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Analysis of the effects of fiscal policy shocks in the Baltic region

Agata Szymańska
Institute of Economics, University of Lodz, Poland
agata.szymanska@uni.lodz.pl
ORCID 0000-0001-5184-931X

Abstract. The study aims to compare the effects of fiscal policy shocks in three Baltic countries – Estonia, Latvia, and Lithuania - within SVAR framework, using the identification scheme proposed by Blanchard and Perotti (2002). The time sample covers quarterly data over the period of 2002q1-2019q4. The main idea of the study is to identify the effects of fiscal policy shocks in three euro area member states under a single monetary policy of the European Central Bank, but with country-specific fiscal policy shaped by the European fiscal framework. The results show that, generally, in the short term (up to four quarters), output reacts consistently with the Keynesian view, emphasizing the importance of using discretionary fiscal policy tools in stimulating economic activity in the Baltic region. However, in Estonia and Latvia, the calculated impact multipliers for net taxes are larger than spending multipliers. Although each country reacts differently to its country-specific fiscal shock, the response to the euro area money market interest rate innovation is quite similar with respect to the direction of the effect, which may indicate the robustness of the Baltic region in terms of the euro area shocks. Thus, the results emphasize the importance of conducting domestic fiscal policy adapted to the conditions of each of the analysed economies. Based on the assumptions and the methodology used in this study, the obtained findings show the limited effects of spending on Baltic economies in comparison with the effects caused by the shocks in net taxes. Moreover, due to the lack of large-scale analysis regarding the effectiveness of fiscal policy in Baltic states, the obtained results are a valuable contribution to the debate about the 'appropriate' size of the fiscal multipliers for the Baltic region.

Keywords: fiscal multiplier, SVAR, money market shock, fiscal shock, social benefits, Estonia, Latvia, Lithuania.

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1. INTRODUCTION

Knowledge about the macroeconomic effects of fiscal policy has become more important in recent years. The increasing interest affects all countries regardless of their level of development or structural characteristics. One reason for this is the growing interest in evaluating the effects of fiscal adjustments, both austerity and stimulus, on the economies. The Great Recession was the first important reason for renewing the evaluation of the effects of using discretionary fiscal policy instruments in stimulating economic activity. Before the crisis, fiscal policy activism was not an object of special interest; most attention was paid to managing short-term fluctuations through monetary policy instruments. As a result, the pre-crisis fiscal policy was limited mainly to the use of automatic stabilizers. The Great Recession changed the role of fiscal policy to a large extent, mainly due to the problem of low interest rates (or zero-lower bound) and many other structural constraints influencing the ineffectiveness of conventional monetary policy.

The Baltic countries (Estonia, Latvia, Lithuania) joined the European Union in May 2004. After the financial and economic crisis (i.e., the Great Recession of 2008-2009), they became members of the euro area (Estonia in 2011, Latvia in 2014 and Lithuania in 2015). The specificity of the countries is that they are under a single monetary policy of the European Central Bank, but the fiscal policy can be conducted on the domestic level, albeit limited to some extent by the European fiscal framework. Moreover, the Great Recession affected the Baltic region and the effectiveness of their domestic stabilization policies. Thus, there is a need to identify the effectiveness of fiscal policy in the Baltic economies, especially since the literature review emphasizes the lack of sufficient existing analysis for these economies.

The large amount of available literature emphasizes that there are scarce studies related to the effects of fiscal policy shocks in the Baltic region. Estonia, Latvia, and Lithuania are examples of European Union countries that are euro area members, but there is a lack of detailed analyses for them. Despite these countries being among those that enlarged the EU in 2004 with seven other CEE countries, there are more studies analyzing the situation in the other 'new' EU countries than for the Baltic region.

As a result, the motivation for the study derives from the literature review. Firstly, as mentioned previously, there is a gap in the wider analysis of the effects of fiscal policy shocks in the Baltic countries. Even though the literature is rich for the euro area or CEE countries, it does not offer a more in-depth analysis for Baltic economies. There are a few studies that cover the Baltic region, but they offer analyses based on different approaches and time frames related to a few years after the Great Recession (e.g., Klyvienė & Karmelavičius 2012, who evaluated the effects of corporate taxation in Lithuania in the SVAR framework for the period 1997q2-2011q4; Stanova 2015, who focused on six CEE countries – Lithuania, Czechia, Hungary, Poland, Slovakia, and Slovenia over the period 1991q1-2013q4 within the SVARX framework; Combes et al. 2016, who dealt with computing output multipliers for Bulgaria, Croatia, Czechia, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia, and Slovenia over the period 1999q1-2013q3 within the panel vector error correction model). Secondly, the literature review is scarce in terms of providing calculations of fiscal multipliers for Baltic countries. Thirdly, the lack of analysis for these countries relates not only to evaluating the effects of fiscal shocks but also how they combine with monetary policy.

Considering the above, the aim of the study is threefold: to analyze the effects of fiscal policy shocks in the Baltic region, to provide calculations of fiscal multipliers, and to compare the results among three Baltic countries – Estonia, Latvia, and Lithuania. The paper contributes to the existing literature on the effects of fiscal policy by providing insights and comparing the effects of fiscal policy shocks on Baltic countries. The novelty is emphasized by the lack of estimates of fiscal multiplier for the three Baltic

countries with respect to the time sample or the exogenous variable i.e. the three-month money market interest rate for the euro area.

Consequently, the important value added of this study is that the paper offers a comparative analysis of fiscal multipliers in the Baltic region from the point of combining monetary and fiscal policy instruments on the basis of the time-sample including the Great Recession and the post-crisis period. As a result, the study evaluates the effectiveness of selected fiscal measures by the assessment of fiscal multipliers. It is a value added of the study, and an input into the debate about the 'appropriate' size of multipliers for the Baltic region. The inclusion of the shock in external variable – euro area money market interest rate – is relevant for the analysis of the behaviour of euro area member state and stands for the value added and novelty of this study.

The comparative analysis of the effects of government spending shock is based on the SVAR approach. The identification scheme follows the Blanchard and Perotti (2002) method, and a separate model is created and analyzed for each country. The time sample is based on the quarterly frequency and covers the period 2002q1-2019q4. The analyses of the dynamic responses are reinforced by calculating short-term fiscal multipliers (up to one year). As a result, a comparison of the strength and significance of the responses of the three Baltic countries to a domestic exogenous fiscal shock is offered in this study.

The structure of the paper is as follows. The second section provides the short literature review. In next section the methodology and data are presented. In the fourth section, the results for the baseline model with three endogenous variables are analyzed, and also it aims to provide robustness checks by extending the baseline model to one with five endogenous variables. The section includes also discussion of the results. The section also presents dynamic impulse-response functions and estimates of the fiscal multipliers. The last section provides conclusions and implications.

2. A BRIEF LITERATURE REVIEW ABOUT FISCAL MULTIPLIERS

The effects of fiscal policy may be analyzed using the concept of the fiscal multiplier. In the literature, the fiscal multiplier is usually defined as a ratio of a change in output (or another measure of the economic activity) to an exogenous change in the fiscal deficit with respect to their respective baselines (Spilimbergo et al. 2009, 2). The literature offers three main 'general' approaches to calculating fiscal multipliers: (i) the New Keynesian approach (e.g., Christiano et al. 2011; Eggertsson 2011; Woodford 2011), (ii) the different types of the VAR (vector autoregression) framework (e.g., Blanchard & Perotti 2002; Perotti 2005; Caldara & Kamps 2008, 2012, 2017; Mountford & Uhlig 2009); or (iii) the narrative approach (Mertens & Ravn 2012; Favero & Giavazzi 2012; Romer & Romer 2010; Ramey 2011, among others). However, the methods used affect the size of the multipliers. As argued by Gechert (2015), based on a meta-analysis, New Keynesian small-scale calibrated DSGE models, designed to recreate stylized facts such as the problem of zero lower bound, make it possible to obtain multipliers similar to those obtained in the VAR framework, but at the same time higher than the multipliers obtained in the large-scale DSGE models. Gechert and Will (2012) and Gechert (2015) emphasize that the size of the spending multiplier is usually around 1 and, on average, it is higher by about 0.3-0.4 than the multiplier calculated for taxes and transfers.

Despite the large number of studies on the subject, there is still a lack of consensus about the 'appropriate' size of multipliers. The literature review concludes that the size depends on many factors, including not only the approach used to evaluate the effects, but also many other factors, including the country being considered and its structural characteristics, the time sample, the phase of the business cycle, the impact of monetary policy, the instrument of fiscal policy used in the analysis (aggregated or disaggregated components of spending or revenues and its applied definitions), exchange rate regimes, and

many others (see, for example, Ilzetzki et al. 2013; Kraay 2014; Erceg & Lindé 2014; Eggertsson 2011; Hemming et al. 2002; Spilimbergo et al. 2009; Gechert 2015; Gechert & Rannenberg 2014; Goode, Liu & Nguyen 2021). The crisis and post-crisis evaluation of the effects of fiscal policy suggest that the size of the multiplier may depend on the phase of economic activity (Parker 2011; Blanchard & Leigh 2013; Berge, De Ridder & Pfajfar 2021). While in 'normal times', the spending multiplier is generally lower than 1, under special circumstances, especially in a recession, the size of the multiplier may be higher than 1 (e.g., Hall 2009; Christiano et al. 2011; Eggertsson 2011; Baum & Koester 2011; Afonso et al. 2018), which leads to the conclusion that the fiscal multiplier can be regime-dependent, and its size depends on the phase of the economic activity. The difference in the size of multipliers in a recession and in expansion is the result of studies provided by Aurebach and Gorodnichenko (2012), Cogan et al. (2010), Coenen et al. (2012), Baum and Koester (2011), or Erceg Lindé (2014), among others, and it is still a subject of many studies.

Recently, many studies have investigated the effects of fiscal policy shocks in the European Union and euro area countries. Fiscal policy shock effects for the euro area countries are analyzed using the New Keynesian models (Coenen & Straub 2005; Cwik & Wieland 2011) and mainly within the VAR frameworks (e.g., Giordano et al. 2007 for Italy; Afonso & Sousa 2011 for Portugal; Borg 2014 for Malta; Cavallo, Dallari, & Ribba 2018a, 2018b for selected euro area countries; Deleidi, Iafrate & Levrero 2021). The Central and Eastern European (CEE) countries that are non-euro area members of the European Union are analyzed mainly using VAR frameworks (e.g., Lendvai 2007 for Hungary; Mirdala 2009 for Czechia, Hungary, Poland, Slovakia, Bulgaria, and Romania; Baxa 2010 for Czechia; Haug, Jędrzejowicz & Sznajderska 2013 for Poland; Szymańska 2019 for Poland, Czechia, and Hungary; Crespo Cuaresma, Eller & Mehrotra 2011 for Czechia, Hungary, Poland, Slovakia, and Slovenia; Benčík 2014 for V4 countries; Grdović Gnip 2014, 2015 for Croatia; Mirdala & Kamenik 2017 for Slovakia, Czechia, and Hungary; Deskar-Škrbić & Šimović 2017 for, among others, Croatia and Slovenia, also including other Balkan country (Serbia); and Ravnik & Žilić 2011 and Ćorić et al. 2015 for Croatia).

3. METHODOLOGY

This section presents the methodology for fiscal VAR. As a distinctive feature, the applied approach incorporates three core variables: government spending, net taxes and GDP. The baseline model includes only the three variables, but in the next part of the study, the three-variable model is extended with inflation and the money market interest rate. In this study a separate model for each country is investigated. The use of a separate model, instead of a panel approach, allows for analysing the reaction of each country to fiscal shocks and interest rate shock.

3.1. Empirical approach

The empirical assessment of the effects of fiscal policy shock in Baltic economies is based on SVAR approach. The common SVAR approach requires a factorization of structural shocks. In this study, the identification of the fiscal shocks follows Blanchard and Perotti (2002) approach, who assumed that fiscal variables cannot react to changes in the macroeconomic background within the same quarter. The identification makes it possible to order structural shocks during the first quarter, after which the variables can behave without initial restrictions. This approach generally predicts a positive output response to a positive spending shock and a negative output response to a shock in taxes.

In order to analyze the effects of fiscal shocks, the following structural vector autoregression model is applied:

$$AX_t = \gamma D_t + \sum_{j=1}^{p} C_j X_{t-j} + Bv_t \quad (1)$$

where the reduced-form representation is given by:

$$X_t = \phi D_t + \sum_{j=1}^{p} \Gamma_j X_{t-j} + u_t \quad (2)$$

The above is a product of the following transformation:

$$A^{-1}AX_t = A^{-1}\gamma D_t + \sum_{j=1}^{p} A^{-1}C_j X_{t-j} + A^{-1}Bv_t \quad (3)$$

where X_t – the vector of endogenous variables, B, Γ_j, C_j, A, ϕ, γ are matrices of parameters, v_t is a vector of structural shocks and $v_t \sim N(0, BE(v_t v_t')B')$, p denotes the order of lags in the model, and D_t is a vector of deterministic variables, like constants or dummy variables. All variables are presented in quarterly frequency, which affects the identification scheme.

In order to identify the structural shocks, the AB representation was employed (Lütkepohl 2005). As presented in equations (2) - (3), the transformation gives the following relation:

$$Au_t = Bv_t \quad (4)$$

where u_t represents the reduced-form residuals, and v_t denotes the vector of structural shocks. The AB representation leads to identification. Taking into account the Blanchard and Perotti (2002) approach, the restrictions for each matrix were imposed on the parameters.

3.2. Data

All data came from the Eurostat database and were based on ESA2010. The frequency of data was quarterly. Blanchard and Perotti (2002) argue that employing quarterly data has many advantages in the identification scheme due to the assumption that the system cannot react to changes in the macroeconomic background within one quarter.

The fiscal data and GDP data were expressed in million units of national currency and presented in constant prices (deflated by the GDP deflator index 2010 = 100). The fiscal data covered the general government sector. The definition of spending follows Blanchard and Perotti (2002) - government spending consists of the sum of government consumption and government investments. In the baseline models, the net taxes were defined as te sum of: (i) taxes on production and imports, (ii) taxes on income and wealth, (iii) social contributions, and next, the sum is reduced by social benefits. In the case of the extended model, inflation (π_t) is represented by the difference of the natural logarithm of quarterly CPI (2010 = 100), and the data source of quarterly CPI is the IMF. The interest rate (i_t) is based on the three-month money market interest rate for the euro area. The decision to use this variable is based on the lack of data for Estonia's money market interest rate after 2010q4. However, the applied interest rate has some advantages – it makes it possible to analyze the response of the Baltic economies to the euro area interest rate shock.

As mentioned, all fiscal variables and GDP were deflated, then seasonally adjusted using the TRAMO/SEATS method, and finally presented in natural logarithms. As a result Y_t denotes natural logarithm of seasonally adjusted GDP in constant 2010 prices, G_t denotes natural logarithm of seasonally adjusted spending in constant 2010 prices, R_t denotes natural logarithm of seasonally adjusted net taxes in constant 2010 prices. The descriptive statistics for finally used variables are presented in Table A2 in the Appendix.

The time series for all data for Latvia and Lithuania are available for 1999q1-2020q3, while for Estonia, they are available for 2002q1-2020q3. Considering the goal of the study, the decision was made to

adjust the time samples, and, as a consequence, the models for each country were estimated on the same dataset, including period 2002q1-2019q4.

As mentioned, the net tax elasticities were calculated exogenously. In order to obtain these elasticities, the information about the partial elasticities of selected categories that involve the definition of net taxes applied in this study was used. This exogenous information was acquired from Price et al. (2014). Next, the components were weighted by: (i) the share of the appropriate category of revenues (the data with yearly frequency were derived from Eurostat) in the total sum of revenues that involves the net tax definition, and (ii) the share of the transfers (unemployment benefits) in the sum of total transfers that involve the next tax definition separately. The difference between the weighted partial elasticities for 'revenues' and 'transfers' defines the final average elasticity for each country. Using Price et al. (2014) as one source of exogenous elasticities makes it possible to ensure the similarity of calculations and helps to reduce the potential bias arising from different calculation methodologies. Considering the presented approach, the obtained values for the period 2002-2019 are as follows: approximately 2.4447 for Estonia, approx. 1.5074 for Latvia, and approx. 2.3506 for Lithuania.

Finally, the unit root test was used to analyze the variables. The results of the ADF test are presented in the Appendix. As shown, the variables are generally non-stationary in levels and contain a unit root but are stationary in first differences (see Table A1 in the Appendix). However, as argued, e.g., by Sims (1980) or Sims, Stock, and Watson (1990), the VAR model aims to determine the relationships between variables, not to determine the estimation of parameters. Canova (2007) points out that estimating the VAR model in levels is possible even if the unit root tests suggest the non-stationarity of the time series. In this context, the main argument is that the VAR focuses on the interrelationships among variables while the parameter estimation is not so important for dynamic analyses of the impulse-response functions. Thus, the decision was made to estimate models with variables in levels, as used by Grdovic Gnip (2014), for example.

4. EMPIRICAL RESULTS AND DISCUSSION

4.1. Baseline model with three variables

This section presents results for the baseline models – the impulse response functions and assessment of fiscal multipliers.

The baseline specification for each country is built upon three variables (Y_t, G_t, R_t). The vector of deterministic variables includes constant and dummy variables for the crisis. The decision about including the dummy variable for the crisis was based on the dynamics of the available data, especially data for real GDP growth rate. The dummy for the crisis was motivated by the observation of the behavior of the variables. In the case of the model for Estonia, it equals 1 over the period 2008q4-2010q1 and 0 otherwise; Lithuania – for the period 2008q4-2012q4; Latvia - it equals 1 for the period 2008q2-2010q4 and 0 otherwise.

The empirical analysis starts by analyzing the lag length criteria for each model. The applied test for lag length in the three baseline models (i.e., for each country) includes the Akaike information criterion (AIC), the Schwarz information criterion (SC), and the Hannan-Quinn information criterion (HQ). The results are shown in Table A3 in the Appendix. As presented, the results are not the same for each country. In the case of Estonia, the AIC suggests four lags, while SC and HQ suggest one lag. For Latvia, all three information criteria indicate the use of two lags. The AIC for Lithuania suggests six lags, while SC applies one lag and HQ three lags. Taking into account the analysis of the condition for stability of the model and additional analysis aimed at the properties of the autocorrelation LM test for residuals (based

on the variant of the lack of serial correlation at lag h), the decision was made to use four lags in the model for Estonia and Lithuania and two lags for Latvia. Using that number of lags ensures the stability of each model (see Table A5 in the Appendix) and makes it possible to conclude that the reduced-form specifications of each model at the chosen lag satisfy the absence of autocorrelation. Moreover, in the case of Latvia, the model with four lags is also analyzed to compare the results with models for Estonia and Lithuania, which were built on the use of four lags. It is valuable, because the number of lags potentially affects the size of multipliers, as emphasized by Čapek and Crespo Cuaresma (2018), among others.

The restrictions imposed on the A and B matrices, including the parameter for exogenously calculated elasticities of net taxes to output (as informed in the subsection Data), guarantee that the analyzed models are just-identified (see Lütkepohl 2005). It allows for impulse-response functions to be generated and leads to further analyses of the behavior of the Baltic economies.

The impulse-response function of the Y_t variable to structural one s.d. shock in government spending is presented in Figures below. The dashed lines represent the 2 s.e. band. The analysis is based on a three-year (12-quarter) horizon.

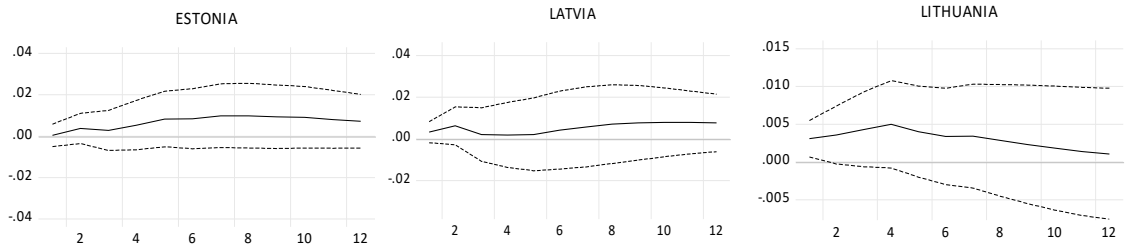

Figure 1. Impulse-response of Y_t to structural one s.d. shock (± 2 s.e. band) in government spending, baseline model, p=4 lags

Source: Own elaboration

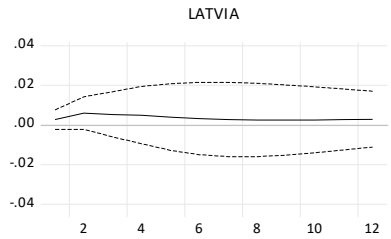

Figure 2. Impulse-response of Y_t to structural one s.d. shock (± 2 s.e. band) in G_t for Latvia, baseline model, p=2 lags

Source: Own elaboration

Figure 1 shows that, taking into account the model specification, the response of variable Y_t to a shock is positive, and in the case of Estonia and Lithuania, it generally expires over time. The positive reaction of output to a shock in government spending is in line with Keynesian theory. The use of four lags shows that the output response in Estonia and Latvia is not significant, whereas, in the case of Lithuania, the significant reaction (considering the ± 2 s.e. band) concerns only a very short run after the shock. The impulse-response functions imply that output in Lithuania reacts lower than in Estonia or Latvia. Furthermore, Lithuania exhibits the lowest persistence to the shock; as a result, the model for

Lithuania indicates that the maximum reaction of GDP to spending shock is less lagged in comparison to the response in Estonia and Latvia (in Lithuania it was in the fourth quarter, in Estonia in the seventh quarter, and in Latvia, in the tenth quarter).

When the use of two lags instead of four in the case of Latvia is applied, then the maximum response is placed earlier – in the second instead of the tenth quarter (compare Figure 1 and Figure 2).

The response of variable Y_t to the shock in net taxes is presented in Figure 3 and Figure 4.

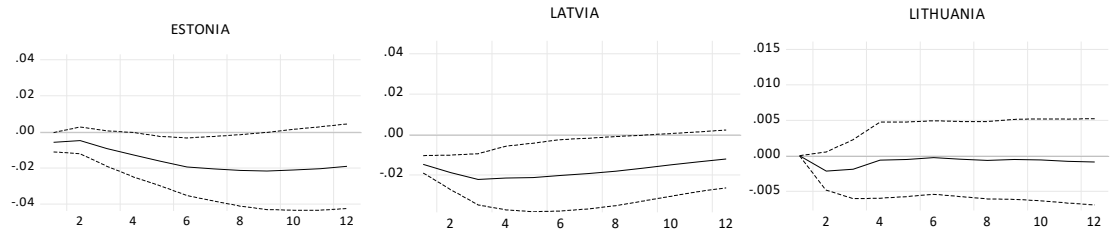

Figure 3. Impulse-response of Y_t to structural one s.d. shock (± 2 s.e. band) in net taxes, baseline model, p=4 lags

Source: Own elaboration

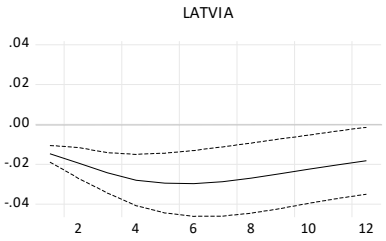

Figure 4. Impulse-response of Y_t to structural one s.d. shock (± 2 s.e. band) in net taxes for Latvia, baseline model, p=2 lags

Source: Own elaboration

The impulse-response functions show a negative reaction of variable Y_t to a structural shock in net taxes. The highest persistence of the shock on output over the 12-quarter horizon is observed in Estonia, where the maximum negative response occurred in the nineth quarter after the shock. Lithuania's response is not statistically significant considering the generated ± 2 s.e. band. When the model with two lags is analyzed for Latvia, the dynamic reaction of Y_t to net tax shock is similar, but the impulse-response function for a model with fewer lags exhibits the shift in time of the maximum negative reaction of output. Moreover, using two instead of four lags affects the significance of the impulse responses of Y_t to a shock. As presented, the model with two lags exhibits a significant response across almost the whole 12-quarter horizon.

4.1.1. Fiscal multipliers

The fiscal multipliers were calculated taking into account the dynamic analysis of the impulse-response of Y_t on the structural shock in government spending and the structural shock in net taxes. The fiscal multiplier inform about the change in GDP (or another indicator of economic activity) in certain period (*t+j*) ahead with respect to a given change of a fiscal variable at time *t*. Table 1 presents calculations for the peak multiplier, and multipliers in the first and fourth quarters after the shock. The presented multipliers are adjusted to be interpreted in % and in the euro currency.

Table 1

Fiscal multipliers for Baltic economies.

		spending multiplier	**net tax multiplier**	**spending multiplier**	**net tax multiplier**
		in %		in euro currency	
Estonia, p=4	peak	0.316 (7)	-0.523 (9)	1.416 (7)	-2.655 (9)
	I quarter	0.012	-0.138*	0.054	-0.702*
	IV quarter	0.171	-0.308	0.767	-1.563
Latvia, p=4	peak	0.167 (10)	-0.594 (3)*	0.780 (10)	-3.292 (3)*
	I quarter	0.067	-0.395*	0.315	-2.191*
	IV quarter	0.039	-0.577*	0.185	-3.200*
Lithuania, p=4	peak	0.170 (4)	-0.056 (2)	0.880 (4)	-0.350 (2)
	I quarter	0.105*	0.000	0.545*	0.000
	IV quarter	0.170	-0.016	0.880	-0.099
Latvia, p=2	peak	0.131 (2)	-0.807 (6)*	0.611 (2)	-4.472 (6)*
	I quarter	0.058	-0.401*	0.273	-2.222*
	IV quarter	0.107	-0.760*	0.498	-4.213*

The quarter with the peak response in parentheses; * denotes the significance of calculations considered within the ± 2 s.e. band; p denotes number of lags.

Source: Own elaboration

In the baseline specification with three endogenous variables, the net tax multipliers were generally higher (in absolute value) compared to the spending multipliers (except for Lithuania). The result may be affected by the definition of the net tax variable, which in this study is restricted only to the net effect of a sum of total inflows to the budget of the general government from direct taxes and indirect taxes and social security contributions, reduced by the general social transfers outflows. The definition of net tax may cause that the net tax variable affects output stronger than spending (while the spending definition is limited to spending on consumption and investment). The response may also be reflected in the high value of the exogenously determined net tax elasticities. The applied elasticity of net taxes is higher than one in Latvia, and higher than two in the case of Estonia and Lithuania. That values may also drive results, especially since elasticity of government spending is assumed to be zero. The use of two instead of four lags in the model for Latvia reduces the peak multiplier for government spending and increases the strength of the reaction in the case of net tax multiplier – it denotes that the model with fewer lags exhibits a weaker ability to stimulate the Latvian economy by spending.

Based on the relations adjusted to be interpreted as a percentage (i.e., to reduce the impact of the differences in the size of spending among countries), the results show that in Estonia the response of GDP to a structural spending shock after four quarters (i.e., one year) was the highest. The highest output effect (i.e., the peak multiplier) also concerns the Estonian economy over the whole horizon, but considering the generated error bands, the reaction of output to structural shock in Estonia was not significant. The calculated peak spending multipliers, within the model specification, were not significant in all countries. Moreover, except for the initial response of output to spending shock in Lithuania, generally, the spending multipliers in the Baltic economies were not significant considering the generated impulse-response functions and their error bands. At the same time, the peak net tax multiplier (interpreted as a % change) in models that incorporate four lags ranges from -0.056 in Lithuania to -0.594 in Latvia – the multiplier in Latvia was nearly ten times higher than multiplier in Lithuania. The computed absolute value of the peak net tax multiplier for Latvia was higher in the model with fewer lags.

Except for the model for Latvia with four lags, spending multipliers for the first quarter were generally lower than after the first year. Similarly, the absolute value of the net tax multiplier was also

higher after one year than those after one quarter. It is also observable in Latvia, regardless of the lags included in the model for the country.

4.2. Extended SVAR - model with five endogenous variables

The extended model includes two additional variables: inflation rate (π_t) and the three-month money market interest rates for the euro area (i_t). Due to the additional variables, matrix A of the residual coefficients requires additional restrictions. The inclusion of the inflation rate requires assumptions to be made about the price elasticities of government spending and net taxes. The literature was used to determine the values. Due to the lack of similar studies for Baltic economies, the literature for another group of 'new' EU countries was considered. Finally, the price elasticity of government spending was assumed to be 0.5 for each model, while the price elasticity of net tax was -0.5. The assumed values were derived from Crespo Cuaresma, Eller, and Mehrotra (2011), who used the same values for separate models for five CEE countries: Poland, Slovenia, Czechia, Slovakia, and Hungary.

As in the baseline model, in each specification, the vector of deterministic variables includes a dummy variable for the crisis. Moreover, the extension of the set of endogenous variables resulted in the deterministic trend also being included in the vector of deterministic variables. It is important in order to maintain the properties of the residuals. Furthermore, in the specification for Lithuania and Estonia, the additional dummy variable is implemented for the first quarter of 2009. This dummy variable ensures that the null hypothesis for serial correlation (based on the LM test) is not rejected for the p-value at the specified level of significance.

The lag length of each model was tested using a maximum of six lags. The results of the AIC, HQ, and SC criteria are presented in the Appendix (see Table A4). Due to the different number of indicated lags by the information criteria, an additional analysis was introduced to focus on the ability of the models with the employed number of lags to satisfy the conditions of stability and serial autocorrelation. As a result, the decision was made to use three lags in each model. The results for the stability test of the models with three lags are presented in Table A6 in the Appendix, while the results for the lag order selection criteria for the model with five endogenous variables are in Table A4 in the Appendix.

The responses of the system to shocks in government spending and net taxes are analyzed on the basis of the impulse-response functions (Figures 5-6). The impulse-response functions to money market interest rate shock are also presented (Figure 7).

The dynamic short-run impulse-response of Y_t to the shock in government spending is presented in Figure 5. Initially, the spending shock affects output positively in all countries. Taking into account the specification of each model, the most persistent effect of structural shock in spending on GDP is in Estonia – over the analyzed period, the response does not expire as fast as in the other two countries. The positive reaction of Y_t to a shock in spending in these countries is significant within the error band only in Lithuania, even 1.5 years after the shock. In Lithuania and Estonia, a positive innovation in spending affects net taxes positively, which is also consistent with the condition regarding balancing the budget – an increase in spending requires an increase in net taxes. In the case of Latvia (a slightly different set of deterministic variables in the specification, i.e. in the vector of deterministic variables), the initial response is the opposite. The imposed restrictions on the first quarter cause a negative but increasing response of R_t to a shock in spending (initially, the net taxes shock also causes the reduction in G_t – compare Figure 5 and Figure 6). In the case of Latvia, even if the response is different than in Lithuania and Estonia in the first quarters after the shock, the response seems to be consistent with balancing the budget. The response of prices is positive after three quarters in all countries, but, regardless of the country, the response expires over the analyzed horizon. The money market interest rate reacts positively to structural shock in the short term in Latvia and Lithuania, and it is significant within the generated $\pm$ 2 s.e. band in Lithuania.

The results of the effects of a shock in spending on the money market interest rate suggest that the strongest crowding-out effect in the short term was in Lithuania.

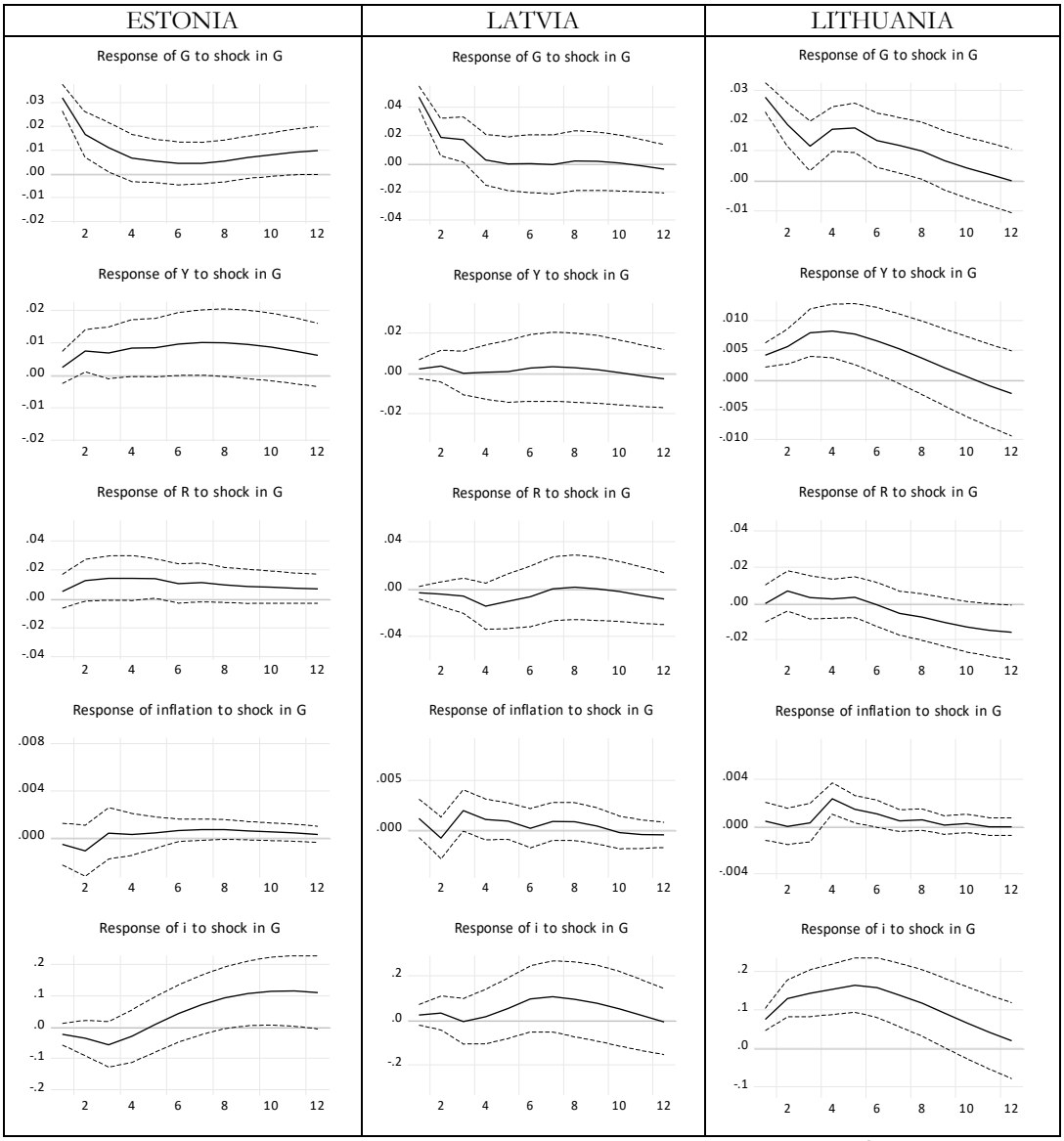

Figure 5. Impulse-response of the system to structural one s.d. shock (± 2 s.e. band) in government spending, p=3 lags

Source: Own elaboration

The responses of the analyzed systems to a shock in net taxes are presented in Figure 6. Generally, output reacts negatively. On impact, a significant reaction is observed in Estonia and Latvia. Commonly, in all countries, in the medium term, Y_t reacts insignificantly within the generated error band. The structural shock increases inflation on impact in Estonia and Latvia, whereas it negatively affects inflation in Lithuania. The impact of the shock on inflation expires faster in Estonia. The short-term impact of the innovation in net tax on the euro area money market interest rate is negative.

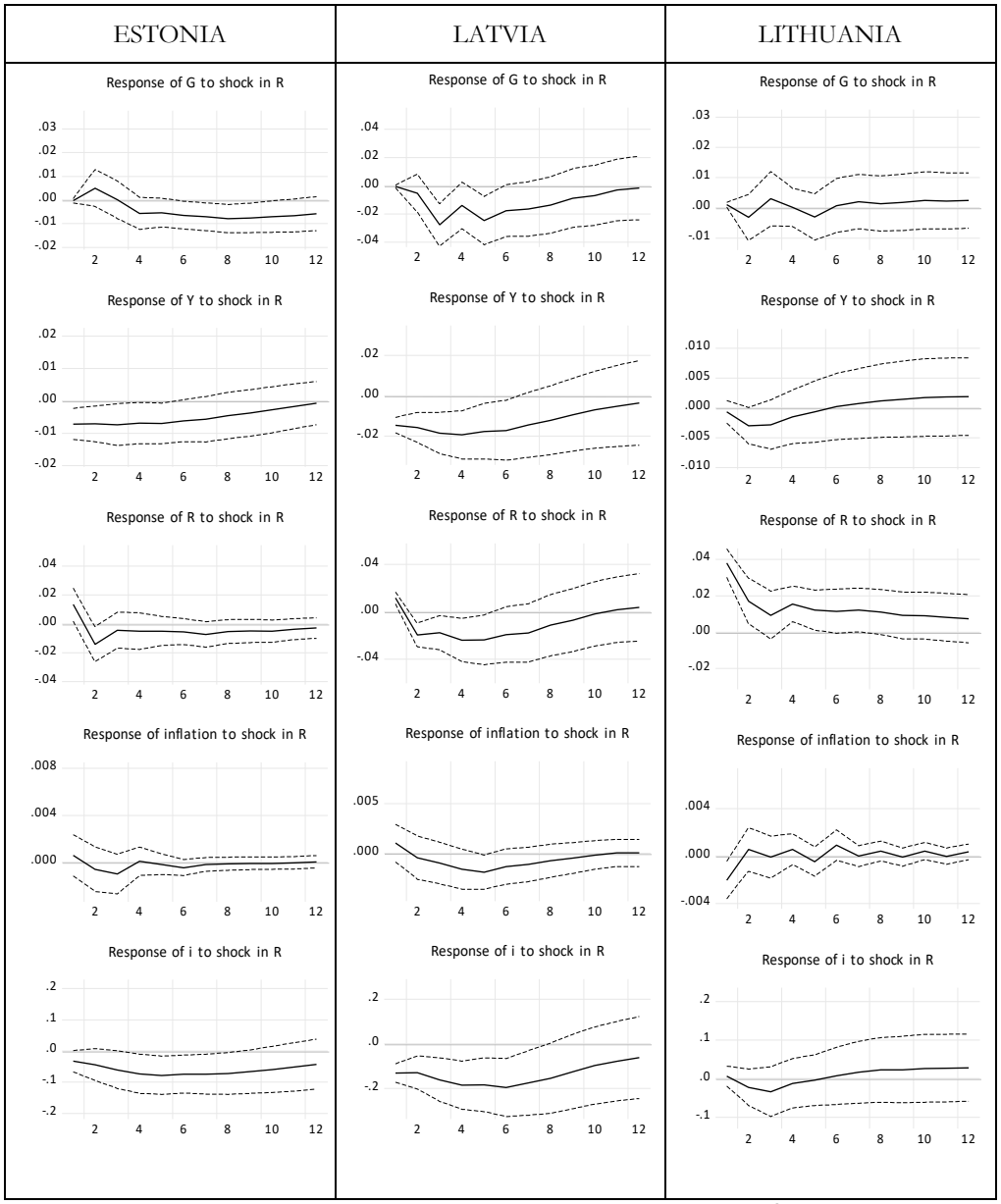

Figure 6. Impulse-response of the system to structural one s.d. shock (± 2 s.e. band) in net taxes, p=3 lags.

Source: Own elaboration

Interestingly, regardless of the differences observed in the reaction of the system to shocks in fiscal instruments, the response of the system to the euro area money market interest rate shock is rather similar. Figure 7 shows that the dynamics of the analyzed systems expresses similar paths of development. Generally, output reacts negatively to the shock; however, in Estonia and Lithuania, the negative reaction occurs with a few quarters delay. The reaction of inflation to the interest rate initially expresses the presence of the price puzzle (often observed in models with standard Cholesky identification), but generally, the positive response of inflation is not significant within the generated error bands. After one year, inflation reacts negatively in analysed countries, consistently with theory of interest rate policy.

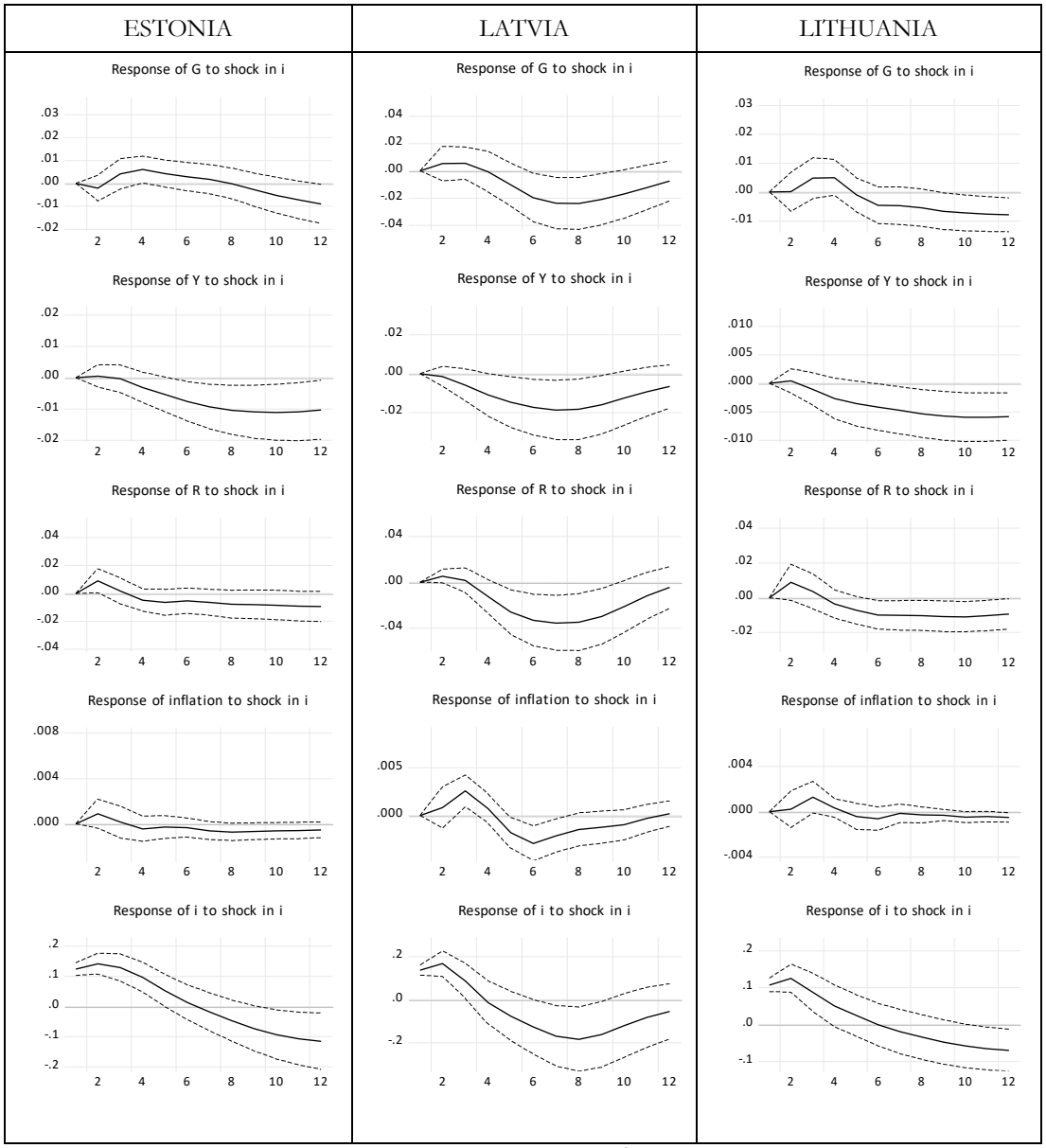

Figure 7. Impulse-response to structural one s.d. shock (± 2 s.e. band) in 3-month money market interest rate in the euro area, p=3 lags

Source: Own elaboration

Taking into account the model specification and all assumptions related to, among others, applied number of lags, elasticities, and the inclusion of deterministic variables, as well as the definitions of the variables used, the Baltic economies exhibit structural differences that are reflected by the dynamic impulse-response functions. The disparities mainly concern the responses to the domestic shocks in fiscal policy instruments, whereas the response to the shock in the euro area instrument is similar.

4.2.1. Fiscal multipliers in the extended model

Table 2 presents fiscal multipliers assessed within models with five variables. The absolute value of the calculated peak multipliers is higher for spending innovation than net tax shock in Estonia and Lithuania, but lower in Latvia. That relationship is also observed in impulse-response functions. The maximum effect of a net tax shock (measured by the peak multiplier) in these countries is observed

approximately in the second half of the first year after the shock. The highest negative net tax multiplier is obtained between the second quarter (Lithuania) and the fourth quarter (Latvia).

Table 2

Fiscal multipliers.

		spending multiplier	**net tax multiplier**	**spending multiplier**	**net tax multiplier**
		in %		**in euro**	
Estonia	peak	0.315 (7)	-0.241 (3)*	1.414 (7)	-1.223 (3)*
	I quarter	0.075	-0.233*	0.337	-1.182
	IV quarter	0.262	-0.224	1.177	-1.134
Latvia	peak	0.073 (2)	-0.585 (4)*	0.342 (2)	-3.238 (4)*
	I quarter	0.044	-0.439*	0.204	-2.432
	IV quarter	0.010	-0.584*	0.045	-3.238
Lithuania	peak	0.296 (4)*	-0.074 (2)*	1.533(4)*	-0.459 (2)*
	I quarter	0.150*	-0.017	0.778*	-0.106
	IV quarter	0.296*	-0.037	1.533*	-0.230

The quarter with the peak response in parentheses; * denotes the significance of calculations considered within the ± 2 s.e. band.

Source: Own elaboration

The peak spending multiplier occurs between the second quarter (Latvia) and the seventh quarter (Estonia). In Latvia, the peak spending multiplier is the lowest compared to the peak multipliers for Lithuania and Estonia, but the peak net tax multiplier is the highest. The significant spending peak multiplier is obtained for Lithuania. In the short term (upon to one year), the spending multipliers were significant also only in this country. The peak multipliers for net tax were significant for all countries. Net tax multipliers over the whole first year were significant only for Latvia.

4.3. DISCUSSION

Based on the applied specifications, time sample, and assumptions about elasticities, the results indicate differences between the Baltic countries in response to fiscal policy shocks. However, the reaction to the exogenous money market shock is similar. The conclusion is that the impulse-response functions built on the applied VAR systems are more vulnerable to country-specific fiscal shock than external euro area shock. This conclusion is supported by the observed dynamic reaction of these economies to shocks in fiscal instruments and the euro area money market interest rate.

Comparing the results for fiscal multipliers with the literature, there is a conclusion that the sizes of multipliers are similar to the calculations of the fiscal multipliers for the euro area countries. For example, the short-term cumulative output multiplier for spending calculated by Burrier et al. (2010) for the euro area as a whole is 0.75 after the first quarter and 0.87 after one year. In the case of net taxes, they obtained a multiplier whose value is -0.79 for the first quarter and -0.63 for the fourth quarter. Both categories of fiscal multipliers are significant over the four quarters. Afonso and Silva Leal (2018) analyzed fiscal multipliers in SVAR for 19 Eurozone countries with dummy variables related to their membership. In the baseline SVAR, they obtained an accumulated spending multiplier (based on primary expenditure) equal to 0.64 after four quarters and 1.10 after eight quarters. The multipliers for income and wealth taxes in the same baseline SVAR are -0.10 (fourth quarter) and -0.31 (eighth quarter), while the multiplier for production and imports taxes is -0.32 for the fourth quarter and -0.24 for the eighth quarter. The size of the impact multiplier for government spending in high debt euro area countries calculated by Cavallo, Dallari, and Ribba (2018b) is as follows: 0.3 in Greece, -0.2 in Ireland, 0.1 in Italy, 0.2 in the Netherlands,

0.1 in Portugal, and 0 in Spain. However, only the multiplier for Greece is significant. The 1-year multipliers occured statistically significant for Greece (1.1), Italy (0.8), the Netherlands (0.6), and Portugal (0.4), while the multipliers for Ireland (-1.3) and Spain (-0.1) are negative and not statistically significant.

The results obtained in this study for Baltic countries are similar to those presented by Combes et al. (2016), who used a PVECM model for a group of 11 CEE countries, including Estonia, Latvia, and Lithuania. In their study, the size of the impact spending multiplier for the whole sample of 11 countries ranges between 0.07 and 0.09, depending on the method. When calculating country-specific multipliers, their impact multiplier in the standard model for Estonia is 0.1, approximately 0.2 for Lithuania – regardless of the estimator used, while in Latvia the size depends on the estimation method and it is 0.03 in the PMG estimator (and not significant) and 0.11 in the MG estimator (significant).

The findings obtained in this study show the limited effects of spending on Baltic economies in comparison with the effects involved by the shock in net taxes. The impact multiplier for spending is quite low, but to some extent, consistent with those presented in the literature. Thus, regardless of the method employed, it seems that the results are quite robust. The findings show that the spending multiplier is generally lower than net tax multiplier. However, the result is inconsistent with e.g. the result obtained by Deleidi (2022) for Italy, who states that public spending, especially public investments, are able to generate high multiplier effect.

One possible explanation of the results obtained in this study is the applied definition of net tax variable - it consists of taxes that are strongly dependent on the economic activity and, as a result, may drive higher effects on the economy than those caused by spending innovations. As a consequence, the output may react stronger to net tax innovations. On the other hand, the results may be affected by the net tax elasticities calculated exogenously or price elasticities taken from the literature.

The result may be influenced by other factors that restrict the study. A potential limitation of the study is data availability. The estimates of multipliers and the dynamic responses are based on a sample covering only 72 quarterly observations for each country. The length of the time series can affect the results, especially since the period covers the Great Recession and the post-crisis recovery. On the other hand, due to the lack of data for country-specific money market interest rates, the study uses the three-month money market interest rate for the euro area. Indeed, such an assumption makes it possible to analyze the response of the Baltic economies to an external euro area shock, but it also limits country-specific analysis related to the structural determinants of the economies. An important limitation is related to the assumption about the elasticity of net taxes. The parameters are not calculated endogenously but are partially based on external information. A final limitation that affects the results may be related to the price elasticities, which are completely exogenous. They are based on a literature review provided for other countries due to a lack of similar estimates for Estonia, Lithuania, and Latvia.

The results contribute to the literature. As presented in the Introduction, there is increasing interest in the importance of fiscal policy, especially in recent years due to many external shocks that affect European economies. The latest two crises from the beginning of the 21st century (the Great Recession and the crisis caused by the COVID-19 pandemic) are an important challenge for the role of fiscal policy adjustments, and they call for a renewal of the Keynesian approach to discretionary policy. Thus, the future analysis, based on an extended time sample covering the COVID-19 pandemic will be valuable. The inclusion of the years 2020-2022 may allow for a comparison of the effects of fiscal shocks in the economic crisis in 2009 with the results obtained for the crisis involved by pandemic in 2020.

The role of fiscal policy is especially emphasized in the context of the single currency area. The limitations of the free use of the interest rate policy mean that economies should concentrate all their efforts on domestic activism, including fiscal policy. Even if the application of fiscal policy is limited by the European fiscal frameworks and fiscal governance, it may be an effective tool to stimulate economic

activity. The presented results suggest that small Baltic countries respond to the euro area shock in similar ways, and it is important from the point of view of their membership of the euro currency area. The countries react in quite a symmetric way to money market shock, although the response to domestic innovations differs, which may result from structural differences within the countries. The result emphasizes the importance of conducting more specific fiscal policy, adjusted to the economic conditions of each analysed economy. The recognition of structural differences is also very important.

5. CONCLUSION

The paper analyzed and compared the effects of fiscal policy shocks in three Baltic countries – Estonia, Latvia, and Lithuania. The study was based on SVAR framework with Blanchard and Perotti's (2002) identification scheme, and it used quarterly data over the period 2002q1-2019q4. The estimates were performed on the country-specific level. The approach was divided into two separate analyses. The first applied a three-variable SVAR (GDP, government spending, and net taxes) and evaluated the effects of fiscal policy shocks on GDP. Generally, the size of the obtained net tax multipliers and spending multipliers (both interpreted as a % change) were low, not higher than 1, and in most cases, not significant in the generated error bands. The peak multipliers, except for Lithuania, were higher for revenue shocks than spending shocks. The response of output to net tax shock (up to one year) was rather significant in error bands, in contrast to the response to spending innovation.

The baseline model was extended with two additional variables: the domestic inflation rate and the three-month money market interest rate for the euro area. In the extended system, the calculated peak multipliers for spending were slightly lower (except for Lithuania), while for net taxes, they were lower than in the three-variable models. The calculated peak spending multipliers (interpreted in euro) ranged between 0.8 and 1.4 in the three-variable model and 0.3 to 1.5 when the extended VAR was applied. The results for net tax were between -0.3 and -3.3, and -0.5 and -3.2, respectively. The estimated models indicated that the responsiveness of the output to the net tax shock was generally higher.

Summing up, the applied methodology yields the following results. Firstly, the output response to government spending was positive in the short term, but the multipliers differed among countries. Secondly, the response of GDP to net tax shock was negative, consistent with the stylized facts for the SVAR models, but the calculated multipliers were higher than in the case of government spending shocks. Moreover, although the model included three or five variables, the peak net tax multipliers in Estonia and Latvia were larger than 1 and, at the same time, they were larger than the spending multipliers. It may indicate that net taxes in Baltic countries may be more effective than spending in stimulating economic activity. Although the countries reacted differently to country-specific fiscal shocks, the response of the system to the euro area money market interest rate innovation was similar with respect to the direction of the reaction, and it may indicate the robustness of the Baltic region to external shocks. This result may be perceived as important in the context of the sensitivity of the Baltic region to shocks in the euro area.

The above results contribute to the literature and are valuable in the context of the continuing discussion on the size of fiscal multipliers. The peak multipliers for spending correspond to the findings in the literature, but the peak multipliers for net tax were higher than 1. In the context of the results, the extended analysis of the endogenous calculations of net tax elasticities and price elasticities of spending and revenues may be a valuable extension of this study and made it possible to check the robustness of the results. Thus, the results and limitations of the study may stimulate and indicate an area for further research.

Considering the above, the study contributes to the debate about the 'appropriate' size of fiscal multipliers by providing the calculations for the Baltic region.

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APPENDIX

Table A1

Unit root test for variables, p-values in brackets

		Estonia	Latvia	Lithuania	Estonia	Latvia	Lithuania
		regression with trend and constant			regression with constant, without trend		
ADF	G_t	-1.803435 (0.6932)	-2.065065 (0.5562)	-1.773008 (0.7079)	-0.713790 (0.8363)	-1.689977 (0.4321)	-1.62362 (0.4656)
	R_t	-2.812739 (0.1976)	-3.381000 (0.0620)	-1.576746 (0.7928)	-1.797870 (0.3789)	-2.960087 (0.0436)	-1.803371 (0.3762)
	Y_t	-3.410864 (0.0580)	-3.250875 (0.0830)	-2.76066 (0.2165)	-1.631939 0.4612)	-2.49403 (0.1211)	-1.87174 (0.3437)
	π_t	-5.116350 (0.0004)	-3.646924 (0. 0329)	-2.777476 (0.2104)	-4.974284 (0.0001)	-2.981522 (0.0416)	-2.649433 (0.0882)
	i_t	-3.083511 (0.1180)	-3.083511 (0.1180)	-3.083511 (0.1180)	-1.842748 (0.3573)	-1.84274 (0.3573)	-1.84274 (0.3573)
ADF	ΔG_t	-8.057359 (0.0000)	-9.874514 (0.0000)	-7.975506 (0.0000)	-8.118132 (0.0000)	-9.90321 (0.0000)	-8.003397 (0.0000)
	ΔR_t	-10.83032 (0.0000)	-4.512029 (0.0028)	-7.435233 (0.0000)	-10.88705 (0.0001)	-4.547261 (0.0004)	-7.439282 (0.0000)
	ΔY_t	-3.563741 (0.0402)	-4.221668 (0.0068)	-5.769456 (0.0000)	-3.557841 (0.0091)	-4.288954 (0.0010)	-5.726193 (0.0000)
	$\Delta \pi_t$	-9.312662 (0.0000)	-5.157701 (0.0004)	-9.601667 (0.0000)	-9.364416 (0.0000)	-5.175646 (0.0000)	-9.596367 (0.0000)
	Δi_t	-4.362561 (0.0045)	-4.362561 (0.0045)	-4.362561 (0.0045)	-4.391071 (0.0007)	-4.391071 (0.0007)	-4.391071 (0.0007)

Table A2

Descriptive statistics of finally used variables. N=72 observations

	G_t	Y_t	R_t	π_t	i_t
ESTONIA					
Mean	6.831638	8.335109	6.702455	0.007234	1.321733
Median	6.870803	8.348817	6.702736	0.007671	0.870000
Maximum	7.254433	8.662163	7.040960	0.035839	4.980000
Minimum	6.415582	7.846053	6.309000	-0.012406	-0.470000
Std. Dev.	0.229587	0.205417	0.201663	0.009464	1.612873
LATVIA					
Mean	7.032552	8.579488	6.861348	0.008652	1.321733
Median	7.042242	8.602477	6.921172	0.009237	0.870000
Maximum	7.377032	8.828068	7.252577	0.050715	4.980000
Minimum	6.612887	8.312101	6.321574	-0.019063	-0.470000
Std. Dev.	0.184744	0.159135	0.245206	0.012823	1.612873
LITHUANIA					
Mean	7.294747	8.954914	7.110535	0.006061	1.321733
Median	7.332389	8.988425	7.143993	0.005465	0.870000
Maximum	7.586621	9.243080	7.452400	0.033568	4.980000
Minimum	6.904308	8.464989	6.651049	-0.016967	-0.470000
Std. Dev.	0.169325	0.196551	0.233247	0.009892	1.612873

Table A3

Lag length criteria for the specification with three endogenous variables

	lag	0	1	2	3	4
ESTONIA	AIC	-6.517	-11.853	-11.730	-11.792	-11.910*
	SC	-6.322	-11.363*	-10.947	-10.714	-10.539
	HQ	-6.440	-11.659*	-11.420	-11.365	-11.3669
LATVIA	AIC	-6.474	-10.887	-12.446*	-12.288	-12.220
	SC	-6.275	-10.389	-11.650*	-11.193	-10.826
	HQ	-6.395	-10.690	-12.132*	-11.855	-11.669
LITHUANIA	AIC#	-5.108	-13.317	-13.475	-13.877	-13.812
	SC	-4.809	-12.720*	-12.579	-12.6837	-12.319
	HQ	-4.990	-13.081	-13.121	-13.405*	-13.222

AIC# - criterion indicates 6 lags

*denotes the lag order selected by the criterion, AIC - Akaike information criterion, SC - Schwarz information criterion, HQ - Hannan-Quinn information criterion

Table A4

Lag length criteria for the specification with five endogenous variables

	lag	0	1	2	3	4	5	6
ESTONIA	AIC	-13.923	-20.216	-20.303	-20.415	-20.597	-20.673	-22.255*
	SC	-13.260	-18.723*	-17.980	-17.264	-16.616	-15.862	-16.615
	HQ	-13.661	-19.626	-19.385	-19.170	-19.024	-18.772	-20.026*
LATVIA	AIC	-12.895	-18.217	-20.191	-20.063	-20.123	-20.631	-21.216*
	SC	-12.397	-16.890	-18.035*	-17.077	-16.307	-15.987	-15.742
	HQ	-12.698	-17.693	-19.339*	-18.883	-18.615	-18.796	-19.053
LITHUANIA	AIC	-14.245	-21.412	-22.030	-22.547	-22.463	-22.742	-22.780*
	SC	-13.582	-19.919*	-19.707	-19.395	-18.482	-17.932	-17.140
	HQ	-13.983	-20.822	-21.112	-21.302*	-20.890	-20.841	-20.552

*denotes the lag order selected by the criterion, AIC - Akaike information criterion, SC - Schwarz information criterion, HQ - Hannan-Quinn information criterion

Table A5

Stability condition – roots of the characteristic polynomial, specification with three endogenous variables

Estonia	Latvia		Lithuania
p=4	p=4	p=2	p=4
0.963656	0.940403	0.950455	0.956715
0.858007	0.826235	0.808110	0.925768
0.858007	0.826235	0.808110	0.925768
0.798937	0.624388	0.635010	0.704978
0.798937	0.624388	0.377327	0.704978
0.712286	0.578042	0.377327	0.679274
0.712286	0.578042		0.679274
0.705862	0.509541		0.626050
0.705862	0.431586		0.547871
0.654175	0.431586		0.452908
0.650098	0.386342		0.452908
0.650098	0.386342		0.170315

Table A6

Stability condition – roots of the characteristic polynomial, specification with five endogenous variables, p=3 lags

Estonia	Latvia	Lithuania
0.965800	0.888494	0.937060
0.965800	0.888494	0.937060
0.769860	0.884321	0.850567
0.769860	0.884321	0.820010
0.666971	0.768124	0.642486
0.666971	0.768124	0.642486
0.661283	0.691818	0.641947
0.661283	0.677889	0.641947
0.592075	0.677889	0.626079
0.482955	0.601328	0.626079
0.482955	0.601328	0.552988
0.420681	0.452298	0.552988
0.420681	0.452298	0.440149
0.345096	0.272749	0.376907
0.345096	0.034572	0.376907