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Analysing bank real estate portfolio management by using impulse response function, Mahalanobis distance and financial turbulence

Ognjen Vukovic*

University of Liechtenstein, Department for Finance, Furst Franz Josef Strasse 15, Vaduz 9490, Liechtenstein

Abstract

During the financial crisis that had its peak a few years ago, one of the interesting questions was raised. Does there exist a possibility that the aforementioned crisis will repeat. As real estate management took one of the key roles in the post-crisis period, it was expected that the lessons that crisis brought with itself, were learnt. Despite lagging effect that the aforementioned turbulence had on Western Europe, real estate prices kept rising and exhibited accelerating growth, although some of the countries didn't react to the stock price movement and real estate growth. This paper will try to address the aforementioned problem by analysing real estate portfolio management by using impulse response function. Afterwards, it will try to implement results obtained from Impulse response function and financial turbulence, by calculating possible correlations between stock prices for EURO area and real estate prices in Germany, Switzerland and Austria. Data was taken from St.Louis FED database. In order to analyse banking portfolio management, it was assumed that state of the art methods are used. Portfolio management is modelled by using Mahalanobis distance and financial turbulence index was analysed. As financial turbulence index was calculated for the total real estate share prices by taking the data from St. Louis FED database, interesting results were obtained. It was proved that real estate prices kept rising in Germany and Switzerland despite the warning foreshadowed by the financial crisis, however Austria real estate prices remained stable. However growth in real estate prices in Switzerland was not caused by financial crisis because the growth is constant and doesn't have any drops.Financial turbulence analysis pointed out that the volatility of real estate prices in the aforementioned countries was highest in the mid-2011 and it still has a high value. This indicates that real estate price bubble is a real threat to the whole financial system of Western Europe, especially Germany as the leading economy.

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* Corresponding author. Tel.:+38163553559;
E-mail address: ognjen.vukovic@uni.li

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1. Introduction

Financial bubbles are a real threat to the system. The arousal of financial bubbles must be closely monitored as there is a possibility to cause havoc in financial systems. In order to analyse the financial bubbles, nonlinearities and illogical movement of correlated time series must be observed. One of the newly introduced tools in the aforementioned time series analysis are impulse response functions.

Impulse response function demonstrate how the endogenous variables react to shock through tume. Although impulse response functions are related to SVAR and VAR models (Pfaff et al.), their observation independently can be very useful as they serve as a perfect tool to observe illogical movement between time series. By observing impulse response functions, it could come to a conclusion that illogical movement could act as a predictor of real estate bubbles, If the link between real estate movement and other macroeconomic variables is broken, it could be said that variables start to follow random walk which is characteristic in the financial theory. At the same time, if variables are correlated in the way that economic and financial theory cannot explain, then the threat of the financial contagion and financial crisis is high. In order to analyse the portfolio management, Mahalanobis distance(Hanke et al. 2013) was introduced. Mahalanobis distance is a well-known tool in mathematical statistics and it is widely used in detection of outliers. At the same time, it is used in calculation of financial turbulence index which demonstrates period of high volatility which could foreshadow possible economic and financial problems.This combination of tools could prove innovative in risk management modelling (Ricardo Rebonato et al. 2010). In the next part of the paper, theory behind the analysis will be introduced.

2. Background and theory

Impulse response functions are part of the VAR and SVAR models (Pfaff et al.). The aforementioned models will be briefly introduced.
VAR model is used to detect interdependencies in the linear interdependent model. It has the following formation(Hamilton James et al. 1994):

$$y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \cdots + A_p y_{t-p} + e_t \quad (1)$$

where the l-periods back observation y_{t-1} is called the l-th lag of y, c is a $k \times 1$ vector of constants (intercepts), A_i is a time-invariant $k \times k$ matrix and e_t is a $k \times 1$ vector of error terms. The thing that must be noted is that all variables must be of the same order of integration. For our analysis, the time series that we observe are Markovian time series and martingale processes that follow Brownian motion(Hacker, R. S. et al . 2008) One of the theorems will be used. The theorem states that:

T.1. One of the continuous martingale process with stationary increments is Brownian motion (Dung N.T et al, 2010).

At the same time there exist other martingale processes but it is assumed that those processes are not observed. In this way, VAR model functions really well and impulse response function can be observed.
Now the SVAR models will be introduced. Structural VAR model is defined with the following equation (Hamilton James et al. 1994):

$$B_0 y_t = c_0 + B_1 y_{t-1} + B_2 y_{t-2} + \cdots + B_p y_{t-p} + \check{\eta}_t \quad (2)$$