THE RELATIONSHIP BETWEEN MACROECONOMY AND ASSET PRICES: LONG-RUN CAUSALITY EVIDENCE FROM LITHUANIA

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Abstract. *The purpose of this paper is to determine the long-run causal impact of various economic factors on Lithuanian stock, government securities and real estate prices, and to assess how accurately future asset returns can be forecasted based solely on economic information. Five macroeconomic indicators, namely, gross domestic product (GDP), foreign direct investment (FDI), consumer price index (CPI), money supply (MS) and Vilnius interbank offered rate (VILIBOR), were included in the model. The results of the created autoregressive distributed lag model (ARDL) revealed that a long-run causal relationship between Lithuanian assets and macroeconomic variables exists and that changing values of these indicators explain about half of the variability of assets' returns. The results of ARDL model forecast showed that the most precise predictions are obtainable in real estate market, while forecasted returns of stock and government securities are not so accurate, especially the further forecast horizon. The possibility to understand driving factors behind changes of asset prices and to predict future return is of a particular importance not only for investors and businessmen, but also for the policy makers who are responsible for making substantiated decisions regarding monetary, macroprudential and fiscal policies they conduct.*

Key words: macroeconomy, stock, government securities, real estate, cointegration.

1. Introduction

How to distribute one's funds successfully? This question arises to the majority of novice or even experienced investors. The search of few undervalued or fast-growing companies and the purchase of their shares or bonds with all available funds is the most commonly used approach. However, due to excessive non-systematic risk (i.e. risk that results from unpredictable factors and is unique to a certain asset or a company) such

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plain strategies mostly misfire in the long-run, so it is no surprise that the majority of individual or even institutional investors are unable to surpass broad market indices. According to Brinson et al. (1991) and Ibbotson & Kaplan (2000), an appropriate asset allocation rather than the stock or bond-picking strategies determines 80–90% of the variation in investment portfolio returns. In such a case an investor should strategically form a long-term investment portfolio from various assets, such as stock, bonds and alternative investments (e.g. hedge funds, privately-held companies, real estate). This can help to improve the risk-adjusted performance by increasing profits and/or reducing the investment risk.

But then another dilemma emerges – how and when to invest in different assets? One of the possible solutions to determine which particular asset class performs best under different economic conditions is to combine both macroeconomics and financial theories. It is obvious that the change of economic situation has an impact on people's and company's behaviour which transmits to investors' projections of future asset returns. Moreover, macroeconomic factors, i.e. determinants that reflect the changing economic and financial situation in a particular country or a region, have an effect on the assumed risks and correlations between the returns of different assets. Due to these reasons, more and more researches about the link between the macroeconomy and asset markets have been performed regarding not only developed, but also emerging markets. Gan et al. (2006) analysed New Zealand, Anokye & Tweneboah (2008) – Ghana, Ibrahim (2011) – Thailand, Golob et al. (2012) – Slovenian, Vejzagic & Zarafat (2013) – Malaysian markets. All these researchers found a cause-and-effect relationship between macroeconomic forces and asset markets.

The main purpose of this paper is to determine the impact of various macroeconomic factors on Lithuanian asset prices. Moreover, this paper tries to answer if it is possible to forecast future asset returns accurately and, as a result, prevent future asset bubbles and financial turbulences, based solely on economic information. Three asset classes are examined: stock, government securities and real estate. The selection of these assets is not accidental: the first two are the most important instruments of capital markets, while real estate is an alternative investment that can provide diversification benefits, i.e. reduce the risk without decreasing portfolio returns. In addition, these three assets constitute the biggest proportion of local investors' portfolios. The historical analysis is conducted with quarterly data from 2000 until 2013, while the out-of-sample forecast – from 2014 until 2016. The effects of five macroeconomic factors are explored: gross domestic product, foreign direct investment, consumer price index, money supply and interest rates.

The novelty and relevance of this study is fourfold. First of all, almost all similar studies were carried out regarding only one Lithuanian asset class. This study, on the contrary, examines how the country's economic development simultaneously affects all three Lithuanian assets. This is especially important in asset allocation and appropri-

ate risk management. Secondly, due to the shortage of long-term historical data, there were few studies regarding causality relationships between macroeconomic factors and Lithuanian markets (particularly in the field of government securities), and majority of the studies were conducted before recent financial crisis that mightily disrupted such relationships. Thirdly, regression or correlation analysis were used in the majority of the researches regarding Lithuanian asset markets, while advanced studies about foreign markets were carried out mostly with relatively newer techniques, especially the cointegration method, which have greater explanatory power concerning causal links. Fourthly, the forecasting of prices and efficient rebalancing of investment portfolio is particularly relevant in today's context because the prices of all three assets have reached high values (local maximum), so further gains are strongly questionable and financial stability (due to possible asset bubbles) may be impaired.

This paper consists of four main parts: the review of literature and analysis of theoretical approaches; the description and examination of the data and main econometric models that are most suitable for conducting such researches; the analysis of the ARDL model; the main findings of the in-sample prediction and out-of-sample forecast for asset prices.

2. Literature review: the impact of macroeconomic factors on asset prices

Although different researchers analyse various macroeconomic factors, most of them examine the effect of gross domestic product or personal income. This is due to the fact that these factors have an intuitively justified influence on all assets. For example, due to the rise of GDP, the company's production, profits and, as a result, the prices of its shares in most cases increase (Singh et al., 2013). Moreover, almost all scientists (Apergis, 2003; Ong & Chang, 2013; and others) found statistically significant and direct impact of country's economic condition on real estate prices. Kohlert (2010) emphasized that GDP is an economic indicator mostly escalated in the mass media, so the change of GDP should have the biggest impact on people's future expectations and real estate prices. In extreme cases this can even lead to the formation of asset bubbles and to financial instability. However, in the case of government securities, the effect of GDP can be twofold: on the one hand, in the environment of deteriorating economic situation governments tend to increase the amount of debt and thus the supply of government securities, so the prices of these securities fall, but on the other hand, the prices of other assets during the economic downturn generally fall even more.

The easiest way to investigate the influence of interest rates on asset returns is by using the discounted cash flow model: interest rates affect both the numerator (dividends, corporate profits, income from bonds or real estate) and the denominator (the discount rate). Due to the fact that many companies finance their purchase of new equipment or inventory by using borrowed capital, the decline of interest rates can cause the growth of corporate profits and the decrease of investors' required return (Chen, 1991;

Vejzagic & Zarafat, 2013). Ultimately, it can even lead to stock market bubbles and pose threat to financial stability. The majority of authors (e.g. Piljak, 2013) who analysed the cause-effect relationship between interest rates and government securities prices found that the change of interest rates is the strongest force of all of macroeconomic factors. This is due to the fact that interest rate is the component of nominal yields and, as a result, affects government securities prices inversely. The change of interest rates should have a statistically significant and inverse effect on real estate prices too, because the biggest share of bank loans are long-term and lent at variable rates. When interest rates increase, the periodic interest payments that are paid to the banks grow as well – so this is obviously a negative signal to the buyers of real estate. For the reasons outlined above, asset prices as well as financial stability is heavily dependent on the monetary policy and sensitive to any, especially unexpected, change of interest rates or the volumes of quantitative easing.

The change of inflation should also have an inverse effect on asset prices. First of all, corporate profits and dividends paid generally do not grow at the same pace as inflation: the costs that companies incur can increase immediately, while due to the long-term contracts many firms fail to raise their output prices quickly. This negative effect of inflation was described in an often quoted study of Calvo (1983). Moreover, in the light of growing inflation monetary policy tends to be tightened, so, as a result, nominal interest rates may be increased by the central bank. In the case of government securities, rising consumer prices should affect the real return earned from government securities inversely. For instance, high and increasing inflation in developing countries often indicates the likely crisis of the balance of payments and an eventual decline of government securities prices (Jaramillo & Weber, 2012). The effects of inflation on real estate prices are the most controversial among three asset classes. It is identified by many researchers (e.g. Tsatsaronis & Zhu, 2004; Tan & Chen, 2013) that investment in real estate sector is a good hedge against inflation and the depreciation of money. However, the rising inflation can have an opposite effect if it increases periodic nominal interests paid to lenders.

The returns from various assets are affected by the change of money supply in several ways. According to monetarism theory (Friedman & Schwartz, 1963), the increase of money supply should improve country's economic determinants (e.g. output, employment) and reduce the costs of borrowing. In such a case, money supply should have a direct effect on future asset returns. In addition, the increased amount of money can be directly channelled to various asset markets. However, a possible side effect can arise: the growth of money supply increases inflationary pressures, which raises borrowing costs and may even reduce asset prices. The effect of money supply can also be justified by the arbitrage pricing theory, formulated by Ross (1976): a whole range of risk factors (including money supply) are responsible for asset returns, so investors who are able to assess the value of the changing money supply can calculate the expected price of each asset, and, if it significantly differs from its market price, earn an arbitrage profit. Due to

these reasons, the majority of the researchers (Hassan & Al, 2012; Vejzagic & Zarafat, 2013; Chowdhury et al., 2013) analyse the causal effect of money supply on asset prices.

Foreign investment can have a direct impact on the national economy and asset prices. The flows of FDI are particularly important to small open economies because these countries often lack local capital resources (Anokye & Tweneboah, 2008). This effect is especially relevant to countries experiencing internal economic shocks. In Lithuania, FDI share in GDP exceeds 35%, so it is no surprise that Danilenko (2009) and Jasienė & Paškevičius (2010) found that the FDI flows are one of the main driving forces behind the change of the stock index values. However, this impact can be twofold on government securities prices: the improvement of country's investment environment usually increases the creditworthiness of such country and thus the yields of government securities decline, but on the other hand, this can lead to the increase of inflation, which has a positive effect on nominal yields (Jaramillo & Weber, 2012). Researchers (e.g. La Paz & White, 2012) who analysed the causal impact of FDI flows on real estate prices, mostly found a direct and strong link because FDI flows. This is possibly due to the fact that these flows often correlate with portfolio investment that can be directly channelled to real estate market.

In summary, the change of several macroeconomic factors (foreign investment, interest rate) should have the same effect or at least the same direction on the prices of different assets, while the change of others (GDP, inflation, money supply) may have strongly diverse effects. This is due to the fact that all three assets are very different. For instance, the main features that distinguish real estate from other asset classes are the high cost of creation (constructing), longevity, heterogeneity (there are no two identical houses) and localized permanence (Durlauf & Blume, 2008). In addition, as compared to stock and real estate sector, the amount of studies regarding the effects of macroeconomic forces on government securities prices is much more limited – many analysts attribute the change of debt securities prices to some internal factors of debt securities market (e.g. yield curve or liquidity risk).

There are few relevant studies about the effect of macroeconomic forces on different asset classes in Lithuania. Laskienė & Pekarskienė (2007) analysed the link between 9 macroeconomic factors and the OMXV index from 2000 to 2006. The authors found not only a strong direct link between the values of the OMXV index and GDP, money supply and the construction cost index, but also an inverse link with the unemployment rate, yield of government securities and the exchange rate. Jasienė & Paškevičius (2010) found that the growth of GDP, FDI or inflation positively affected the stock returns, but were negatively affected by the growth of unemployment and government debt. Pilinkus (2010) analysed the period from 2000 to 2008 with the help of several time-series models. However, this author found links that are difficult to support by various economic theories, e.g. the cointegration model revealed that interest rates and inflation had direct, while the money supply, investment and net exports – an inverse effect on the OMXV index. Tvaronavičius & Tvaronavičienė (2008) analysed the relation-

ship between fixed investments and economic growth in Lithuania, while Galinienė & Stravinskytė (2016) found a strong correlation between the real GDP growth and the Bank of Lithuania's financial assets/profitability. Alexopoulou et al. (2009) examined the government securities markets from new EU members and found that the countries with the largest fiscal imbalances (Lithuania was no exception), suffered the biggest drop in debt securities prices and the rise of borrowing costs. According to them, inflation and the openness of the country were the main driving forces behind Lithuanian government securities prices. One of the most relevant researches regarding real estate market was made by Simanavičienė & Keizerienė (2011): GDP, inflation and investment in residential buildings had the biggest impact on the prices of old apartments in Lithuania, while investment had no significant effect on the prices of new dwellings.

However, fundamental forces not always play a crucial role in the formation of asset prices. Financial assets have a peculiar feature – the increase of their prices in most cases does not reduce the demand (which is the usual effect in goods and services markets), but raises it (Case & Shiller, 1990). The increase of asset prices may attract even more buyers, so the prices may continue their upward trend in future periods and, as a result, can make a huge threat to financial stability. People's expectations are the principal determinants of real estate prices, so there is a clear inertia in this sector (Tupėnaitė & Kanapeckienė, 2009). While it is impossible to measure behavioural factors precisely, the previous returns of different assets are frequently included in similar models.

3. Data and construction of the model

The first step to identify the main driving forces behind the prices of Lithuanian companies stock, government securities and real estate, is to choose the most appropriate expressions of asset values. Researchers who analyse stock markets in most cases include stock indices in their models (e.g. Chen, 1991; Anokye & Tweneboah, 2008; Singh et al., 2013). Indices reflect not the state of individual company, but the dynamics of the whole market and its various systemic risks – this is justified by the Ross (1976) arbitrage pricing theory. It is most appropriate to examine the impact of macroeconomic factors on the *NASDAQ OMX* Vilnius index because it consists of almost all the shares listed on the Vilnius stock exchange. Moreover, the values of this index were included in the models of nearly all previous researches regarding Lithuanian companies stock. In the case of government securities, it is most meaningful to analyse the index calculated by the Bank of Lithuania (GS index) – it is the only publicly available index regarding Lithuanian government securities prices (The Bank of Lithuania, 2013). Since there are no exchange-traded real estate funds in Lithuania and the values of the housing price index are provided by Statistics Lithuania only from 2006, it was decided to use the transacted real estate index (RE index) calculated by the Centre of Registers. The construction of this index highly resembles real estate price index that is most commonly used by other researchers in similar studies (e.g. La Paz & White, 2012; Galvao et al., 2011).

There is no consensus among researchers on how many macroeconomic variables should be included in econometric models: some authors use just 1 or 2 variables (Fama & Schwert, 1977; Hou & Cheng, 2010), others – over 100 indicators (Ludvigson & Ng, 2009), but mostly – from 4 to 6 variables (Chen, 1991; La Paz & White, 2012; Singh et al., 2013). In the case of this study, it was decided to choose five most frequently analysed macroeconomic variables: Lithuanian gross domestic product, foreign direct investment, consumer price index, money supply M2 and 6 month Vilnius interbank offered rate (the description of these variables is provided in Annex 1). Although other macroeconomic factors may often have a greater impact on certain assets (e.g. net exports or the exchange rate – on stock, country's deficit and debt – on government securities, the unemployment rate – on real estate market), it was decided to choose only those indicators that could be the driving forces behind all three Lithuanian assets. Moreover, the quarterly data was used in this analysis as there is a longer history for the variables of such frequency and it should be more stable than shorter-term data (e.g. quarterly GDP versus monthly industrial production). Also, this analysis focuses on longer-term dynamics of asset prices and effects of macroeconomic variables, so quarterly data seems a suitable fit. The quarterly frequency data was used by most of other authors (e.g. Apergis, 2003; Laskienė & Pekarskienė, 2007; Simanavičienė & Keizerienė, 2011; Ong & Chang, 2013; etc.). It is also important to note that the stationarity of the variables should also be checked by performing unit-root tests before constructing time-series models.

In order to evaluate the impact of various macroeconomic factors on asset prices simultaneously, the following function should be constructed:

$$X_t = f(GDP_t, FDI_t, CPI_t, MS_t, VILIBOR_t, X_t) \tag{1}$$

where: X_t – OMXV, real estate or government securities index.

Various researchers use different methods to evaluate this function. It is important to note that several decades ago most examinations to capture similar links were carried out by using regression or other statistical analysis tools, but later on the use of time-series models (vector autoregression for short-term and cointegration for long-term links) gained momentum. This can be explained by the fact that time-series models are used not only for capturing a statistical relationship between variables (which can be performed by simpler statistical methods), but also for the identification of causal effects that macroeconomic forces have on asset prices. Moreover, the majority of time-series models are multidimensional, so, unlike simpler econometrical/statistical methods, they help to examine the interactions between many variables simultaneously. However, while foreign researchers apply advanced time-series models for a long time, the majority of the authors who analysed Lithuanian asset markets still mostly use regression or correlation analysis (apart from Pilinkus, 2010; Dubinskas & Stungurienė,

2010). For all these reasons it was decided to fill this gap and to examine the causal relationships between variables using a long-term time-series model – cointegration.

Cointegrated variables are such variables that individually are not stationary (i.e. have unit roots), but their linear derivative creates a stationary process due to the common trends. If this is the case, then equilibrium exists, and over time variables do not move far away from each other and respond to each other's deviations from equilibrium. For example, the values of real GDP, money supply, price levels and interest rates are mostly non-stationary (should be differentiated once or twice), but according to the theory of cointegration, their linear combination is stationary (Enders, 1995). The main advantage of cointegration models is that they (unlike other time-series models) help to determine the adjustment speed in which the system returns to its long-term equilibrium.

The most commonly used cointegration method is Engle & Granger (1987) and Johansen (1988) vector error correction model. However, when investigating the relationship between macroeconomic variables and assets, these two methods can be inaccurate due to the complexity of multi-equation function and endogeneity issue, so many authors (e.g. Maysami et al., 2004; Hassan & Al, 2012) prefer to employ a simpler vector error correction model – ARDL. This model is also a cointegration method and helps to asses causal relationships, but, unlike other methods, it is a regression model and more advantageous in small sample researches (such as in the case of this study). This is due to the fact that the majority of time-series models (Engle & Granger, 1987; Johansen, 1988, are no exception) suffer from the high number of lags included – when the sample size is small and the amount of variables used is quite high, every lag included in these models greatly increases the risk of multicollinearity. Moreover, the parameters of the ARDL model are estimated by ordinary least squares procedure, so it helps to avoid potential mistakes that occur in more complex vector error correction models. To add to the point, the majority of researchers in similar studies found out that not all macroeconomic variables were responsible for the elimination of the deviation from equilibrium, so multidimensional methods become excess and a simpler model – ARDL – could present more accurate and unbiased results. As a result, ARDL model can help to examine the causal effect of macroeconomic forces on asset prices with a lower probability of error.

The simplest form of ARDL model (with just three variables) has the features from both error correction and regression models:

$$\Delta Z_t = \alpha \left(Z_{t-1} - \beta_1 - \beta_2 \times Y_{t-1} - \beta_3 \times W_{t-1} \right) + \delta_1 \times \Delta Y_t + \delta_1 \times \Delta W_t + \mu_t \qquad (2)$$

where:

$\Delta Z_t, \Delta Y_t, \Delta W_t$ – the first difference of respectively endogenous variable Z and exogenous variables Y and W;

$\Delta Z_{t-1}, \Delta Y_{t-1}, \Delta W_{t-1}$ – lags of respectively Z, Y and W;

a – the coefficient of the adjustment speed, which shows the time needed for the process to return to equilibrium;

β – the set of coefficients that shows the cointegration links between variables and ensures that Z_t returns to its constant status;

δ – the coefficient that shows the effect of differentiated exogenous variables Y and W on variable Z.

The coefficient of the adjustment speed (a) and estimates of the parameters of cointegration (β) are the most important elements in this ARDL model because only they reveal a long-term relationship between variables. If it is found out that the adjustment speed (a) is not significantly different from 0, it means that the variable is weakly exogenous and does not eliminate the disequilibrium. In order to determine the values of β, the normalization in relation to the endogenous variable should be carried out for all the parameters in the model. In addition, due to the fact that the assessment of ARDL model is performed using the least squares method, it is particularly useful in making short-term and long-term forecasts and might be less prone to errors due to the simplicity of estimation process.

4. Empirical findings of the autoregressive distributed lag model

Before the construction of ARDL model, the stationarity of the variables was examined. When additional lags due to possible autocorrelation were included in the unit-root tests, all variables (even interest rates) were found to be non-stationary by three tests: Augmented Dickey Fuller (ADF), Phillips-Perron (PP) and Zivot Andrews (ZA) (see Annex 2). As the majority of the variables were integrated by the first order, and in order to be consistent with interpretation of the results, the ARDL models were constructed with the first differences of each variable.

The results of created ARDL models (left columns of Annex 3, 4 and 5) prove that all three assets are cointegrated in respect to macroeconomic variables – this is evident from the coefficients of the adjustment speed (a). These adjustment speeds are statistically significant and equal –0.24, –0.26 and –0.5 respectively in the case of stock, government securities and real estate. It takes from about two (real estate) to four (stock and government securities) quarters for the asset index to eliminate completely the disequilibrium that occurs in t-1 period. The residual standard error reveals that the model fits the data pretty well and is estimated reliably. The coefficients of determination of ARDL models are equal to 46% (in the case of stock), 57% (in the case of government securities) and 59% (in the case of real estate), i.e. about half of the variability of indices values can be explained by the changing values of macroeconomic determinants. It becomes clear that the predictions based on macroeconomic factors are the least useful in the case of the stock market and the most useful for the real estate market.

After the normalization of all the parameters, the following equations of long-run relationship between the variables were derived:

$$\Delta OMXV = 431.2 - 3.37 \times GDP_{t-1} + 1.91 \times FDI_{t-1} - 3.96 \times CPI_{t-1} + 1.97 \times$$
$$\times MS_{t-1} - 4.16 \times VILIBOR_{t-1} + \mu_t \tag{3}$$

$$\Delta GS = 59.3 - 0.32 \times GDP_{t-1} - 0.04 \times FDI_{t-1} - 0.92 \times CPI_{t-1} + 0.2 \times$$
$$\times MS_{t-1} - 1.85 \times VILIBOR_{t-1} + \mu_t \tag{4}$$

$$\Delta RE = -100.4 + 1.07 \times GDP_{t-1} + 0.39 \times FDI_{t-1} - 2.9 \times CPI_{t-1} + 0.63 \times$$
$$\times MS_{t-1} + 1.15 \times VILIBOR_{t-1} + \mu_t \tag{5}$$

In the long-run the changes of macroeconomic factors have strong and long-lasting effects on the OMXV index, though the directions of various drivers are different. OMXV index values increase by nearly 2% when FDI flows or money supply grows, and declines from 3 to over 4% when GDP, inflation or interest rate increase by 1%. Even though these impacts are strong, the direct effect of FDI flows and money supply, as well as an inverse impact of inflation and interest rates should not be surprising – the majority of other researchers obtained similar results. The long-term and strong inverse impact of GDP on the OMXV index is more difficult to explain: various economic theories prove that the production directly affects the expected cash flows and stock prices. This result probably confirms that investors can predict the prospective GDP figures by interpreting, for instance, data of monthly production indices and export-import volumes, so they manage to reallocate funds before the publication of the quarterly GDP indicator.

Although many analysts attribute the changes of debt securities prices to various bond-specific factors, this ARDL model proved that in the long-term macroeconomic factors also affect (for the most part – inversely) Lithuanian government securities prices. In particular, inflation and interest rates have strong effects – when they increase, the prices decrease by respectively 0.92% and 1.85%. Such conclusions were made by almost all researchers who analysed the link between the inflation, interest rates and the debt securities prices, though Alexopoulou et al. (2009) found that the rise of inflation in Lithuania increased government securities prices. Inverse, but much weaker effect (amounting to less than 0.5%) is noticeable from two other macroeconomic factors – output and foreign investment. This suggests that the improvement of macroeconomic situation worsens the prospects of debt securities market and makes riskier investments look more attractive. From all macroeconomic determinants only money supply can have a direct impact on government securities prices – when it increases by 1%, government securities prices grow by 0.2%.

The increase of the values of macroeconomic indicators, contrary to the case of government securities, has a positive effect on real estate prices. For instance, index values increase by 0.39%, 0.63% and 1.07% respectively when FDI, money supply and GDP

grows. This is compatible with the results of other studies regarding Lithuanian real estate sector (Simanavičienė & Keizerienė, 2011; Tupėnaitė & Kanapeckienė, 2009). However, it is surprising to notice that the real estate in Lithuania is a very poor protection against inflation in the long-run (when it grows, real estate prices decrease by almost 3%), so rapidly increasing consumer prices can lead to the instability of real estate market and, as a result, can even disturb the financial stability in Lithuania. Moreover, in contrast to the results obtained by the majority of other researchers, there is a direct impact of interest rates on real estate prices – the effect is strong and amounts to more than 1%. So growing interest rates do not distract investors and they continue purchasing property even with higher costs.

From the obtained results it becomes clear that the changes of various macroeconomic factors can have an uneven impact on different assets, so investors may exploit this opportunity by reallocating their funds. When the country's economic situation and people's expectations improve, it is likely that in a long term real estate prices will increase the most. Almost identical conclusions can be drawn with respect to interest rates – it can have a direct impact only on real estate prices. In the case of deteriorating economic situation, the best investment is the least risky asset, i.e. government securities. The change of money supply can have a direct effect on all assets, but the biggest – on stock prices. When choosing investments based only in terms of FDI indicator, the changes of stock index are best reflected by this factor, while government securities prices often react inversely. The rise of inflation is negative for all asset prices, but the least – for the government securities prices.

In addition, two different robustness exercises were performed to check the stability and reliability of the findings obtained with ARDL model. First of all, two variables were separately added to the model: money supply M3 versus M2 and industrial productions versus GDP. Inclusion of another money supply indicator had only marginally affected model results (middle columns of Annex 3, 4 and 5). Although the effect of money supply decreased somewhat, the main conclusions remain the same for all other variables and the adjustment speed. Meanwhile, industrial production, probably due to higher variability than GDP, affected model results more significantly (right columns of Annex 3, 4 and 5): the value of intercept increased, impact of industrial production (compared with the case of GDP) – decreased, multiple R^2 squared become somewhat lower, etc. Still, the main findings of the effects of macroeconomic variables remain almost unchanged, so the constructed ARDL model seems to be quite stable.

The Johansen vector error correction model was also performed to examine if the conclusion of the causality links hold not only for the created ARDL model. The trace and eigenvalue tests (without linear trend and constant) revealed that at least two stationary combinations of cointegrated vectors exist. The coefficient of the adjustment speed for the Johansen model with two cointegrated vectors (Annex 6, 7, 8) showed that asset prices react to the dis-balance that originated between asset prices and macroeconomic variables in the previous periods, though in different magnitude and scale.

So the long-term equilibrium links between asset prices and macroeconomic determinants seem to prevail, meaning that asset prices react to the changing macroeconomic environment. However, not all determinants were responsible for the elimination of the deviation from the equilibrium, so Johansen cointegration procedure might be redundant, especially in small sample researches. As a result, a simpler single-equation model, i.e. ARDL, might be a more useful tool for examining historical and future links between asset prices and macroeconomic determinants.

5. Results of the forecast model for asset returns

The biggest issues for the reliability of the created model arise when the results of identified causal relations are used for the short- and, especially, long-term forecasts. Many models which are suitable for capturing only the past links between variables become imprecise in predicting future changes (Goyal & Welch, 2008). In this study, an attempt was made to identify the accuracy of predicted asset returns until the end of 2013 (in-sample testing), as well as the precision for the period between 2014 and 2016 with the inclusion of the latest available macroeconomic data in the ARDL model (out-of-sample testing).

Until the end of 2013, the predicted returns quite accurately reflected the actual changes of the OMXV index values (Fig. 1) – this is especially true for the period from 2005 until 2010. Although the returns indicated by the model often diverged from the actual index changes (e.g. from 2001 until 2004), a high correlation coefficient (0.67) proves that the model overall reveals fairly accurate assessment of the historical rela-
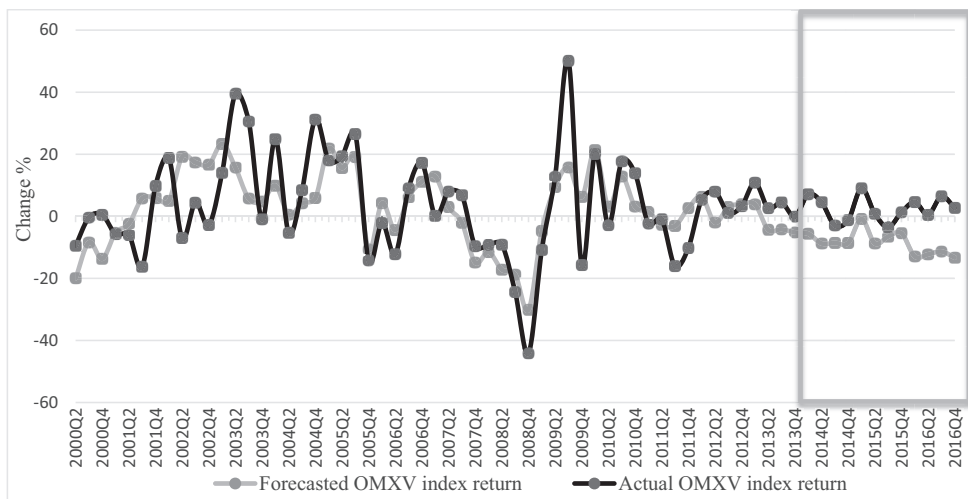

FIG. 1. **The predicted and actual returns of OMXV index from 2000 until 2016, %**

Note: Grey box indicates the period of the out-of-sample forecasting

Source: Compiled by the authors

tionship between variables. However, the forecasts for the period of 2014–2016 were too pessimistic with the inclusion of the latest available data: investors were receiving higher returns than the ARDL model indicated, especially in the latest periods. A possible explanation is that there were many determinants that were not included in the model (e.g. global factors, speculations, expectations) that potentially have an influence on the behaviour of individual and institutional traders who invest their funds in Lithuanian stock market.

Similar conclusions can be drawn with regard to the predictions of government securities returns. Although the correlation coefficient (0.72) is even higher, the forecasted growth rates were lower than actual ones since 2014 (Fig. 2). This discrepancy can be attributed to the fact that the macroeconomic situation in Lithuania had been steadily improving and, more recently, the monetary policy has become more accommodative, and thus had a positive impact on government securities prices, while the model did not capture these effects. It is also important to note that the further the forecast horizon, the bigger differences were recorded, so the model-based forecasts should be employed only for the near future.

The forecasts based on the identified links between variables were the most accurate for the real estate prices. Until 2006 the actual real estate prices were much more variable than predicted estimates, but afterwards the explanatory power of the model increased (Fig. 3). Although the correlation coefficient (0.75) is only slightly higher than in the case of the government securities or OMXV index, the forecasted real estate returns from 2014 quite accurately reflected the actual gains, possibly due to highly
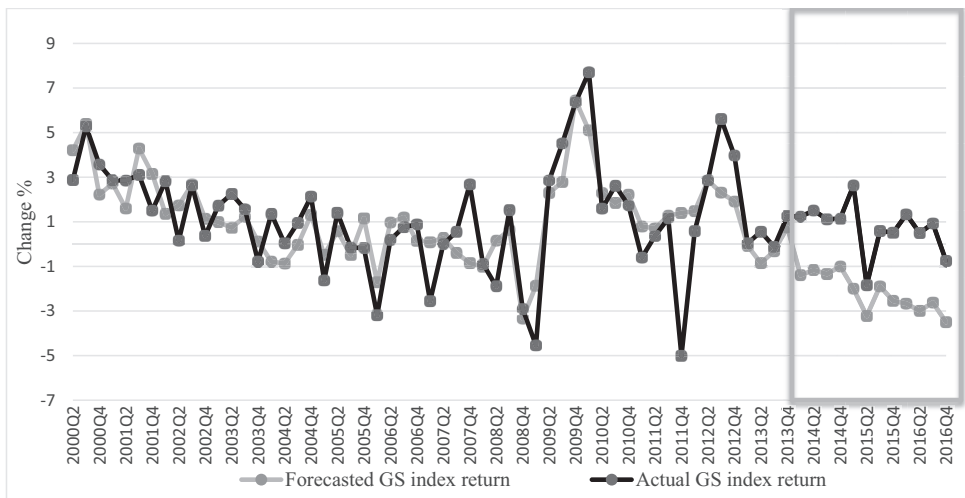

FIG. 2. **The predicted and actual returns of government securities index from 2000 until 2016, %**

Note: Grey box indicates the period of the out-of-sample forecasting
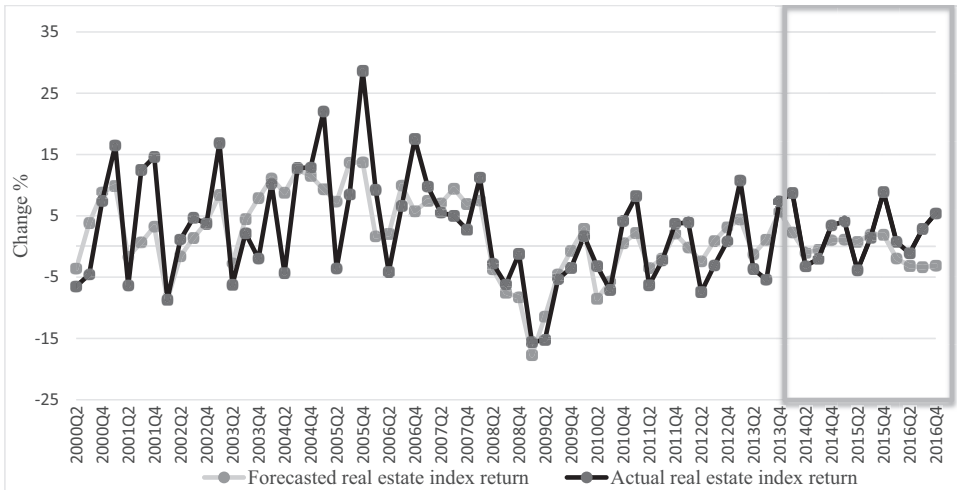
Source: Compiled by the authors

FIG. 3. The predicted and actual returns of real estate index from 2000 until 2016, %

Note: Grey box indicates the period of the out-of-sample forecasting

Source: Compiled by the authors

inert real estate prices. However, actual real estate prices have increased much faster during the last couple of quarters.

It should be mentioned that successful identification of causal links and predictions faces a number of practical challenges. First of all, although the created ARDL model revealed that the changes of macroeconomic factors account for about a half of variability of asset returns, it is obvious that asset prices are also affected by other factors (e.g. market liquidity, speculative forces, various risk factors, unconventional monetary policy measures). Secondly, the Lithuanian companies stock, government securities and real estate markets are relatively small, thus sensitive to the changes of global macroeconomic conditions. Thirdly, not all macroeconomic indicators or index values are announced at the same time, e.g. values of FDI flows and real estate index are announced more than half a year later. Thus, in order to increase the accuracy of asset price predictability, it could be helpful to include more frequent periodicity, a higher number and more various types of global and local macroeconomic and microeconomic factors, as well as to perform a sensitivity analysis of these changes.

6. Conclusions

The literature review carried out in this paper revealed that authors justify their selection of macroeconomic determinants by many different theories, e.g., the arbitrage pricing theory, the discounted cash flow model. On the basis of these theories, five macroeconomic indicators that have an intuitively justified effect on Lithuanian companies' stock, real estate and government securities prices were selected: gross domestic product, inflation, interest rates, money supply and foreign investment.

Although regression and other statistical models (e.g. correlation analysis) were the most commonly used methods for the identification of inter-dependencies, the autoregressive distributed lag model was chosen in order to find causal effects that macroeconomic factors have on asset prices. This method also overcomes the problems of other cointegration methods due simplicity of the estimation process and suitability for researches with small sample sizes.

The constructed model revealed that in the period from 2000 to 2013 the Lithuanian government securities, real estate and companies' stock prices were cointegrated with all five macroeconomic factors and that could explain about half of the variability of asset prices. Previously announced macroeconomic data can be used for the prediction of future stock returns: foreign direct investment and money supply have a direct, while inflation and interest rates – inverse impact on the stock prices of Lithuanian companies. It is odd that the growth of gross domestic product can lower stock prices. Rising values of macroeconomic indicators should reduce prices of Lithuanian government securities, while only the change of money supply can have a direct impact. The dynamics of real estate prices are most closely related to the changes of macroeconomic factors: gross domestic product, foreign investment and money supply in Lithuania have a direct impact on real estate prices. In contrast to the results of similar studies, the rise of interest rates can have a positive impact on real estate prices in Lithuania, and in the background of rising inflation real estate can be a poor investment. The additionally performed robustness checks broadly confirmed the main messages of the constructed models.

The results of the forecasts of autoregressive distributed lag model revealed that the most accurate predictions (with high coefficients of correlation) were obtainable in real estate market, while the forecasted returns of stock and government securities were much lower than the actual ones, possibly due to the many determinants not included in the model. Also, the out-of-sample forecasts were becoming more inaccurate the further the start of forecast period. In order to improve these results, it would be useful to experiment with a more frequent periodicity of data and a wider variety of different global and Lithuanian indicators. Moreover, according to the rules of strategic asset allocation, the success of investment performance is not only dependent on the earned profits, but also on the assumed risks. So, in the future it would be useful to examine how various factors affect price variances and the correlations between the returns of different assets.

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Annex 1. **Description of the variables used in the analysis**

Ticker	Indicator and source	Brief description
OMXV	OMXV index (points). Nasdaq OMX Vilnius	Daily return index of most liquid stocks traded at Nasdaq OMX Vilnius.
GS	Government securities index (points). The Bank of Lithuania	Quarterly index representing average prices of tradable Lithuanian treasury bills and bonds from 2006. The missing values from 2000 were obtained by averaging the quarterly government securities prices of transactions concluded at *Nasdaq OMX Vilnius* exchange.
RE	Real estate price index (points) Centre of Registers	Average quarterly change of transaction prices of existent and newly constructed dwellings from 1998.
GDP	Gross domestic product (in millions euro). Statistics Lithuania	Gross domestic product by expenditure approach. Seasonality is eliminated and working days adjusted.
FDI	Foreign direct investment (in millions euro). Statistics Lithuania	All foreign direct investment at the end of the period.
CPI	Harmonized index of consumer prices (points). Statistics Lithuania	Index of the change of consumer prices compared to the index reference period (2005 = 100).
M2/M3	Money supply (in millions euro). The Bank of Lithuania	M2 consists of currency in circulation, overnight deposits and other short-term deposits. M3 additionally encompasses money market instruments. Overall dynamics of M2 is very similar to M3. M2/M3 is adjusted by corresponding euro area M2/M3 growth due to introduction of euro in 2015.
VILIBOR6	Vilnius interbank offered rate for 6 months (percentage). The Bank of Lithuania	The arithmetic average of 6 months interbank interest rate at which banks are willing to lend funds to one other. Adjusted by 6-month EURIBOR changes due to introduction of euro in 2015.

Annex 2. **Results of ADF, PP and ZA unit-root tests**

Variable	Lags	ADF value	PP value	ZA value	ADF value	PP value (diff)	ZA value (diff)
OMXV	1	0.7286	-1.3832	-3.4474	-5.4229	-5.4864	-6.0633
GS	1	1.8929	-1.6511	-3.8978	-4.1971	-4.6962	-6.6538
RE	4	0.4291	-1.6445	-3.4219	-1.7688	-5.8945	-7.5871
GDP	1	2.3768	-1.0608	-4.4971	-3.9269	-4.8909	-5.1137
FDI	1	2.5397	-1.7878	-3.7673	-4.2639	-5.2583	-6.2397
CPI	4	1.0973	0.2931	-4.503	-1.33	-4.7815	-3.3826
MS	4	0.7212	-2.2864	-3.3834	-1.0845	-6.5338	-4.1853
VILIBOR6	2	-1.703	-1.8546	-3.4795	-3.646	-7.4759	-5.1968

Note: critical value of ADF is -1.95, PP is -2.91, and ZA is -4.8 at 95% confidence interval.

Annex 3. **The results of the non-normalised ARDL model regarding the impact of macroeconomic indicators on OMXV index**

Formula: ΔOMXV = OMXV + GDP + FDI + CPI + MS + VILIBOR + ΔGDP + ΔFDI + ΔCPI + ΔMS + ΔVILIBOR

Coefficients	Estimate	Std. error	Estimate	Std. error	Estimate	Std. error
α	−0.23536	0.09559	-0.23738	0.09677	-0.22837	0.09391
(Intercept)	431.152	230.613	426.297	236.99832	781.30748	666.79881
GDP	−0.79349	0.6133	-0.7876	0.6229	**-0.43512****	**0.4769****
FDI	0.44966	0.45827	0.49641	0.45408	0.14853	0.42673
CPI	−0.93301	0.48731	-0.91656	0.48876	-1.45391	0.50257
MS	0.46424	0.38332	**0.41087***	**0.37412***	0.53391	0.45192
VILIBOR	−0.98082	1.08803	-1.06476	1.08025	-2.03718	1.14882
ΔGDP	0.06572	0.93614	0.03815	0.93798	**-0.16831****	**0.36581****
ΔFDI	1.322	0.46656	1.34723	0.46567	1.26444	0.48225
ΔCPI	−2.27724	2.395	-2.24896	2.39955	-2.99332	2.26721
ΔMS	0.0185	0.76667	**0.03077***	**0.8108***	0.08917	0.80303
ΔVILIBOR	−2.67789	2.306	-2.7666	2.30783	-4.15766	2.0215
RSE:	13.84		13.89		14.05	
Multiple R^2	0.4615		0.458		0.4453	
p-value	0.002116		0.002362		0.003473	

*Note: * Money supply M3 is added to the model and M2 removed; ** IP is added to the model and GDP removed;* Source: *Compiled by the authors*

Annex 4. **The results of the non-normalised ARDL model regarding the impact of macroeconomic indicators on government securities index**

Formula: ΔGS = GS + GDP + FDI + CPI + MS + VILIBOR + ΔGDP + ΔFDI + ΔCPI + ΔMS + ΔVILIBOR

Coefficients	Estimate	Std. error	Estimate	Std. error	Estimate	Std. error
α	−0.25965	0.105	-0.25041	0.10342	-0.28977	0.11088
(Intercept)	59.306	41.327	51.81639	41.43042	110.90835	86.03543
GDP	−0.08217	0.07714	-0.07478	0.07753	**-0.04708****	**0.06455****
FDI	−0.01147	0.05932	-0.01126	0.05819	-0.03383	0.05285
CPI	−0.23780	0.05634	-0.2409	0.05639	-0.17902	0.07614
MS	0.05112	0.05226	**0.04496***	**0.05***	0.05573	0.06
VILIBOR	−0.48044	0.38786	-0.44984	0.38531	-0.77173	0.36156
ΔGDP	0.12704	0.11835	0.122	0.11791	**-0.02763****	**0.05065****
ΔFDI	−0.01816	0.06047	-0.01079	0.05973	-0.01964	0.06275
ΔCPI	−0.32962	0.30835	-0.34796	0.30663	-0.35138	0.29331
ΔMS	0.23297	0.09627	**0.25299***	**0.10011***	0.26082	0.10323

Coefficients	Estimate	Std. error	Estimate	Std. error	Estimate	Std. error
ΔVILIBOR	–0.88591	0.34033	-0.87339	0.33873	-1.10912	0.30923
RSE:	1.788		1.78		1.851	
Multiple R²	0.5674		0.5715		0.5367	
p-value	4.431e-05		3.722e-05		0.0001542	

*Money supply M3 is added to the model and M2 removed; ** IP is added to the model and GDP removed;
Source: Compiled by the authors

Annex 5. **The results of the non-normalised ARDL model regarding the impact of macroeconomic indicators on real estate index**

Formula: ΔRE = RE + GDP + FDI + CPI + MS + VILIBOR + ΔGDP + ΔFDI + ΔCPI + ΔMS + ΔVILIBOR

Coefficients	Estimate	Std. error	Estimate	Std. error	Estimate	Std. error
α	–0.49585	0.1077	-0.50708	0.10928	-0.34414	0.11193
(Intercept)	–100.360	107.647	-94.6589	108.736	-370.259	300.643
GDP	0.53184	0.28279	0.52091	0.28302	**0.34723****	**0.21385****
FDI	0.19123	0.20978	0.19698	0.20744	0.46244	0.19054
CPI	–1.43833	0.29393	-1.45001	0.29458	-0.84107	0.31895
MS	0.31259	0.19268	**0.3229***	**0.18923***	-0.03927	0.23491
VILIBOR	0.57519	0.37093	0.36387	0.26724	0.5104	0.39125
ΔGDP	1.243	0.40678	1.23349	0.40517	**0.49364****	**0.1746****
ΔFDI	0.03051	0.21243	0.03129	0.21067	0.26706	0.21835
ΔCPI	–0.24902	1.092	-0.23088	1.08823	0.55683	1.03845
ΔMS	0.11383	0.34207	**0.09644***	**0.35658***	-0.01492	0.35708
ΔVILIBOR	0.31078	1.102	0.35422	1.09881	0.72862	1.03557
RSE:	6.324		6.304		6.431	
Multiple R²	0.5874		0.5899		0.5733	
p-value	1.85e-05		1.648e-05		3.444e-05	

*Money supply M3 is added to the model and M2 removed; ** IP is added to the model and GDP removed;
Source: Compiled by the authors

Annex 6. **The results of the non-normalised Johansen VECM regarding OMXV index**

Response OMXV:
Coefficients:

	Estimate	Std. Error
ect1	-0.12805	0.05005
ect2	-0.97423	0.39284
OMXV.dl1	0.22658	0.15046
GDP.dl1	1.17498	0.96827
FDI.dl1	0.46005	0.50150
CPI.dl1	-1.82354	2.30520
MS.dl1	1.03247	0.71562
VILIBOR6.dl1	1.29044	2.23016

Residual standard error: 15.62 on 46 degrees of fr.
Multiple R-squared: 0.279,
F-statistic: 2.224 on 8 and 46 DF, p-value: 0.04264

Response CPI:
Coefficients:

	Estimate	Std. Error
ect1	8.140e-06	2.851e-03
ect2	1.245e-02	2.238e-02
OMXV.dl1	-9.040e-03	8.570e-03
GDP.dl1	1.573e-01	5.515e-02
FDI.dl1	-2.855e-02	2.857e-02
CPI.dl1	2.010e-01	1.313e-01
MS.dl1	-4.107e-02	4.076e-02
VILIBOR6.dl1	7.143e-02	1.270e-01

Residual standard error: 0.8897 on 46 degrees of fr.
Multiple R-squared: 0.5903,
F-statistic: 8.285 on 8 and 46 DF, p-value: 7.126e-07

Response GDP:
Coefficients:

	Estimate	Std. Error
ect1	0.013665	0.006568
ect2	0.083669	0.051555
OMXV.dl1	0.014202	0.019746
GDP.dl1	0.011819	0.127071
FDI.dl1	0.096221	0.065815
CPI.dl1	0.549812	0.302525
MS.dl1	0.411138	0.093914
VILIBOR6.dl1	-1.292163	0.292676

Residual standard error: 2.05 on 46 degrees of fr.
Multiple R-squared: 0.7219,
F-statistic: 14.93 on 8 and 46 DF, p-value: 1.687e-10

Response MS:
Coefficients:

	Estimate	Std. Error
ect1	0.024885	0.007579
ect2	0.249964	0.059493
OMXV.dl1	0.037239	0.022786
GDP.dl1	0.086951	0.146636
FDI.dl1	0.270239	0.075948
CPI.dl1	-1.389177	0.349105
MS.dl1	-0.161764	0.108374
VILIBOR6.dl1	-1.153071	0.337739

Residual standard error: 2.365 on 46 degrees of fr.
Multiple R-squared: 0.7891,
F-statistic: 21.51 on 8 and 46 DF, p-value: 3.765e-13

Response FDI:
Coefficients:

	Estimate	Std. Error
ect1	0.007368	0.014667
ect2	0.078283	0.115130
OMXV.dl1	0.012291	0.044095
GDP.dl1	-0.015964	0.283770
FDI.dl1	0.218294	0.146975
CPI.dl1	-0.658348	0.675585
MS.dl1	0.446476	0.209726
VILIBOR6.dl1	-0.371158	0.653591

Residual standard error: 4.577 on 46 degrees of fr.
Multiple R-squared: 0.4476,
F-statistic: 4.66 on 8 and 46 DF, p-value: 0.0003215

Response VILIBOR6:
Coefficients:

	Estimate	Std. Error
ect1	0.013121	0.002802
ect2	0.096355	0.021993
OMXV.dl1	-0.012695	0.008423
GDP.dl1	-0.092302	0.054208
FDI.dl1	0.001909	0.028076
CPI.dl1	0.022260	0.129055
MS.dl1	-0.057802	0.040063
VILIBOR6.dl1	-0.182119	0.124854

Residual standard error: 0.8744 on 46 degrees of fr.
Multiple R-squared: 0.4008,
F-statistic: 3.846 on 8 and 46 DF, p-value: 0.001551
Source: Compiled by the authors

Annex 7. **The results of the non-normalised Johansen VECM regarding GS index**

Response GS:
Coefficients:

	Estimate	Std. Error
ect1	0.10160	0.05573
ect2	-0.07393	0.05673
GS.dl1	0.16228	0.17662
GDP.dl1	0.11015	0.14180
FDI.dl1	0.10227	0.06294
CPI.dl1	-0.20727	0.32347
MS.dl1	-0.03093	0.10204
VILIBOR6.dl1	-0.79317	0.34760

Residual standard error: 2.158 on 46 degrees of fr.
Multiple R-squared: 0.4408,
F-statistic: 4.533 on 8 and 46 DF, p-value: 0.000409

Response GDP:
Coefficients:

	Estimate	Std. Error
ect1	-0.06664	0.05351
ect2	0.03688	0.05447
GS.dl1	-0.00576	0.16957
GDP.dl1	0.06142	0.13614
FDI.dl1	0.11687	0.06043
CPI.dl1	0.60075	0.31056
MS.dl1	0.40624	0.09797
VILIBOR6.dl1	-1.21400	0.33373

Residual standard error: 2.072 on 46 degrees of fr.
Multiple R-squared: 0.7158,
F-statistic: 14.49 on 8 and 46 DF, p-value: 2.709e-10

Response FDI:
Coefficients:

	Estimate	Std. Error
ect1	-0.04240	0.11722
ect2	0.07675	0.11932
GS.dl1	-0.25205	0.37147
GDP.dl1	0.05444	0.29824
FDI.dl1	0.24139	0.13239
CPI.dl1	-0.87757	0.68033
MS.dl1	0.50028	0.21463
VILIBOR6.dl1	-0.68334	0.73110

Residual standard error: 4.539 on 46 degrees of fr.
Multiple R-squared: 0.4568,
F-statistic: 4.836 on 8 and 46 DF, p-value: 0.000231

Response CPI:
Coefficients:

	Estimate	Std. Error
ect1	0.020584	0.022722
ect2	-0.002463	0.023130
GS.dl1	-0.088495	0.072007
GDP.dl1	0.199598	0.057812
FDI.dl1	-0.035234	0.025662
CPI.dl1	0.187314	0.131876
MS.dl1	-0.013114	0.041603
VILIBOR6.dl1	-0.002690	0.141717

Residual standard error: 0.8799 on 46 degrees of fr.
Multiple R-squared: 0.5993,
F-statistic: 8.599 on 8 and 46 DF, p-value: 4.467e-07

Response MS:
Coefficients:

	Estimate	Std. Error
ect1	-0.21680	0.06567
ect2	0.28335	0.06684
GS.dl1	0.33084	0.20810
GDP.dl1	0.07477	0.16707
FDI.dl1	0.36746	0.07416
CPI.dl1	-1.34532	0.38112
MS.dl1	-0.18234	0.12023
VILIBOR6.dl1	-0.81551	0.40956

Residual standard error: 2.543 on 46 degrees of fr.
Multiple R-squared: 0.7562,
F-statistic: 17.84 on 8 and 46 DF, p-value: 9.304e-12

Response VILIBOR6:
Coefficients:

	Estimate	Std. Error
ect1	-0.110424	0.020375
ect2	0.106045	0.020741
GS.dl1	0.038895	0.064570
GDP.dl1	-0.113015	0.051841
FDI.dl1	-0.011786	0.023012
CPI.dl1	0.060957	0.118255
MS.dl1	-0.077414	0.037306
VILIBOR6.dl1	-0.002092	0.127080

Residual standard error: 0.789 on 46 degrees of fr.
Multiple R-squared: 0.5122,
F-statistic: 6.037 on 8 and 46 DF, p-value: 2.668e-05

Annex 8. **The results of the non-normalised Johansen VECM regarding RE index**

Response RE:
Coefficients:

	Estimate	Std. Error
ect1	-0.01467	0.05137
ect2	-0.09573	0.12814
RE.dl1	-0.12591	0.13426
GDP.dl1	0.25658	0.41511
FDI.dl1	0.36791	0.19821
CPI.dl1	0.17066	0.97326
MS.dl1	1.51889	0.30982
VILIBOR6.dl1	0.01796	0.89819

Residual standard error: 6.762 on 46 degrees of fr.
Multiple R-squared: 0.5228,
F-statistic: 6.3 on 8 and 46 DF, p-value: 1.699e-05

Response GDP:
Coefficients:

	Estimate	Std. Error
ect1	0.01406	0.01622
ect2	0.01715	0.04045
RE.dl1	-0.01058	0.04239
GDP.dl1	0.11604	0.13105
FDI.dl1	0.13813	0.06257
CPI.dl1	0.59766	0.30726
MS.dl1	0.42581	0.09781
VILIBOR6.dl1	-1.24337	0.28356

Residual standard error: 2.135 on 46 degrees of fr.
Multiple R-squared: 0.6984,
F-statistic: 13.31 on 8 and 46 DF, p-value: 9.96e-10

Response FDI:
Coefficients:

	Estimate	Std. Error
ect1	0.02862	0.03469
ect2	0.08569	0.08654
RE.dl1	-0.01173	0.09067
GDP.dl1	-0.03948	0.28035
FDI.dl1	0.25172	0.13386
CPI.dl1	-0.74288	0.65729
MS.dl1	0.46274	0.20924
VILIBOR6.dl1	-0.33804	0.60659

Residual standard error: 4.567 on 46 degrees of fr.
Multiple R-squared: 0.4502,
F-statistic: 4.709 on 8 and 46 DF, p-value: 0.0002932

Response CPI:
Coefficients:

	Estimate	Std. Error
ect1	-0.009458	0.006279
ect2	-0.012899	0.015663
RE.dl1	0.047654	0.016410
GDP.dl1	0.143323	0.050739
FDI.dl1	-0.048344	0.024227
CPI.dl1	0.273792	0.118962
MS.dl1	-0.054459	0.037870
VILIBOR6.dl1	0.129221	0.109786

Residual standard error: 0.8265 on 46 degrees of fr.
Multiple R-squared: 0.6464,
F-statistic: 10.51 on 8 and 46 DF, p-value: 3.106e-08

Response MS:
Coefficients:

	Estimate	Std. Error
ect1	0.04842	0.01972
ect2	0.16020	0.04918
RE.dl1	-0.05456	0.05153
GDP.dl1	0.24037	0.15932
FDI.dl1	0.37478	0.07607
CPI.dl1	-1.45140	0.37354
MS.dl1	-0.10226	0.11891
VILIBOR6.dl1	-1.01959	0.34472

Residual standard error: 2.595 on 46 degrees of fr.
Multiple R-squared: 0.7461,
F-statistic: 16.9 on 8 and 46 DF, p-value: 2.29e-11

Response VILIBOR6:
Coefficients:

	Estimate	Std. Error
ect1	0.033385	0.006391
ect2	0.077436	0.015941
RE.dl1	-0.018157	0.016702
GDP.dl1	-0.084114	0.051641
FDI.dl1	0.010165	0.024658
CPI.dl1	0.067500	0.121076
MS.dl1	-0.034928	0.038543
VILIBOR6.dl1	-0.024762	0.111737

Residual standard error: 0.8412 on 46 degrees of fr.
Multiple R-squared: 0.4455,
F-statistic: 4.619 on 8 and 46 DF, p-value: 0.0003474