional covariance matrix. In turn, conditional heteroscedasticity processes serve as typical models for capturing volatility of financial time series. However, some research has proven, that, on the one hand, variability of macroeconomic time series (measured, for example, by conditional covariance matrix) is not constant over time, and also, on the other hand, that on financial markets there do exist long-term relationships.

The main objective of this research project is to continue and advance our research concerned with formulation and applications of vector error correction (VEC) models with time-variable conditional covariance matrix for short-term and long-term relationships in macroeconomic and financial phenomena. In the abovementioned model structures it will be assumed that the elements of conditional covariance matrix are governed by some latent stochastic process, either belonging to the multivariate Stochastic Volatility family (leading to the VEC-SV specification) or admitting switches according to a finite-dimension Markov process (resulting in the VEC-MSH specification, with MSH standing for *Markov-Switching Heteroskedasticity*). Within the framework of these two types of model structures, i.e. VEC-SV and VEC-MS, both featuring time-variable conditional covariance matrix, Bayesian analysis of cointegration will be performed.

Another objective of the study is to examine the forecasting abilities of the considered Bayesian VEC models (both with constant and time-variable conditional covariance matrix, particularly the VEC-SV and VEC-MSH specifications), in the context of modelling macroeconomic and financial time series. The main criterion used in this study for drawing such comparison will be predictive Bayes factor. We will also use methods based on Probability Integral Transform (based on the sequence of predictive cumulative distribution functions evaluated at actual observations), the Continuous Ranked Probability Score, and the Energy Score.

As a yet another aim of the research, the models with Markov switching heteroskedasticity (VEC-MS) will also be studied and utilized in the context of statistical identification of the structural shocks underlying modelled phenomena. Most commonly, in applied, empirically-oriented studies, the so-called zero restrictions are employed and imposed either on the immediate or delayed reactions of the endogenous variables of the system. Such an approach excludes arbitrarily a possible impact of a given structural shock upon some variable, which largely affects the structural analysis performed within such a (constrained) model. Moreover, such restrictions ensure only just identification, therefore prohibiting any testing of their statistical validity. It appears, however, that allowing for conditional heteroskedasticity may substantially facilitate the task at hand by providing more statistical information from the data to accomplish the identification. Such an approach, based on a purely statistical procedure, not only may result in the just identification, but, and what appears even more relevant, may lead to the over-identification, thereby allowing for formal testing of other types of commonly used restrictions.

It is worth noting that the literature on the statistical identification of the shocks *via* Markovian heteroskedasticity within Bayesian structural VAR models is scarce. To the best of our knowledge, there are only three scientific papers, by Kulikov and Netšunajev (2013), Woźniak and Droumaguet (2015), and Lütkephol and Woźniak (2018) in which the authors work within the Bayesian (rather than frequentist) framework. Therefore, we additionally aim for and believe that the results of our research will contribute to this apparently still new and uncharted strand of research, by providing both theoretical considerations and insights, and empirical analyses based on real-world data.

Bayesian statistical analysis within the class of the models proposed above requires employing advanced numerical methods, such as Markov Chain Monte Carlo, in particular. Therefore, another of the research project's objectives will be to elaborate on specific numerical methods to be adopted and suitably adapted for estimation, prediction and structural analysis within the models under study.

The results of planned empirical research, based on real-world macroeconomic and financial data, will allow us to examine and evaluate empirical adequateness of introducing variety time-varying covariance structures (SV and MS) into the VEC specification. To that end, the macroeconomic data for selected economies (including the US and Polish ones) will be used. Additionally, the VEC-SV specifications will also be applied for description of relationships and volatility on financial markets.