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## MULTIVARIATE ANALYSIS OF SHORT AND LONG-IMPACT INDICATORS FOR CORPORATE BOND MARKET DEVELOPMENT

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**Abstract:** An additional instrument or established access to the capital market funding would increase business opportunities for performance, development, growth, channeling financing for sustainable and long-term economic growth and job creation. Capital market and its level of development or further development opportunities are exposed to different factors. Clear identification of them mobilizes the attention of accurate and useful decisions or actions influencing the expected results, their adoption and implementation, monitoring. With the purpose to identify a set of factors influencing the capital market development as well as to introduce a model of their short term and long term impact projections, the ARDL model for the US and Lithuanian cases is introduced. The concluding remarks state on different legal and regulatory framework, banking sector and ICT measures exposures to the different stages of the corporate bond market development.

**Keywords:** corporate bond, ARDL, long term impact, dynamic models.

**JEL Classification:** G14, G31.

### 1. Introduction

By cooperating in funds allocation process, financial and credit markets share the nature of the measures and sets of concurrent players, while the general economic cycle features highlight the differences of these markets. Starting 2007 in United States and in 2008 in Europe, the financial crisis led to a review of the balance sheets of the credit institutions and further restrictions. Tighter standards for business loans force to look for alternatives (to the knowledge of European Commission in 2013 (European Commission 2015), there were rejected around 35 percent of SME credit applications in the euro area). One of them is corporate bonds or debentures. The favor of this instrument in the market has grown after the financial market crisis in 2008 and moratoria of its players (such as Lehman Brothers, Inc.). Since 2009, corporate bond market faces its every year growth by almost 2 per cent in Europe, extends the GDP of US. However, Lithuanian corporate bond market has been still underdeveloped. Its role in financing

growth is miserable and businesses remain heavily reliant on banks, making the economy vulnerable to a tightening of bank lending. Some of SME's are even looking for financing in the neighboring capital markets (e.g. Warsaw stock exchange). This reduces the concentration of financial markets competition-driven advantages – the reduction of the cost of raising the capital, favorable debt conditions (terms, collaterals needed, etc.), greater diversification and allocation of risk, shock-absorption capacity, allows for more investment without increasing levels of indebtedness. The domination of one source of borrowing creates some restrictions for market participants, in association with restricted access to funding for development or financing of investment projects and other business needs, increasing dependence on the economic cycle mediated segment reactions and changes. Therefore, an additional instrument or established access to the capital market funding would increase business opportunities for performance, development, growth, channeling financing for sustainable and long-term economic growth and job creation.

On the other hand, the declining interest on deposits, diminishing yields of government securities lead to more profitable investment with minimal risk tolerance amplitude as the corporate bond demand activation. Investors who opt for investment direction or specific instruments in assessment of the minimum risk are of conservative financial behavior, but relatively high profitability expectations. Declining real return on the instruments held by the portfolio or the interest of the deposit, the scope of a conservative investment strategy sought for alternatives. Such expectations of market participants and market conditions for the period 2009–2013 increase the attractiveness of corporate bond instrument in Europe and the United States.

The development of corporate bond market is characterized by higher emission volumes or a measure of market depth. In addition to more effectively implemented business or investor needs, capital market development promotes further economic growth, creating conditions for the improvement of the other components – labor productivity, investment, etc. The more rapid development of the capital market is characterized by term of “financialization” which describes a systematic and sustainable process in transcendent with economic growth. Such aspirations and market integration led the European Commission to launch a single capital market and capital market union (CMU) development process<sup>1</sup> by issuing a Green Paper, indicating potential courses of actions and measures, in consultation with Member States. CMU creation process is expected to end by 2019.

Capital market and its level of development or further development opportunities are exposed to different factors: the intervention or market created innate qualities,

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<sup>1</sup> Building a true single market for capital and creating a Capital Markets Union (CMU) for all 28 member states aim to increase the efficiency of the EU investment chain, finding the ways of linking investors and savers with growth. EC key actions are oriented to identify and remove the barriers which stand between investors' money and investment opportunities, and overcome the obstacles which prevent businesses from reaching the investors. EC performance measures: legislation and its improvement (the prospectus and other directives), specific recommendations to Member States, promotion of market forces (European Commission 2015).

which in turn result in market liquidity, and further impact on the entire country or region's economy. In differential impact, probability of occurrence, the nature or source of market factors determine the scope or depth of its development (growing, stagnating or moderating). Clear identification of market development factors mobilizes the attention of accurate and useful decisions or actions influencing the expected results, their adoption and implementation, monitoring. Well known (projected) market development opportunities and trends ensure timely and appropriate measures of performance targets. In the case of corporate bond market, identification of market development factors conditions more effective capital market supervision and efficient market participants' activity, resulting in wider funding opportunities. A possibility to predict the development of the corporate bond market, identified the drivers of change will create conditions for sustainable and systematic development of the market to the benefit of both businesses and investors, and the whole country or region's economy.

The *purpose* of this paper is to identify a set of factors influencing the capital market development as well as to introduce a model of their short term and long term impact projections.

Although corporate bond market is less dynamic than stock, similar techniques are used for its analysis. Therefore a multivariate factor analysis was conducted in accordance with autoregressive distributed lag model (ARDL). The motivation of the choice is explained in detail in the third section of the paper.

The paper contains of five sections. First section briefly introduces the relevance of the topic. The literature review on different factors and their impact to capital market development is summarized in section two. The third section contributes to the motivation, the methodology and the main steps of ARDL technique. Its implementation and empirical results are introduced in the fourth section. Finally, the conclusions and insights are made.

## **1. Literature review**

In the scientific literature, the corporate bond market and its impact factors are examined in several dimensions:

- In the contain of the capital market (see Klimašauskienė, Moščinskienė 1998; Leipus, Norvaiša 2003; Brzozowska 2008; Raddatz, Schmukler 2008; Chami *et al.* 2009; Peiris 2010; Stankevičienė, Gembickaja 2012; Bianchi *et al.* 2012; Sienaert 2012; Laeven 2014);
- In the scope of credit instruments (see Hubbard 1998; Greenwood, Hanson 2013);
- In developing (see Srinivas *et al.* 2000; Eichengreen, Luengnaruemitchai 2006; International 2011; Sui 2011; Jaramillo, Weber, 2012; Gozzi *et al.* 2012; Felman *et al.* 2014; Levinger, Li 2014 ) or developed (see Bayoumi, Bui 2012; Australian... 2014) samples of countries.

In the contain of capital market, the corporate bond market and its market performance are analyzed in the context of information efficiency (Klimašauskienė, Moščinskienė 1998; Bianchi *et al.* 2012), the efficient market hypothesis (Leipus, Norvaiša 2003; Stankevičienė, Gembickaja 2012), institutional investors (Raddatz, Schmukler 2008), government regulation (Chami *et al.* 2009), internationalization (Peiris 2010; Sienaert 2012) by identifying the mandatory prerequisites for the effective functioning of the market (Laeven 2014). Separate analysis of the macro-environment for corporate bond market has not been conducted.

In the scope of credit instruments, corporate bond analysis covered credit ratings (Greenwood, Hanson 2013), state grants and equivalent market information (Hubbard 1998) as well as their impact on the profitability of the instrument and its price. Greenwood and Hanson (2013) demonstrated that a significant reduction in the company's credit rating leads more to credit market "overheating" than the sudden increase in the debt capital gains. The authors agreed on the less meaningful market information that credit rating for corporate bond did provide. So far other authors provided the measures favoring the corporate bond instrument. He saw the strengths and weaknesses of granted corporate bonds, in order to encourage the activity in the sector, renew funding, protect against further financial crises and reduce the price of the loan. On the other hand, the state guarantees are regarded as an instrument of competitive distortions in the market, giving more favorable conditions for some market participants over others. Other market distortions are examined by Hubbard (1998). When assessing the information asymmetry in the credit market, Hubbard (1998) named it of little concern for the minor consequences it causes. Asymmetric information that is possessed by borrowers and lenders causes internal and external financing cost differences, which are represented in prices and yields of debt instruments.

However, the strongest motivation in the development of the market analysis of multiple factors influencing the capital market is a cross country competition and comparison. Srinivas *et al.* (2000) compared the taxation of capital in Latin America and Eastern Europe, indicating the favorable circumstances for further development. Moreover, Eichengreen and Luengnaruemitchai (2006) proved the relationships of Asian, European and Latin American capital markets, in the meaning of systemic risk and vulnerability to the effects of economic shocks. Other findings were more concrete on the reasons or consequences of underdeveloped capital markets, identifying the solutions to further improvements. For example, Sui (2011) examining the evolving Chinese corporate bond market, identified lack of innovation (most tools are of limited duration, low yield, tight range of risk management and the relationship with the profitability measures), excessive administrative control of state level projects for corporate bond issues (which must be inspected and approved by several institutions), the lack of trusted credit rating agencies (in China), undeveloped secondary market (deficiency of specialized institutional investors, dealers), poor disclosure and publicity as the interference of capital market

development. Meanwhile, Levinger and Li (2014) complemented with the factors that encouraged the Asian corporate bond market development, which could be distributed to internal and international ones. These are lower interest rates in the developed countries, which encouraged investors to seek higher-yielding in Asia market. On the supply side, the development of the market was driven by regulatory and policy initiatives in developing the market infrastructure (Levinger, Li 2014). On the contrary, Felman *et al.* (2014) catalyst factors of the development of corporate bonds in Asia attributed to foreign investment. However, in unison Levinger and Li (2014) and Felman *et al.* (2014) for efficient corporate bond market development identified the development of investor base or the critical mass and the importance of investments to the market infrastructure.

Generally without the specific country or region classification, the corporate bond market in developing countries was examined by International Organization of Securities Commissions in collaboration with the World Bank Group (2011), Jaramillo and Weber (2012), Gozzi *et al.* (2012). The interferences of emerging capital markets to develop could be summarized like (International 2011):

- Limited variety and quality of corporate bonds;
- Low liquidity of the secondary market;
- Relatively underdeveloped market regulatory framework;
- Inefficient market infrastructure;
- The lack of diversity of instruments and a narrow investor base.

Followed by the insignificance of fiscal factors for bond yields in developing economies, but being valued by market participants, when investing in different countries (see Jaramillo, Weber 2012) and uncompetitive internationalization when local and international corporate bond markets are complementary, not competing for different duration and nature of the instruments (Gozzi *et al.* 2012).

On the other hand, the comparative analysis of developed capital markets reveals a bandwidth of the markets to economic shocks and a dispersion of these effects. Bayoumi and Bui (2012) identified that the US impact on other markets (EU, Japan) is a much more significant than other markets impacts to the United States in terms of financial crises or economic shocks dissemination. Also they found a correlation between the UK and the euro area member states. Meanwhile, the Australian corporate bond market development factors are defined as the exception of short term “vanilla” corporate bonds prospectus publicity, attraction of retail investors to the market, emission of covered bonds by authorized banks – these are the changes of regulatory and legal framework. The importance of the developed market is based on the diversification of investment opportunities for local investors as well as for issuers of debt (borrowing or investing into a market not only a bank instrument) and the arguments of systemic risk mitigation. The latter can be subject to market interference: from the issuer side – an unfavorable tax base, the investor – low liquidity (Australian... 2014).

The corporate bond market development is identified as a challenge to all states and there is no rapid deployment of this task, the need of which is justified by arguments (International... 2011):

- A developed corporate bond market can act as a source of stability, especially during periods of financial crisis, when credit markets are often stagnating;
- Liquid corporate bond market will reduce the country's reliance on the banking sector and increase funding for a variety of asset classes for diversification;
- The corporate bond market also helps to reduce the risk of currency mismatches and funding periods, especially in long-term projects.

Laeven (2014) sums up all the factors in the appropriate fields and lists mandatory conditions for local capital markets to operate which divides into three groups (see Laeven 2014):

- Sound macroeconomic policies (for market openness and integration into international markets);
- A strong institutional and legal framework (legislation, investor protection has a positive correlation with the corporate bond market development, less severe than the macro-economic factors);
- And a well-functioning financial infrastructure (contract terms, credit ratings, investors' rights).

Nevertheless, the effective functioning of the market is defined by the requirements of minimum size (often there is not sufficient of existing infrastructure, legislation or policy, encouraged demand for investors, intensified private pension funds and other institutional investors are needed) (Laeven 2014). This was supported by Chami *et al.* (2009) indicating the development of the market requiring the borrower's and the lender's willingness to enter into transactions, favorable liquidity sources and means of conditions that can be supported, developed or removing obstacles that prevent them by different regulatory structures.

Of more specific measures and recommendations to develop the corporate bond market are (International... 2011):

- *Market efficiency*: the development of methods for the initial distribution of securities, reducing the corporate bond issue registration or registration confirmation periods standardizing bond offering documents, creating a benchmark of government bond yield and the pre-publication of the auction calendar.
- *Market infrastructure and development of investor base*: increasing the efficiency of trade, the development of the market system, creating a corporate bond index and the establishment of a specific guarantee institution; cancelling market entry barriers as well as opening up the market to investors in particular to boost the retail ones.
- *Enhancing Investor Protection*: promoting price and trade transparency, enhancing the quality and timeliness of information made public, strengthening the supervision

and control of the market mechanisms, defining the use of the credit ratings and tightening the rules on bankruptcy (insolvency laws) and restructuring.

- *Favorable Tax System*: reviewing the tax system and the creation of the corporate bond market competition conditions for adequate ones to government bonds or bank lending markets.

Other authors extend the proposals to capital and bond market development by democratization (Shiller 2012) and standardization (Novick *et al.* 2014). Democratization is described as the opening of financial market to the public. It's a target to create the legal and infrastructural capabilities for retail investors in transactions (not through intermediaries), thereby increasing the activity of the market, liquidity, transparency and confidence (Shiller 2012). Meanwhile, standardization is understood as uniformity of the duration or extent of the instrument (in this case, the corporate bond), which would also increase market liquidity, reduce emissions and transaction costs, increase transparency of the price and etc. (Novick *et al.* 2014). To the view of the author of this paper this reform is disadvantaged as well: in particular, by the standardization of the instruments in the capital market there would be reduced access to credit for small businesses (proposals for minimum emissions starts from 750 million USD). On the other hand, standardization creates favorable conditions for the transfer of statistical data collection, enabling bigger data sets for the analysis of scale and research.

A variety of influencing capital and corporate bond market factors were identified (in the sense of development or interference). For a comprehensive complex analysis according to the data access and unexplored areas the following corporate bond market factors influencing the development are chosen:

- *Legal framework, state regulation and taxes*. Factor argumentation for the choice consists of the theoretical base, highlighting the efficient functioning of the corporate bond market assumptions within the existing infrastructure, the legal basis (the protection of investors, tax laws) which are under the maintenance, development and direct responsibility of the governments.
- *Information and communication technologies (ICT)*. Factor is considered and selected as a counterweight to the information asymmetry; new technological infrastructures are leading to the development of the market (faster transactions taking place and those served by ICT) and transparency (widely available set of information).
- *Competition with bank loans*. While arguments of the need of the capital market development stand for the alternative to bank loans, the author of this paper has decided on the inclusion of this factor into the analysis to be investigated on further and the relevant market dependence, mutually owned or designated development.

International integration component in this paper will continue to develop a comparative analysis: comparing the corporate bond market development in the US and Lithuania. These cases were chosen for the different level of the market development as well: US standing for the developed, while Lithuania – underdeveloped market category.

Besides the geographic factor, with accordance of dynamic nature of the research object (corporate bond market and its development), time series approach is introduced with an exposure of long-term or short-term impact of the dependents.

Simplifying the analysis of factors with the assumptions of previous works of the author (Astrauskaitė, Paškevičius 2014; Astrauskaitė 2014), the proxy measures of the listed groups, underlying the strongest relationship with the corporate market development were chosen. Each variable set is represented within the empirical results of the cases studies.

### 3. The methodology

The corporate bond market, as each economic phenomenon, is of complex composition (instruments, participants, organization of activities). Therefore it is appropriate a systematic analysis of the overall impact of market influence factors. Since no one single indicator does not have such a feature collection, which integrates the essential aspects of the whole market, a complex analysis is used (see Podvezko 2008), which reveals the integrity of the impact of the factors and the market reaction to it. Under this argumentation all variables are combined into one multivariate equation.

For the investigation of the long-term factors effects on corporate bond market development, an autoregressive distributed lag (ARDL) model methodology was adapted. The motivation of the selection of the model contains:

- Relatively short set of observations that limited the application of the multiple regression model;
- Good practices of the application of the model to investigation of long-term economic relations (Atkins, Coe 2002; Fedderke, Liu 2002; Ioannides *et al.* 2005; Byrne, Davis 2005; Dritsakis 2011);
- The model encompasses not only the static but also the dynamic characteristics of the factors (the difference in the amount of delay);
- Assessing both short-term and long-term effects of the factors (the integrated data I (0) and I (1));
- There is unnecessary to set a level of factor integration.

In the ARDL model, the coefficients are calculated by the least squares technique, integrating and differentiating the different sets of primary data (I(1) and I(0)) by deriving and later on combining several VAR equations (1) (Pesaran *et al.* 2001):

$$\Delta Y = \alpha_0 + \sum_{i=1}^m \beta_i \Delta Y_{t-i} + \sum_{i=0}^n \varphi_i \Delta X_{t-i} + \delta_1 Y_{t-1} + \delta_2 X_{t-1} + \varepsilon_t, \quad (1)$$

where  $Y$  – the dependent variable,  $X$  – the independent variable,  $t$  – the number of periods,  $i$  – series of delays,  $\Delta$  denotes the first order of the integral  $I(1)$ ,  $\varepsilon_t$  – standard error (“white noise”),  $\alpha_0$  – intercept,  $\beta_i$ ,  $\varphi_i$ ,  $\delta_1$ ,  $\delta_2$  – coefficients of the independent variables. This is a generalized the first delay ARDL (1) equation. For the optimal



amount of delays for each variable the AIC criteria was used (minimum value of the criterion marks the optimal delay). Correlograms and ADF (Augmented dickey Fuller) tests are used to the data stationarity (the mandatory condition of autoregressive data models) check.

ARDL model evaluates only co-integrated long-term and short-term factors. Co-integration between the factors is understood as long-term relationship or a presence of long-term dynamics or interfaces. The co-integration between the model variables is tested by the F statistics and Wald test, approving or rejecting the hypothesis  $H_0: \delta_1, \delta_2 = 0$  defining the absence of coefficients of independent variables. Alternatively, a hypothesis  $H_1: \delta_1 \neq \delta_2 \neq 0$ , meaning the co-integration between the factors, is approved (Pesaran *et al.* 2001). Notably Pesaran *et al.* (2001) use non-standard distribution of two-valued F, where a higher limit of the range shows the integration between the variables when one can reject the hypothesis  $H_0$ .

Calculated coefficients of independent variables in integrated ARDL factor model were assessed by their statistical significance to the dependent factor. The significance level (p-value) procedure with the chosen level of 0.05 was used for estimating. Insignificant factors were removed from the equation. The adequacy of the whole model (based on normal distribution for distributed, uncorrelated, homoscedasticity of errors) in the manner of p-value and F statistics was inspected by LM (Lagrange multiplier), White and Jarque-Bera tests.

Statistically significant variables of adequate ARDL model equation were interpreted in the calculation of elasticity (2):

$$E_{xy} = -\frac{\delta_2}{\delta_1}, \quad (2)$$

where  $E$  – elasticity,  $\delta_2$  – coefficient of independent variable,  $\delta_1$  – coefficient of dependent variable. Calculated values of the elasticity factor represent the percentage of independent variable's impact on the dependent variable. Integrated I(1) data elasticity shows short-term effects while non-integrated I(0) – the long-term ones.

With the purpose of the systemic exposure of corporate bond market development factors and time as well as different regions or level of development valuation targets, ADRL model was adapted to the cases of Lithuania and the United States.<sup>2</sup> The input data and the results and the main insights of their description are provided in accordance with each case study. The calculation of ARDL models was proceeded with statistical package of Eviews.

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<sup>2</sup> *Note:* the different cases were chosen according to country market level of development in order to adopt the research results to different kind of markets.

## 4. Empirical results

### 4.1. Case study of USA

According to the factor groups which were identified as the influencing to the corporate bond market development, the US ARDL model input data contains of the following independent variables<sup>3</sup>:

- *An index on regulatory burden of corporate bond market (RBI) ( $INDEX_{US}$ )*, representing the corporate bond market regulations, regulatory and fiscal environment and the influence of these components to the development of the market (this index was constructed by the author of the paper, including qualitative assessment of the legal and regulatory framework of the corporate bonds in the country, tax system as well as administrative burden (costs of issuing and meeting other legal requirements); all these categories were evaluated in the range of 1 to 10 and weighted equally);
- *Internet dissemination (% of population with access to the Internet) ( $INTERNET_{US}$ )* – a factor that describes the impact of ICT on the development of corporate bond market (Astrauskaitė 2014);
- *Local banks' loans to the private sector in billions of USD ( $LOANS_{US}$ )* – a factor that characterizes the influence of the banking sector to the corporate bond market development (Astrauskaitė, Paškevičius 2014).

As a dependent variable of the model two corporate bond market development characteristics were chosen: volume, which is measured in nominal value of corporate bonds issues ( $ISSUE_{US}$ ), and market depth indicator (in percentage of GDP) ( $DEPTH_{US}$ ), measuring the coverage of the demands of corporate bond market participants.

Analysis was performed using time series of 2002S1-2013S2. Frequency was selected according to the data available.

Before concluding ARDL model, the optimal number of delays for each independent variable identified by AIC criteria is given in Table 1.

Table 1. An optimal number of delays of independent variables in US ARDL model (AIC criteria) (source: compiled by the author)

| Dependent variables | Independent variables |                 |              |
|---------------------|-----------------------|-----------------|--------------|
|                     | $INDEX_{US}$          | $INTERNET_{US}$ | $LOANS_{US}$ |
| $ISSUE_{US}$        | 1<br>(10.19)          | 1<br>(14.71)    | 2<br>(23.87) |
| $DEPTH_{US}$        | 1<br>(-7.89)          | 2<br>(-3.77)    | 1<br>(4.65)  |

Note: the lowest value of the AIC criterion is shown in brackets.

<sup>3</sup> Note: The independent variables differ across country samples, because their influence to local corporate bond market was found to be of different significance (see Astrauskaitė 2014; Astrauskaitė, Paškevičius 2014).

As can be seen from Table 1, the most common delay among independent variables is one semester, distinguishing the Internet dissemination ( $INTERNET_{US}$ ) on the corporate bond market depth ( $DEPTH_{US}$ ) and private sector loans ( $LOANS_{US}$ ) on corporate bonds in the nominal value ( $ISSUE_{US}$ ) equations, which were delayed by a year (2 semesters of delay). Such delays mean that the corporate bond market depth of the US can be projected of the latter half of the legal and regulatory framework and banking sector data and ICT development in recent time, or such period is necessary for the reflection of the above-mentioned sector changes in the corporate bond market depth metric. Meanwhile, the US corporate bond issuance can be projected of the latter half of the legal and regulatory framework data and ICT development in recent time and the last year data of the banking sector. These periods show when and for a while components affect the corporate bond market by volume or in depth.

However, the estimates of least squares referred to optimal number of delays because of perfect correlation of regressors were not found. Therefore, the following analysis of all variables was conducted with assessment of minimum period of one delay, shown in ARDL(1) equations (3) and (4):

$$D(ISSUE_{US}) = C + ISSUE_{US(-1)} + INDEX_{US(-1)} + INTERNET_{US(-1)} + LOANS_{US(-1)} + D(ISSUE_{US(-1)}) + D(INDEX_{US(-1)}) + D(INTERNET_{US(-1)}) + D(LOANS_{US(-1)}); \quad (3)$$

$$D(DEPTH_{US}) = C + DEPTH_{US(-1)} + INDEX_{US(-1)} + INTERNET_{US(-1)} + LOANS_{US(-1)} + D(DEPTH_{US(-1)}) + D(INDEX_{US(-1)}) + D(INTERNET_{US(-1)}) + D(LOANS_{US(-1)}), \quad (4)$$

where  $D$  represents disaggregated data,  $(-1)$  – the first delay,  $C$  – intercept,  $INDEX_{US}$  – an index on regulatory burden of corporate bond market,  $INTERNET_{US}$  – Internet dissemination (% of population with access to the Internet),  $LOANS_{US}$  – Local banks’ loans to the private sector in billions of USD,  $ISSUE_{US}$  – nominal value of corporate bonds issues,  $DEPTH_{US}$  – mark depth indicator (in percentage of GDP).

For the evaluation of co-integration of the indicators of the estimated equations (3) and (4), the conducted Wald test results led to the following conclusions:

- the calculated level of significance of the equation (3) parameters in Wald test was lower than the selected ( $0.01 < 0.05$ ); moreover the statistics  $F_k$  is higher than the upper mean of F critical value interval to a value  $F_3$  ( $5.16 > 2.79^4$ ), so the hypothesis  $H_0$ : “There is no integration between the factors” was rejected and the

<sup>4</sup> Pesaran *et al.* 2001.

alternative hypothesis  $H_1$  accepted that these factors are co-integrated (their coefficients are not equal to zero).

- the calculated level of significance of the equation (4) parameters in Wald test was lower than the selected ( $0.02 < 0.05$ ); moreover the statistics  $F_k$  is higher than the upper mean of F critical value interval to a value  $F_3$  ( $4.23 > 2.79^5$ ), so the hypothesis  $H_0$ : “There is no integration between the factors” was rejected and the alternative hypothesis  $H_1$  accepted that these factors are co-integrated (their coefficients are not equal to zero).

As it was confirmed, that the factors were characterized by long-term dynamics, the analysis was continued by the evaluation of their statistical significance using a measure of t statistics. Removing statistically insignificant variables previous equations were transformed into (5) and (6) models:

$$D(ISSUE_{US}) = -495.65 + 0.11 * ISSUE_{US(-1)} + 0.03 * LOANS_{US(-1)} - 0.44 * D(ISSUE_{US(-1)}) + 0.08 * D(LOANS_{US(-1)}); \quad (5)$$

$$D(DEPTH_{US}) = -0.03 + 0.001 * INTERNET_{US(-1)} - 0.11 * D(INTERNET_{US(-1)}), \quad (6)$$

where  $D$  represents disaggregated data,  $(-1)$  – the first delay,  $C$  – intercept,  $INTERNET_{US}$  – Internet dissemination (% of population with access to the Internet),  $LOANS_{US}$  – Local banks’ loans to the private sector in billions of USD,  $ISSUE_{US}$  – nominal value of corporate bonds issues,  $DEPTH_{US}$  – market depth indicator (in percentage of GDP).

US ARDL(1) models indicate that the corporate bond market development in the country is due to bank loans to the private sector and ICT development. Impacts differentiate in size, direction, and the market component which is affected. To ensure the correct interpretation of the coefficients, the evaluation of both equations error autocorrelation, heteroscedasticity and distribution according to the normal distribution phenomena is introduced. Summarized LM (Lagrange multiplier), White and Jarque-Bera test results are as follows:

- The model of US corporate bond issues and the factors that determine it (5) satisfied the assumption of homoscedasticity (the calculated significance level of White test was above the selected ( $0.85 > 0.05$ ), so the hypothesis  $H_0$ : “The model error distribution is of constant homoscedasticity” was adopted); there were no autocorrelated errors (for number of 2 delays the calculated values of significance level were higher than at the level of 0.05, so the hypothesis  $H_0$ : “Errors of delays do not correlate” was adopted); and the distribution was normal (the significance level of

<sup>5</sup> Pesaran *et al.* 2001.

an overall estimate of Jarque-Bera test was greater than the chosen ( $0.76 > 0.05$ ), so the hypothesis  $H_0$ : “The model errors are distributed under the normal distribution” was adopted).

- The model of US corporate bond market depth and the factors that determine it (6) also satisfied the assumption of homoscedasticity (the calculated significance level of White test was above the selected ( $0.96 > 0.05$ ), so the hypothesis  $H_0$ : “The model error distribution is of constant homoscedasticity” was adopted); there were no auto-correlated errors (for number of 2 delays the calculated values of significance level were higher than at the level of 0.05, so the hypothesis  $H_0$ : “Errors of delays do not correlate” was adopted); and the distribution was normal (the significance level of an overall estimate of Jarque-Bera test was greater than the chosen ( $0.13 > 0.05$ ), so the hypothesis  $H_0$ : “The model errors are distributed under the normal distribution” was adopted).

As calculated estimates of equations models are concerted, efficient and unbiased, they are used for the further estimation of the impact (in the sense of its direction and size) to corporate bond market development by the evaluation of the elasticity (see Table 2).

Table 2. Elasticity measures of US ARDL model coefficients (source: compiled by the author)

| Dependent variables | Independent variables  |                            |                    |                        |
|---------------------|------------------------|----------------------------|--------------------|------------------------|
|                     | INTERNET <sub>US</sub> | D(INTERNET <sub>US</sub> ) | LOAN <sub>US</sub> | D(LOAN <sub>US</sub> ) |
| ISSUE <sub>US</sub> | –                      | –                          | –0.27              | –0.75                  |
| DEPH <sub>US</sub>  | 0.08                   | –0.01                      | –                  | –                      |

One percentage point increase in Internet dissemination in US conditions a short-term decrease of 0.01 percent in corporate bonds market depth. However, in the long-term the same factor increases market depth of 0.08 percent. Significant differences by the period of the impact of ICT development are explained by the psychosomatic preferences of the users of technological diffusion, admissibility of learning and adaptation features: when skills are get and experienced, the advantages of them are conditioned by the long term. Notably there is a bigger long than short-term impact of ICT on the corporate bond market depth.

In contrast, one percent increase in US bank loans to the private sector in terms causes 0.75 percent short-term and 0.27 percent long-term losses of corporate bonds issues in the nominal value. Although changes are negative, there are no significant arguments of these markets substitution effect. It should be noted that short-term corporate bond market shrinkage effect is amortized in the long run.

Statistically insignificant and eliminated from the equation factor of the legal and regulatory framework has no significant short-term or long-term impact on the US corporate bond market development.

In summary, it must be concluded that the most prominent factor considering the US corporate bond market development is ICT development in the long term, as well as both the short and long term declining in business loan portfolios by local banks.

#### 4.2. Case study of Lithuania

By adapting ARDL model to the case of Lithuania, the corporate bond market development factors are chosen by analogy with the United States. Therefore, the model independent variables contain:

- *An index on regulatory burden of corporate bond market (RBI) ( $INDEX_{LT}$ )*, representing the corporate bond market regulations, regulatory and fiscal environment and the influence of these components to the development of the market;
- *Number of mobile telephone subscribers per 100 inhabitants ( $MOBILE_{LT}$ )* – a factor that describes the impact of ICT on the development of corporate bond market (Astrauskaitė 2014);
- *Bank loans for the private companies in billions EUR ( $LOAN_{LT}$ )* – a factor that characterizes the influence of the banking sector to the corporate bond market development (Astrauskaitė, Paškevičius 2014).

Likewise the case of the US, as a dependent variable of the model two corporate bond market development characteristics were chosen: volume, which is measured in nominal value of corporate bonds issues ( $ISSUE_{LT}$ ), and market depth indicator (in percentage of GDP) ( $DEPTH_{LT}$ ), measuring the coverage of the demands of corporate bond market participants.

Analysis was performed using time series of 2003S1-2013S2. Frequency was selected according to the data available.

Before concluding ARDL model, the optimal number of delays for each independent variable identified by AIC criteria is given in Table 3.

Table 3. An optimal number of delays of independent variables in Lithuanian ARDL model (AIC criteria) (source: compiled by the author)

| Dependent variables | Independent variables |               |              |
|---------------------|-----------------------|---------------|--------------|
|                     | $INDEX_{LT}$          | $MOBILE_{LT}$ | $LOAN_{LT}$  |
| $ISSUE_{LT}$        | 1<br>(3.07)           | 4<br>(9.84)   | 4<br>(8.79)  |
| $DEPTH_{LT}$        | 1<br>(-5.75)          | 4<br>(0.97)   | 4<br>(-0.02) |

Note: the lowest value of the AIC criterion is shown in brackets

Comparing the optimal number of variable delay in United States and Lithuania ARDL models, Lithuania indicators distinguished permanently. As can be seen from Table 3, the biggest delay is characterized by loans granted to private companies ( $LOAN_{LT}$ ) and mobile penetration ( $MOBILE_{LT}$ ) using 2 years old the historical data (delay of 4 semesters) for making corporate bond nominal value ( $ISSUE_{LT}$ ) and or market depth ( $DEPTH_{LT}$ ) predictions.

On the other hand, the two-year period change in the market, i.e. the diffusion of mobile or increasing portfolio of bank loans to private companies, the changes of these factors will be reflected in the corporate bond market only after 2 years. Meanwhile, the measures of the index ( $INDEX_{LT}$ ) prove the country's corporate bond market sensitivity to changes in the legal and regulatory framework. The last half of the year (1 semester delay) RBI index value is used for making forecast of corporate bond market development or RBI and the corporate bond market and the characteristics of these components changes and synergies are appointed by a half of the period.

However, the estimates of least squares referred to optimal number of delays because of perfect correlation of regressors were not found. Therefore, the following analysis of all variables was conducted with assessment of minimum period of one delay, shown in ARDL(1) equations (7) and (8):

$$D(ISSUE_{LT}) = C + ISSUE_{LT(-1)} + INDEX_{LT(-1)} + MOBILE_{LT(-1)} + LOANS_{LT(-1)} + D(ISSUE_{LT(-1)}) + D(INDEX_{LT(-1)}) + D(MOBILE_{LT(-1)}) + D(LOANS_{LT(-1)}); \quad (7)$$

$$D(DEPTH_{LT}) = C + DEPTH_{LT(-1)} + INDEX_{LT(-1)} + MOBILE_{LT(-1)} + LOANS_{LT(-1)} + D(DEPTH_{LT(-1)}) + D(INDEX_{LT(-1)}) + D(MOBILE_{LT(-1)}) + D(LOANS_{LT(-1)}), \quad (8)$$

where  $D$  represents disaggregated data,  $(-1)$  – the first delay,  $C$  – intercept,  $INDEX_{LT}$  – an index on regulatory burden of corporate bond market,  $MOBILE_{LT}$  – number of mobile telephone subscribers per 100 inhabitants,  $LOAN_{LT}$  – bank loans for the private companies in billions EUR,  $ISSUE_{LT}$  – nominal value of corporate bonds issues,  $DEPTH_{LT}$  – market depth indicator (in percentage of GDP).

For the evaluation of co-integration of the indicators of the estimated equations (7) and (8), the conducted Wald test results led to the following conclusions:

- the calculated level of significance of the equation (7) parameters in Wald test was lower than the selected ( $0.0007 < 0.05$ ); moreover the statistics  $F_k$  is higher than the upper mean of F critical value interval to a value  $F_3$  ( $9.71 > 2.79^6$ ), so the

<sup>6</sup> See Pesaran *et al.* 2001.

hypothesis  $H_0$ : “There is no integration between the factors” was rejected and the alternative hypothesis  $H_1$  accepted that these factors are co-integrated (their coefficients are not equal to zero).

- the calculated level of significance of the equation (8) parameters in Wald test was lower than the selected ( $0.0003 < 0.05$ ); moreover the statistics  $F_k$  is higher than the upper mean of F critical value interval to a value  $F_3$  ( $11.52 > 2.79^7$ ), so the hypothesis  $H_0$ : “There is no integration between the factors” was rejected and the alternative hypothesis  $H_1$  accepted that these factors are co-integrated (their coefficients are not equal to zero).

As it was confirmed, that the factors were characterized by long-term dynamics, the analysis was continued by the evaluation of their statistical significance using a measure of t statistics. Removing statistically insignificant variables previous equations were transformed into (9) and (10) models:

$$D(ISSUE_{LT}) = 43.27 - 0.86 * ISSUE_{LT(-1)} - 0.27 * LOANS_{LT(-1)} + 0.03 * MOBILE_{LT(-1)} - 10.97 * INDEX_{LT(-1)} + 0.33 * D(LOANS_{LT(-1)}) + 7.66 * D(INDEX_{LT(-1)}); \quad (9)$$

$$D(DEPTH_{LT}) = 0.55 - 0.91 * DEPTH_{LT(-1)} - 0.003 * LOANS_{LT(-1)} + 0.0003 * MOBILE_{LT(-1)} - 0.14 * INDEX_{LT(-1)} + 0.004 * D(LOANS_{LT(-1)}) + 0.1 * D(INDEX_{LT(-1)}), \quad (10)$$

where  $D$  represents disaggregated data,  $(-1)$  – the first delay,  $C$  – intercept,  $INDEX_{LT}$  – an index on regulatory burden of corporate bond market,  $MOBILE_{LT}$  – number of mobile telephone subscribers per 100 inhabitants,  $LOAN_{LT}$  – bank loans for the private companies in billions EUR,  $ISSUE_{LT}$  – nominal value of corporate bonds issues,  $DEPTH_{LT}$  – market depth indicator (in percentage of GDP).

Unlike the case of the USA, Lithuania corporate bond market development is determined by the majority of indicators examined, which are evenly spread across the prediction of different corporate bond market characteristics (e.g. volume and depth). To ensure the correct interpretation of the coefficients, the evaluation of both equations error autocorrelation, heteroscedasticity and distribution according to the normal distribution phenomena is introduced. Summarized LM (Lagrange multiplier), White and Jarque-Bera test results are as follows:

- The model of Lithuanian corporate bond issues and the factors that determine it (9) satisfied the assumption of homoscedasticity (the calculated significance level of White test was above the selected ( $0.26 > 0.05$ ), so the hypothesis  $H_0$ : “The model

<sup>7</sup> See Pesaran *et al.* 2001.



error distribution is of constant homoscedasticity” was adopted); there were no auto-correlated errors (for number of 2 delays the calculated values of significance level were higher than at the level of 0.05, so the hypothesis  $H_0$ : “Errors of delays do not correlate” was adopted); and the distribution was normal (the significance level of an overall estimate of Jarque-Bera test was greater than the chosen ( $0.58 > 0.05$ ), so the hypothesis  $H_0$ : “The model errors are distributed under the normal distribution” was adopted).

- The model of Lithuanian corporate bond market depth and the factors that determine it (10) also satisfied the assumption of homoscedasticity (the calculated significance level of White test was above the selected ( $0.27 > 0.05$ ), so the hypothesis  $H_0$ : “The model error distribution is of constant homoscedasticity” was adopted); there were no auto-correlated errors (for number of 2 delays the calculated values of significance level were higher than at the level of 0.05, so the hypothesis  $H_0$ : “Errors of delays do not correlate” was adopted); and the distribution was normal (the significance level of an overall estimate of Jarque-Bera test was greater than the chosen ( $0.72 > 0.05$ ), so the hypothesis  $H_0$ : “The model errors are distributed under the normal distribution” was adopted).

As calculated estimates of equations models are concerted, efficient and unbiased, they are used for the further estimation of the impact (in the sense of its direction and size) to corporate bond market development by the evaluation of the elasticity (see Table 4).

Table 4. Elasticity measures of Lithuanian ARDL model coefficients (source: compiled by the author)

| Independent variables   | Dependent variables |                     |
|-------------------------|---------------------|---------------------|
|                         | ISSUE <sub>LT</sub> | DEPTH <sub>LT</sub> |
| LOAN <sub>LT</sub>      | -0.31               | -0.004              |
| MOBILE <sub>LT</sub>    | 0.03                | 0.0003              |
| INDEX <sub>LT</sub>     | -12.79              | -0.15               |
| D(LOAN <sub>LT</sub> )  | 0.39                | 0.004               |
| D(INDEX <sub>LT</sub> ) | 8.94                | 0.11                |

As can be seen from Table 4, from all market development indicators analyzed, Lithuanian corporate bond market is mostly sensitive to changes in the index (RBI), the direction of the reaction depending on the period. One percent increase in RBI evaluation leads to almost 9 percent development of the market in the short term, while adequate change of the index in the long run reduces the corporate bond nominal value by almost 13 percent. RBI impact on the corporate bond market depth has identical mark and period, but stands out with significantly smaller size of the effect: only 0.15 per cent corporate bond market contraction in the long term and 0.11 percent development in the short term are accompanied by 1 percent RBI changes.

Another factor that affects the market value of corporate bonds in long and short term is bank loans for the private companies. One percent increase in private bank loans to business increases the corporate bond issues by 0.39 percent in the short term. However, the same scope of change in bank loans reduces the corporate bond issues by 0.31 percent in the long term. This effect must be regarded as an amortization of business loans effect on corporate bond market when the positive and negative change in value is approximately the same size. This is supported by market depth and elasticity analysis of corporate loans in the long and short terms at the opposite effect and the identical size: one percent increase in business loan portfolio increases the corporate bond market depth by 0.004 percent in the short term, but equally decreases (–0.004 per cent) in the long term.

Compared with other factors of influence, mobile penetration effects considered to be of the lowest impact to Lithuanian corporate bond market: one percent increase in the number of subscribers, causes 0.03 percent increase in the corporate bond issuance and 0.0003 percent increase in market depth indicator. It should be noted that the dissemination of mobile stands in a long-term impact on the corporate bond market.

To conclude, in the short term Lithuanian corporate bond market development is ensured by the legal and regulatory framework and bank loans to private entrepreneurs. The complementarity of the banking sector and the corporate bond markets is approved and the importance of legal framework and regulatory infrastructure possibly is linked to the emerging market phase. Meanwhile, the long-term negative impact of legal and regulatory framework and bank loans to the corporate bonds market could be diminished by a wider development of ICT.

## **Conclusions**

Factors influencing the development of corporate bond market could be summarized as *legal framework, state regulation and taxes, information and communication technologies (ICT), competition with bank loans*.

General conclusion of the multivariate complex analysis is formulated on US and Lithuanian models. It should be noted that the ICT factor displayed a stronger long-term impact on the developed corporate bond market, than in developing one. On the contrary, the legal and regulatory framework and mechanism and tax environment is more robust to the developing markets, regardless the period, which determines the direction of the impact being often conditioned by market participants' expectations, preferences or other psychosomatic effects. The short-term positive market reaction to changes in the legal framework can be changed in long-term negative ones because of tightened regulatory system or increase in the tax burden on the market participants' mood. Differential effects of the impact of the banking sector to the corporate bond market in emerging markets are influenced by the importance of greater market development than there is the developed markets' reaction to the change in bank loans which is one-way.

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