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Fiscal adjustments: lessons from and for the Baltic states

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ABSTRACT

This paper aims to investigate the effects of various fiscal policy measures for small and open economies by analysing the implications of fiscal shocks in the Baltic countries based on data for the period from 1995 to 2018. For this purpose, we have chosen structural VAR estimation methods following Blanchard, O., & Perotti, R. (2002). An Empirical Characterization of the Dynamic Effects of Changes in Government Spending and Taxes on Output. *The Quarterly Journal of Economics*, 117(4), 1329–1368, approach and relied on local projections for robustness checks. We find that the impact on growth of direct taxes, government consumption and public investment is strong and persistent in the analysed cases. Although the responses of FDI to fiscal shocks are less consistent as compared to output, in most cases, we get strong and persistent negative reactions in FDI to increasing tax burden.

1. Introduction

The choice of policies to respond to an economic crisis depends on different factors, with the exchange rate regime, size and openness of the economy being among the most important ones. The toolbox for small and export-orientated countries with a hard peg, as the Baltic states were in 2008, relies on fiscal policy, which can help smooth volatility of economic activity through automatic stabilizers or discretionary policy actions (Mohl et al., 2019).

In 2009, Estonia, Latvia and Lithuania experienced a sudden stop of capital inflow with the banks abruptly cutting down on lending, which caused a sharp drop in domestic demand. This consequently led to notable fiscal consolidation in order to adjust to the different economic reality. Previously, the economies of the Baltic states had already been challenged by the Russian financial crisis of 1998. During these two crisis periods, all three countries reacted in a similar way, i.e. by implementing procyclical fiscal conso-lidation. Expenditure cuts, mostly to wages and public investment, were the immediate policy choice, especially during the global financial crisis. In addition, the Baltic states also increased taxes, primarily in 2009 and 2010, and tax measures that targeted an

increase in indirect and property taxes helped Latvia and Lithuania mitigate a drop in government revenues. In the case of Estonia, the greatest positive impact on revenues stemmed from non-tax income, i.e. dividends from public enterprises. In addition, it should be noted that Estonia's situation was somewhat better due to a previously secured fiscal buffer. Overall, the measures taken by the Baltic states concerned both government revenue and expenditure, though the composition of the adjustments differed only slightly.

One way to evaluate the effectiveness of fiscal measures is through the assessment of fiscal multipliers that measure the impact of changes in fiscal variables on output. There is a lack of literature on fiscal multipliers in the Baltic States not to mention quantitative assessment of responses of other macro variables foreign to fiscal shocks. Our analysis therefore aims to address this by estimating fiscal multipliers of the most important taxes and government expenditure groups as well as modelling the behaviour of foreign direct investment and interest rates in the Baltic states. The inclusion of external variables such as foreign direct investment and interest rates is particular relevant for small open economies such as the Baltic states as they display high vulnerability to external shocks and volatile financial market sentiment.

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The estimation of direct and indirect tax multipliers serves as an important benchmark for fiscal policy implementation. In order to spur growth and job creation in the EU after the 2008 economic and financial crisis, the European Commission promoted structural reforms based on reducing the tax burden on the labour force. A heavy reliance on labour taxation can reduce both labour supply and demand therefore dampening economic recovery. In this context, a reduction or shift from labour taxes to indirect or environmental taxes can be considered as a lesser distortion to economic growth. This is also true more than a decade later during economic recession linked to the COVID-19 pandemic.

Following the outbreak of COVID-19, the Baltic states and the EU used different approaches as compared to the global financial crisis. Various fiscal measures have been put forward to cushion economies and all countries plan to increase transfers to households, maintain public sector consumption at pre-pandemic levels and increase public investment through the support of EU funds. The literature on the effect of public investment on output varies depending on country, time and estimation methods. From theoretical point of view, the increased public investment may generate a multiplier effect on output through creating indirect positive externalities (the 'crowding-in' effect). However, it might also lead to an increase in the cost of private capital and potentially depress private investment leading to a 'crowding-out' effect. Therefore, it is important to consider the impact of fiscal measures on aggregate demand (especially

when the country in question seeks to recover from the COVID-19 crisis) and on countries' development goals in general.

For our estimates, we use the structural vector auto-regression models (SVAR) proposed by Blanchard and Perotti (2002). Additionally, we run robustness checks by applying the local projection methodology (Jordà, 2005) to support the reliability of our conclusions. A few of the main findings of this research are linked to the importance of disposable income in the fiscal policy transmission. To be more precise, an increase in direct taxes has had a significant negative effect on growth in all three countries, while the results for indirect taxes are less consistent. In addition, in Lithuania and Estonia, the reaction of output to an increase in government consumption, of which the main part is public sector wages, is strong and positive, which is in line with the results of other empirical studies. At the same time, reductions in government investment would be the least preferable option as they have a strong and persistent positive impact on growth. However, some authors argue that output gains also depend on the effectiveness of public investment (De Jong et al., 2017).

Based on the research results, we conclude that, overall, fiscal adjustment based on indirect taxes rather than direct taxes would have a more limited negative impact on growth as increases in corporate income taxation could inhibit investment. At the same time, weaker negative effects of indirect taxes in the Baltic states could be justified by relatively inelastic consumption patterns in the region. This phenomenon has also been observed in Portugal (Bova & Klyvienė, 2020). Furthermore, according to our model, in all three Baltic economies a significant negative reaction of FDI to higher taxes did not reverse over the analysed period. Concerning a government spending shock, for Lithuania and Latvia, model responses capture the importance of the supply side channel, namely through public investment, whose increase could facilitate inflows of FDI. Our analysis also finds that in most cases interest rate reactions to fiscal policy shocks remain inconclusive and insignificant.

The remainder of the paper is organized as follows. Section 2 provides a review of the literature, including studies on the Baltic states. Methodology and references to the data are presented in Sections 3 and 4. Section 5 outlines the results and is followed by conclusions.

2. A short literature review

Different literature sources state that the fiscal policy effects depend on a number of factors such as: (1) the composition of fiscal measures (Alesina & Perotti, 1996); (2) the initial stance of public finances (Alesina & Perotti, 1996); (3) the macroeconomic environment (Hebous, 2011); (4) the monetary and exchange rate policy (Combes et al., 2016; Perotti, 2002); (5) openness of the economy (Combes et al., 2016; Riguzzi & Wegmueller, 2017); (6) access to foreign capital market (Sin, 2016).

Combes et al. (2016) found that fiscal multipliers are strongly sensitive to country characteristics. By applying the Panel Vector Error Correction (PVEC) model for Central and Eastern European countries, they found significant multipliers in countries with a fixed exchange rate regime; relatively lower income levels, low public debt to GDP ratios, and a relatively less open economy. Some authors (Corsetti et al., 2010) who analysed the effects of fiscal consolidation and macroeconomic stabilization effects argue

that, if countries are also dependent on the financial markets and sensitive to external fluctuations, their capabilities to stimulate the economy during a recession can be very limited. In the case of Italy, Giordano et al. (2007) used the SVAR (structural vector auto-regressive) model to confirm that a shock from government purchases of goods and services has a sizeable and robust effect on economic activity and increases private output by 0.6% after three quarters. The effects of positive fiscal shocks, i.e. an increase in government spending and/or tax cuts, on employment, private consumption and investment are also positive. In the case of the German economy, Heppke-Falk et al. (2016) found that, based on SVAR, effects of increases in expenditure on output are only short-lived and the government expenditure multiplier is smaller than 1. At the same time, the previously mentioned authors concluded that raising direct taxes lowered output significantly whereas persistent indirect tax shocks had little effect on growth in Germany.

One of the recent discussion papers by the European Commission also pointed out the importance of the relationship between tax efficiency and inclusive growth at the EU level (Kalyva et al., 2018). Overall, their recommendation was to avoid excessively high marginal direct tax rates, which could trigger behavioural reactions leading to economic distortions. It was also agreed that the possible design of the labour taxation system should be viewed in the broader context of a tax-transfers system and in light of the specifics of the country. Some studies have also confirmed that the composition of the expenditure-based adjustment also matters. Empirical study by Afonso and Aubyn (2008) confirmed that higher public investment increases labour productivity, technological progress and competitiveness in the economy. Deleidi et al. (2020), using the local projections method, found that public investment multipliers tend to be larger than 1 as public investment creates a permanent and persistent effect output. This was in line with the European Commission approach and the conclusions by Bom and Ligthart (2014) who advocates for public investments – especially in infrastructure – as one of the main policy instrument supporting economic growth (European Commission, 2014).

The issues of fiscal policy effects on FDI are also remaining items of controversies. This stems from the fact that a number of other factors, not related the tax burden might play a more important role in FDI location. However, there is some empirical evidence that tax policy has an effect on FDI. According to Bénassy-Quéré et al. (2005), high corporate taxation does impede the inflow of FDI, even after the researchers controlled for the other factors such a market potential. The VAR model-based analysis of the Australian economy confirmed that a reduction in capital taxes significantly benefits FDI performance particularly in the long-term perspective (Wijeweera & Mounter, 2007). Egger and Radulescu (2011) found that an increase in employee-related labour taxes had a significantly negative effect on FDI, while the effect of the employer's part was insignificant. Hansson and Olofsdotter (2014) discovered that, in the case of the 27 EU member countries, labour taxes had a negative impact on FDI of almost the same magnitude as corporate income tax.

The literature on the impact of fiscal policy on interest rates is not as extensive as on growth multipliers. The theory states that an increase in the deficit could lead to an increase or decrease in the interest rate. In those cases when deficits and interest rates are moving in the same direction, it is more often argued that loosening of the fiscal stance can worsen market sentiment and, therefore, cause the departure of investors from the sovereign bond market. A sharp spike in spreads in the euro area illustrated

this during the peak of the economic and financial crisis (Krugman, 2012). Laubach (2011) found that there is a clear link between time variation in risk aversion and the sensitivity of EMU government bond spreads to the fiscal position of individual countries, but this non-linear effect is difficult to capture by standard models. When the deficit and the interest rates move in opposite directions, the theory would interpret this as a contemporaneous change in fiscal and monetary policies and not as the impact of changes in the deficit on interest rates (Perotti, 2002).

The effects of fiscal policy on macroeconomic variables in the Baltic States has been examined in a rather fragmented manner. Klyvienė and Karmelavičius (2012), by implementing the SVAR approach for the period 1996–2012, obtained that in Lithuania increases in taxes have a negative impact on GDP, employment and FDI. It was also found that the dynamics of FDI in Lithuania are very sensitive not only to the internal tax policy changes but also to the neighbouring countries. Borys et al. (2014), by using panel data techniques in the case of new Members States, including Baltic states, over the period 1995–2011, found that investment and export growth would increase after fiscal consolidation and decelerate after expenditure-based fiscal expansion. However, a study by Combes et al. (2016) found a negative expenditure multiplier only in the case of in Latvia, while positive but small (around 0.3) in Estonia and Lithuania. Kilponen et al. (2019) with the general equilibrium (CGE) model also confirmed that in Estonia, a reduction in government consumption has a negative effect on real GDP and the spending multiplier varies between 0.7 and 1.0, depending on assumptions. On the revenue side, the authors found a strong, negative multiplier for direct taxes, and a negligible or even positive one of indirect taxes. However, one of the most recent studies by Ianc and Turcu (2020) using a Panel VAR estimated that, on average, the so-called new EMU countries, which include the three Baltic states, have a small negative expenditure multiplier while results for tax multipliers were inconclusive. Although some of the empirical results for the Baltic states presented in this section show some similarities in the fiscal policy transmission mechanism, the magnitude and even the sign of fiscal multipliers is model-dependent.

3. Methodology

The empirical approaches to analyse the fiscal policy transmission mechanism can be vary significantly. Models can take forms such as Bayesian structural VARs, structural vector error-correction models, dynamic stochastic general equilibrium models and various SVARs. Therefore, the results obtained are quite diverse. Despite some limitations, Blanchard and Perotti (2002) have created a breakthrough modelling technique and many empirical publications have filled the gap in the literature using this method. Therefore, we use structural VAR (SVAR) estimation methods and impose some restrictions based on Blanchard and Perotti's (2002) approach.

The standard SVAR model takes this form:

$$AX_t = A\Gamma_0 + \sum_{i=1}^{p} A\Gamma_i X_{t-i} + AU_t \tag{1}$$

where A is a k dimensional matrix of the underlying structural coefficients and X_t is a 6×1 vector of endogenous variables: GDP, short term interest rate, foreign direct investment,

revenue of direct taxes, revenue of indirect taxes and government spending $\left(Y_t \quad E_t \quad I_t \quad T1_t \quad T2_t \quad G_t \right)'$; Γ_0 is a 6×1 vector of constants; Γ_i is a 6×6 matrix of parameters; B is a six-dimensional matrix of structural shock coefficients and Ψ_t is a six-dimensional vector of structural shocks $\left(\varepsilon_t^Y \quad \varepsilon_t^E \quad \varepsilon_t^I \quad \varepsilon_t^{T1} \quad \varepsilon_t^{T2} \quad \varepsilon_t^G \right)'$. The identification strategy of this structural VAR (SVAR) is based on the Blanchard-Perotti method (2002), according to which fiscal shocks are identified by imposing contemporaneous restrictions on the U_t vector in order to derive a vector of 'structural' fiscal shocks, orthogonal to each other and to the other, non-fiscal, shocks of the model. Such identification procedure allows separating the reaction related to automatic stabilizers, which would usually have a simultaneous change to output, and the other related to discretionary fiscal policy changes. Therefore, we use the so-called AB-model where a linear relation is assumed to hold between the reduced form residuals and the structural shocks:

$$AU_t = B\Psi_t, \tag{2}$$

According to the Blanchard-Perotti approach, the estimation procedure of the SVAR model is divided into four steps: (1) the estimation of the unrestricted VAR, (2) the identification of the reduced form, (3) the ordering of the variables, and (4) the estimation of the parameters. The estimation of the unrestricted VAR takes the form of six equations estimated using a simple OLS. In the second step, the reduced form innovations of every fiscal variable are expressed as linear combinations of the three types of shocks: (a) the automatic response of the fiscal variables to GDP, FDI and interest rate innovations; (b) the discretionary response of fiscal variables to the macro variables in the system; and (c) structural shocks. Thus, Equation (2) is transformed into:

$$u_t^{T1} = \alpha_Y^{T1} u_t^Y + \alpha_P^{T1} u_t^E + \alpha_I^{T1} u_t^I + \beta_{T2}^{T1} \varepsilon_t^{T2} + \beta_G^{T1} \varepsilon_t^G + \varepsilon_t^{T1}, \tag{3}$$

$$u_t^{T2} = \alpha_Y^{T2} u_t^Y + \alpha_P^{T2} u_t^E + \alpha_{T1}^{T2} u_t^I + \beta_{T1}^{T2} \varepsilon_t^{T1} + \beta_G^{T2} \varepsilon_t^G + \varepsilon_t^{T2}, \tag{4}$$

$$u_t^G = \alpha_Y^G u_t^Y + \alpha_P^G u_t^{E1} + \alpha_I^G u_t^I + \beta_{T1}^G \varepsilon_t^{T1} + \beta_{T2}^G \varepsilon_t^{T2} + \varepsilon_t^G. \tag{5}$$

The parameters α_i^j are the exogenous elasticity of the fiscal variables to the macro variables (Y, P, I) and represent the automatic response of fiscal variables to a changing macro environment. The parameters β_i^j estimate the impact of the structural and fiscal shocks on each other. The parameters of the equations cannot be estimated by the usual OLS because the reduced form residuals and structural shocks are correlated. Therefore, in the next step, cyclically-adjusted reduced form fiscal policy shocks are used. According to the Blanchard-Perotti methodology (2002), the discretionary response of fiscal policy to macroeconomic conditions is restricted to zero. In order to compute cyclically-adjusted reduced form fiscal policy shocks based on Blanchard and Perotti (2002), exogenous elasticities α_i^j are used.

In the second step of the estimates, a change in a fiscal variable should be distinguished between the change directly triggered by macroeconomic variables (the cyclical change), and discretionary one. The parameters of Equations (3)–(5) were estimated by using exogenous elasticities in order to compute cyclically adjusted reduced-form fiscal

policy shocks, which are specified as follows:

$$u_t^{T1\prime} = u_t^{T1} - \alpha_Y^{T1} u_t^Y - \alpha_P^{T1} u_t^E + \alpha_I^{T1} u_t^I = \beta_{T2}^{T1} \varepsilon_t^{T2} + \beta_G^{T1} \varepsilon_t^G + \varepsilon_t^{T1}, \tag{6}$$

$$u_t^{T2\prime} = u_t^{T2} - u_t^Y + \alpha_P^{T2} u_t^E + \alpha_I^{T2} u_t^I = \beta_{T1}^{T2} \varepsilon_t^{T1} + \beta_E^{T2} \varepsilon_t^{ET} + \varepsilon_t^{TR}, \tag{7}$$

$$u_t^{G\prime} = u_t^G - \alpha_Y^G u_t^Y - \alpha_I^G u_t^I = \beta_{T1}^G \varepsilon_t^{T1} + \beta_{T2}^G \varepsilon_t^{T2} + \varepsilon_t^G. \tag{8}$$

In the third step, in order to identify the structural shocks to fiscal variables, a decision with respect to the ordering of the fiscal variables should be taken. In this paper, it was assumed that the spending decision comes first. This ordering is consistent with Blanchard and Perotti ([2002]). In particular, Blanchard and Perotti ([2002]) find that the correlation between government revenue and spending is rather small and, hence, it does not have a great impact on the results. Therefore, the following restriction has been imposed: $\beta_{T1}^{T2} = \beta_{T1}^G = \beta_{T2}^G = 0$. The first restriction means that any indirect tax shock cannot be quickly transmitted to the direct taxes. The other two restrictions mean that both direct and indirect taxes shocks at the same time cannot affect public spending.

$$u_t^{G\prime} = \varepsilon_t^G, \tag{9}$$

$$u_t^{T2\prime} = \beta_G^{T2} \varepsilon_t^G + \varepsilon_t^{T2}, \tag{10}$$

$$u_t^{T1\prime} = \beta_{T2}^{T1} \varepsilon_t^{T2} + \beta_G^{T1} \varepsilon_t^G + \varepsilon_t^{T1}. \tag{11}$$

The estimation of the non-restricted β coefficients is made by carrying out OLS recursively. Finally, the remaining parameters of the macroeconomic variables (u_t^I, u_t^E, u_t^Y) were estimated using the following specification:

$$u_t^I = \alpha_{T1}^I u_t^{T1} + \alpha_{T2}^I u_t^{T2} + \alpha_G^I u_t^G + \varepsilon_t^I \tag{12}$$

$$u_t^E = \alpha_Y^E u_t^Y + \alpha_I^E u_t^I + \alpha_{T1}^E u_t^{T1} + \alpha_{T2}^E u_t^{T2} + \alpha_G^E u_t^G + \varepsilon_t^E, \tag{13}$$

$$u_t^Y = \alpha_P^Y u_t^E + \alpha_I^Y u_t^I + \alpha_{T1}^Y u_t^{T1} + \alpha_{T2}^Y u_t^{T2} + \alpha_G^Y u_t^G + \varepsilon_t^Y. \tag{14}$$

The regressions from the Equations (12)–(14) were estimated by applying the instrumental variables technique recursively using the structural shocks of previous equations as instruments. Since the structural shocks ε_t are orthogonal, they can be used as instruments. For more details, see Bova and Klyvienė ([2020]).

4. Data

In the benchmark model, three macro and three fiscal variables have been used: GDP, FDI, the nominal short-term interest rate for interbank market, revenues of direct taxes (including social insurance contributions) and indirect taxes, and government spending. All variables were adjusted by using GDP deflator. Due to the limited data on long-term interest rates, a short-term interest rate was chosen. In addition, short-term interest rates were popular for borrowing in the Baltic domestic markets and could reflect some of the transmission channels of the fiscal policy. As regards government spending, two separate shocks, one of government consumption and one of investment, were simulated.

All our data is retrieved from EUROSTAT, AMECO[1] and the national statistical databases of Lithuania, Latvia and Estonia. It should be noted that in this paper direct taxes do not meet the standard concept as they include not only corporate and personal income taxes but also social insurance contributions. It corresponds to the general understanding of social security systems in the region where social security contributions are treated as taxes due to the existence of a large element of redistribution in the social security system. The indirect tax definition is in line with ESA 2010. The dataset is quarterly and in the case of Lithuania covers the period from 1995 to 2018 while for Estonia and Latvia the data series start from 1997 to 2018. All data are seasonally adjusted and expressed in logarithms, except interest rates. The data were tested for the existence of unit roots. Based on augmented Dickey-Fuller and Phillips-Perron tests under different specifications, the data series can be considered as integrated of order one, with the exception of the interest rate. Given that the series are non-stationary, the estimation uses first differences for all variables except the interest rates. This paper solely focuses on SVAR models and no cointegration tests were applied. It is worth noting that Blanchard and Perotti (2002) in their study present results under the some cointegration restriction, and this makes little difference relative to benchmark model.[2] In order to use Blanchard and Perotti's approach, there is a need to assess elasticity coefficients of exogenous fiscal variables. All three Baltic countries have undergone significant changes in their tax systems, and this can significantly affect the elasticity coefficients. The choice of elasticity is critical for VAR estimates, which are generally sensitive to the magnitude of elasticity in the estimation. Therefore, in the case of Lithuania, the elasticities of every single tax revenue group with respect to GDP are obtained following Jakaitienė and Klyviene's (2013) study based on quarterly data, including the evaluation of the impact of legislative changes and other one-off effects on elasticities. Authors suggest that for Lithuania GDP can be selected as an analogue of the tax base due to sufficiently synchronized cyclical fluctuations between GDP and its main components. In the long-run, GDP with dummy fiscal variables comprises 95% of all analysed tax revenues on average. In the absence of quarterly estimates, OECD approach (Price et al., 2015) based on annual data were used for Estonia and Latvia.

The OECD computes elasticity of revenues from information on the tax code and the distribution of taxpayers in each bracket. Therefore, the elasticity of taxes to output is obtained by multiplying the annual elasticity of the separate tax items vis-à-vis the relevant tax base by the elasticity of the latter to output. Elasticities of the tax base to output were estimated by using regression analysis. As regards the personal income tax and social security contributions, the wage is considered as a proxy for its macroeconomic base. The elasticity of the wage bill to GDP is estimated through two sub-elasticities: (i) employment on GDP and, (ii) wages on employment. The employment/GDP relationship in Estonia and Latvia suggest an average elasticity equal to 0.38 and 0.48 accordingly, which is similar to the results presented by the Botelho and da Silva study (2019). This elasticity is typically smaller than 1 due to Okun's law that states change in GDP is partly absorbed by the labour productivity dynamic. The second sub-elasticity is interpreted as the 'Phillips curve' effect on wages. The results for Estonia and Latvia are, respectively, 0.60 and 0.89, in line with some of the recent studies that have pointed out the non-elastic pattern of the relationship between wage dynamics and employment in the euro area since the economic and financial crisis (Conti et al., 2020).

In the case of corporate income tax, which is relatively elastic to income, operating surplus and mixed income are chosen as the profit tax base. The aggregate direct tax elasticity to GDP is therefore calculated as the weighted average of the three revenue categories: corporate, personal income taxes, and social insurance contributions. Finally, in the case of indirect taxes that are also relatively non-elastic in the Baltic states private consumption is assumed as the tax base. (See Appendix A). Overall, the elasticity coefficients used in this study are broadly consistent with their theoretical values and the results of other studies. (See Table 1).

Information on the elasticity of public spending to GDP is more limited. Therefore, for all three countries, it was assumed that government spending, except some social transfers, is relatively rigid and does not easily change with output. The duration of the procedures governing most of the public expenditure simply exclude the possibility that changes in real GDP will affect the public spending in the same quarter, either through automatic stabilizers or through discretionary actions. Hence, public consumption and investment elasticity coefficients were set to zero. The European Commission (Mourre et al., 2014) has applied the same approach. Following Blanchard and Perotti (2002) method, elasticities of fiscal variables to interest rate innovations and FDI these were set to zero. In the case of interest rates, expenditure data excludes interest payments; while tax revenue from interest rates related income constitute a small fraction in the Baltic states. The complexity of the relationship between FDI and fiscal variables and the lack of empirical studies on this topic were the main drivers of such an assumption.

5. Empirical results

VAR of order 1 was selected for further SVAR identifications. The lag length was mainly based on the Schwarz criterion (SC) and Hannan Quinn (HQ) criterion. (See Appendix B).[3] In addition, the intercept vector was selected for identification, as trend components did not improve the results. On the expenditure side, two different types of expenditure were tested separately: government consumption and government investment.[4] As a benchmark, we apply a shock of 1% to tax revenue and expenditure growth rates. The two-standard deviation confidence intervals for the values of impulse response functions were calculated by employing the bootstrap method (Monte Carlo simulations with 1000 simulations, 5% significance level). For many impulse responses, estimates are insignificant, largely due to the small size of the sample, a factor behind the common imprecision of impulse-response functions in VAR models.

Table 1. The main taxes budget elasticity to GDP in the selected countries.

	Personal income tax	Corporate income tax	Social security contributions	Indirect taxes
Germany	1.1	0.9	1.0	0.9
Greece	1.7	1.7	0.4	0.7
Spain	0.7	1.0	0.8	1.2
Franc	1.0	1.3	0.6	1.2
Ireland	1.0	2.0	0.9	0.9
Italy	0.9	0.7	0.7	1.5
Latvia	1.0	1.8	0.9	1.0
Lithuania	0.8	2.1	1.1	0.8
Estonia	0.7	2.1	0.7	0.9

Source: Bernardi (2012), for Latvia, Lithuania and Estonia – authors' calculations.
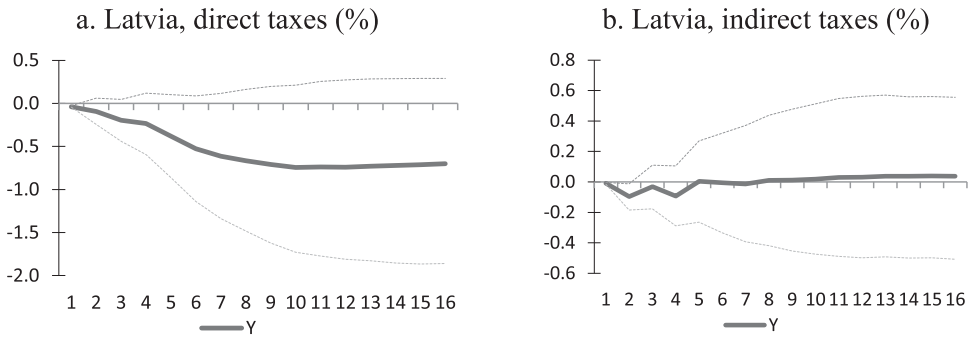
Figure 1. Accumulated response of GDP to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

5.1 Output response

The simulation results show negative output responses to direct taxes in all Baltic states. Figure 1(a) shows that the impact of an increase in direct taxes on GDP in Latvia is relative sluggish reaching a maximum value of 0.7% in the tenth quarter. However, this is significant only in the first period. The impulse response values in Lithuania (Figure 2(a)) are very similar to the Latvian ones, but are more persistent and significant over the estimation horizon. The impulse response coefficient is initially 0.04% and increases to 0.5% in the fourth quarter, peaking at 0.8% in the sixth quarter. The effect of direct taxes on GDP in Estonia (Figure 3(a)) is negative as in other Baltic countries, although not statistically significant except the first quarter.

The effect of indirect taxes on GDP is less consistent across the region and remains small and unstable throughout the estimation horizon (see Figure 1(b), Figure 2(b) and Figure 3(b)). For example, in Lithuania, it is positive and significant only in the first quarter and then turns negative and insignificant. In Estonia, it remains positive but small for the entire impulse response horizon, reaching a maximum value of 0.2% in the fourth quarter before gradually converging to 0. In the case of Latvia, it starts as
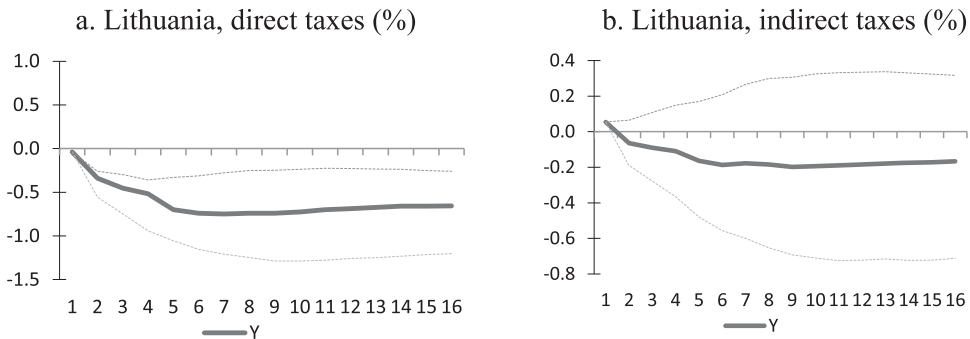

Figure 2. Accumulated response of GDP to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Estonia, direct taxes (%)

b. Estonia, indirect taxes (%)

Figure 3. Accumulated response of GDP to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).
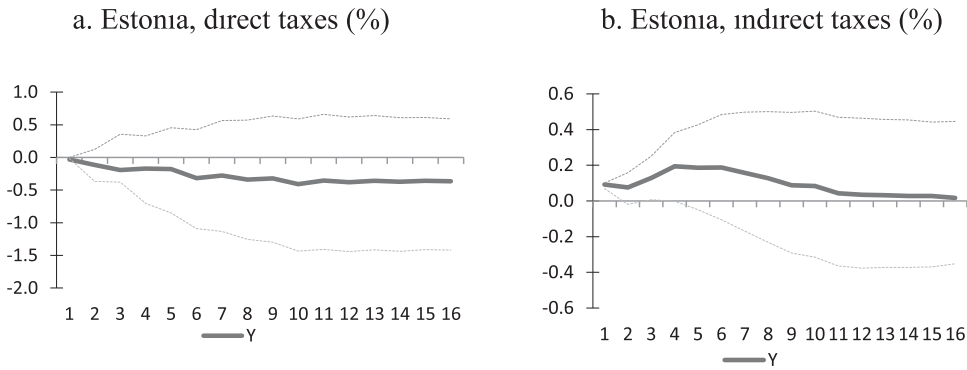
negative in the first quarter to then also gradually converge to 0. Weak and unstable coefficients for indirect taxes could be explained by relatively inelastic private consumption patterns in the Baltic countries.

Output responses to increases in government consumption in Latvia are negative for their entire analysis period; however, it is significant only in the first period. (See Figure 4 (a)). In Lithuania, the impulse response coefficients are positive and increase substantially from 0.3 in the first quarter to 1.0 in the sixth quarter, showing a high persistence of government consumption shocks on GDP.

Since government wages are the largest component of government consumption, it can be argued that disposable income is an important channel for fiscal policy in Lithuania (see Figure 5(a)). Results related to government consumption in Estonia show a positive output response only for the first five quarters, which later turns negative (see Figure 6(a)). However, as in the case of Latvia, the results are significant only in the short term i.e. in the first and second quarters. Results of the impulse responses to government investment shocks for Latvia and Lithuania are positive and significant. The coefficients are significant and stable over the entire estimation horizon in Lithuania and up to one year in Latvia (see

a. Latvia, consumption (%)

b. Latvia, investment (%)

Figure 4. Accumulated response of GDP to a 1% shock in expenditure variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

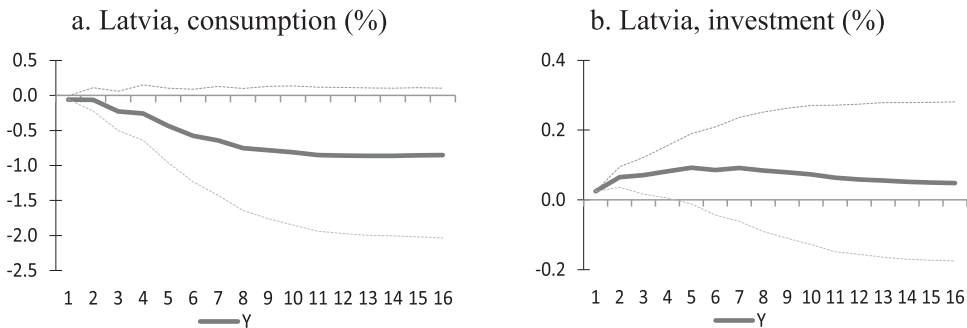a. Lithuania, consumption (%) 	 b. Lithuania, investment (%)

Figure 5. Accumulated response of GDP to a 1% shock in expenditure variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).
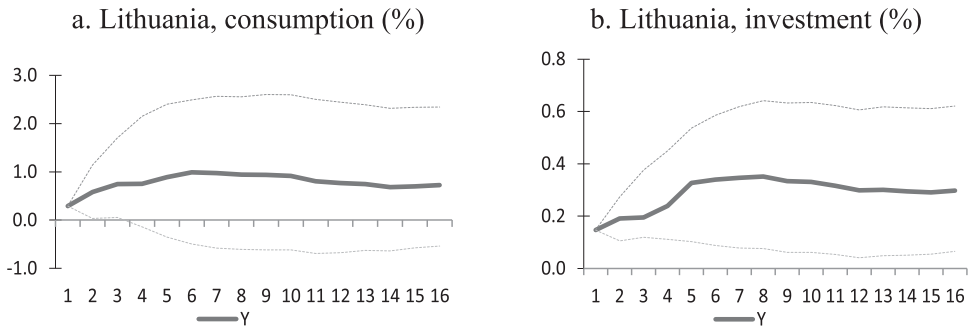
Figure 4(b) and Figure 5(b)). On the contrary, in Estonia, results point to an almost zero output response to investment shock (see Figure 6(b)).

The cumulative first year fiscal multipliers are better indication of the magnitude and importance of the impact of fiscal shocks on GDP. They were calculated following Blanchard and Perotti's (2002) concept, i.e. cumulative GDP response values were divided by the ratios of selected fiscal variables to GDP. Therefore, Table 1 reports the reaction of GDP to a one euro change in fiscal variables.

The first year multiplier for direct taxes is negative in all Baltic states, with the largest magnitude being in Lithuania where the multiplier amounts to -2.5 indicating that a one euro increase in taxes would reduce real GDP by 2.5 euro. In Estonia and Latvia, the impact is much smaller although in Estonia not statistically significant except the first quarter. The government consumption multiplier is positive in Lithuania and Estonia, reaching values of 2.7 and 1.1 respectively in the first year. However, in Latvia, the government consumption multiplier is persistently negative, albeit significant, in the first period only. In the specific context of Latvia, due to a more severe crisis as compared to the other nations, the impact of fiscal policy on growth would unfold very slowly or might even have a negative effect according to the simulation results.

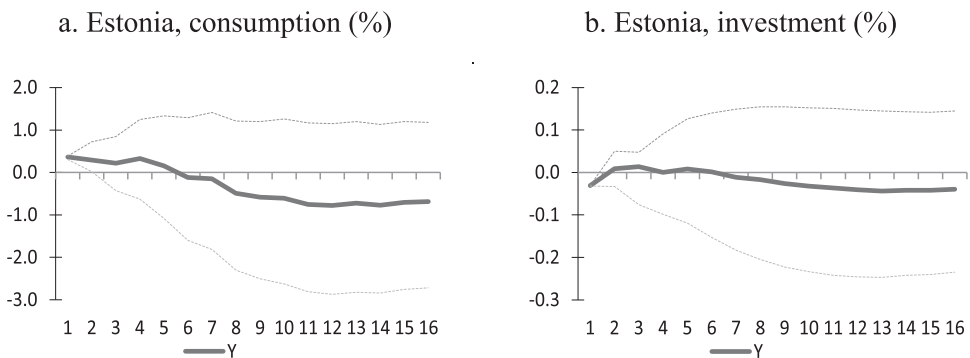a. Estonia, consumption (%) 	 b. Estonia, investment (%)

Figure 6. Accumulated response of GDP to a 1% shock in expenditure variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

In the case of the first year investment multipliers for Lithuania and Latvia, they tend to be quite large throughout the horizon with a value of 3.7 and 1.8, respectively. This result might be explained by the fact that public investment can lead to crowding–in of private investment. For example, public investment can create additional favourable conditions for private investment by providing relevant infrastructure. This was also consistent with the conclusions by Bom and Ligthart (2014), Deleidi et al. (2020); they found that public investment particularly in the infrastructure might have a stimulating effect on private investment growth and are and tends to be higher in countries hit harder by crises. An important positive effect for the Baltic states also stems from the use of EU structural funds. However, the results for Estonia are counterintuitive as the first year investment multiplier is small and insignificant.

5.2 Foreign direct investment response

In general, FDI might be insensitive to a tax differential between the host and the investor country as other structural determinants such as the size of the domestic market or proximity to the final markets and the characteristics of competition may play a more important role in FDI location decision. However, there is some empirical evidence that fiscal policy has an effect on FDI and that multinational companies react to tax incentives (Bénassy-Quéré et al., 2005; Egger & Radulescu, 2011; Hansson & Olofsdotter, 2014)

Results of our simulations show a negative impact of both tax groups on foreign direct investment in all three Baltic states (see Figures 7–9). However, more persistent and significant results for all three countries have been achieved with indirect taxes, although in the case of direct taxes, impulse responses are mostly insignificant except for Latvia and the first quarter for Lithuania. While the impact of taxes on FDI seems rather intuitive, insignificant results for direct taxes in the case of Lithuania and Estonia are puzzling and warrant further research into the design of taxation in the Baltic countries (see Figures 8(a) and 9(a)).

In the cases of Latvia and Lithuania, increases in public expenditure have a positive impact on FDI and are in line with output responses (see Figures 10–11). The results of public investment in Lithuania are less consistent; the first quarter result is negative and then turns positive, although the impact remains significant only for the first quarter (see Figure 11(b)). In Estonia, the impact of government consumption and investment is
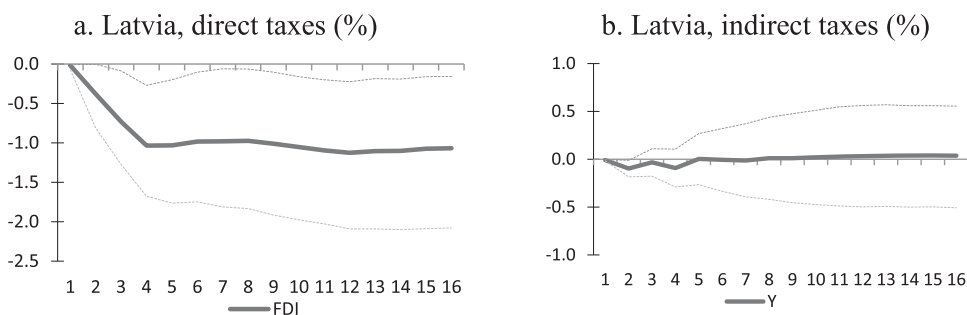

Figure 7. Accumulated response of FDI to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Lithuania, direct taxes (%)

b. Lithuania, indirect taxes (%)

Figure 8. Accumulated response of FDI to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Estonia, direct taxes (%)

b. Estonia, indirect taxes (%)
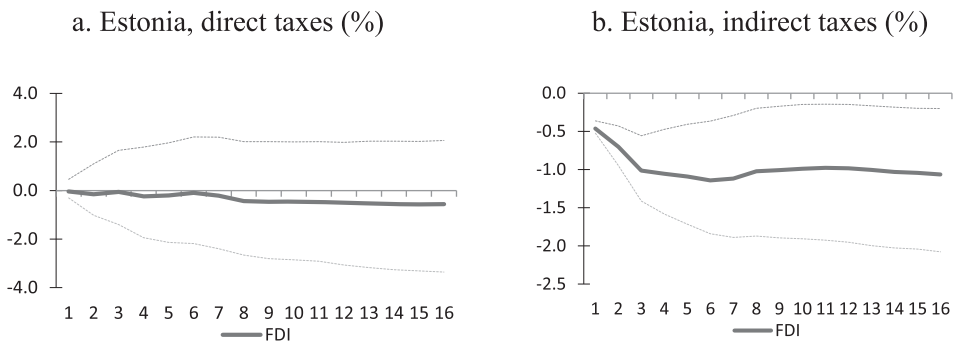
Figure 9. Accumulated response of FDI to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

negative and significant only in the short run (up to one-year period). From a theoretical perspective, public investment can have two effects on FDI, similar to private investment. On the one hand, a positive impulse in terms of public investment in, for example,

a. Latvia, consumption (%)

b. Latvia, investment (%)

Figure 10. Accumulated response of FDI to a 1% shock in spending.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).
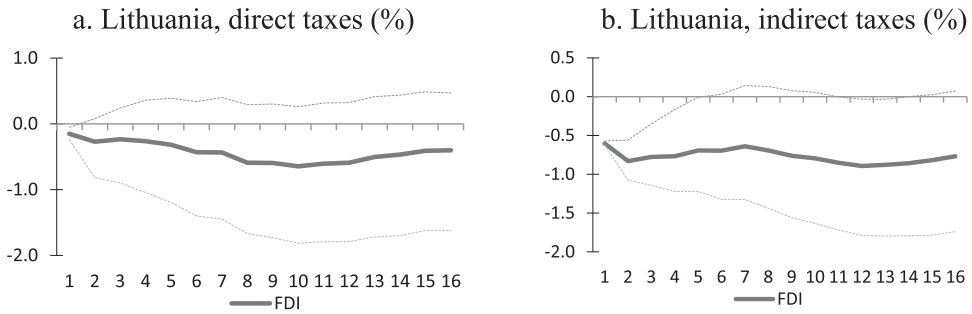
a. Lithuania, consumption (%)

b. Lithuania, investment (%)
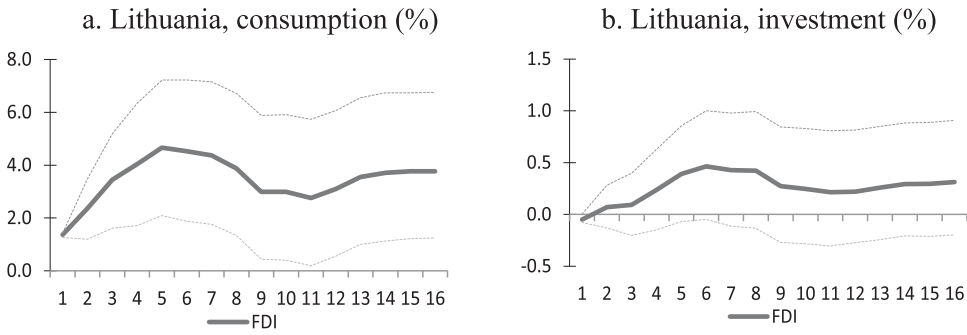
Figure 11. Accumulated response of FDI to a 1% shock in spending.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

infrastructure or productivity enhancement can create additional favourable conditions in the domestic economy and therefore stimulate a foreign direct investment inflow, i.e. resulting in a positive crowding-in effect. However, the FDI might to crowd out domestic investment particularly in the short-run. Therefore, In Latvia and Lithuania, an increase in public spending is generally positive for FDI, while in Estonia the results are opposite (Figure 12).

5.3 Interest rate response

For all three Baltic states, our analysis points to a very small and in general statistically insignificant impact of tax variables shocks on interest rates (see Figures 13–15). In Latvia, the reaction of interest rates to higher indirect taxes is negative or equals 0. The effect of direct taxes also remains small and is unstable throughout the estimation horizon starting negative and significant at 0.2 in the first quarter and then turning positive. In the fifth quarter, it starts at around 0.1 and again turns negative and insignificant throughout the rest of the estimation horizon (see Figure 13(a)). In Lithuania and Estonia, an increase in direct taxation triggers a positive although small impact on the interest rate only in the

a. Estonia, consumption (%)

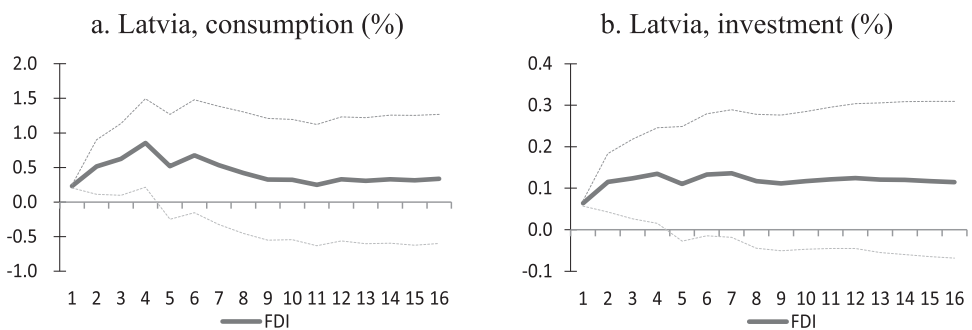### b. Estonia, investment (%)

Figure 12. Accumulated response of FDI to a 1% shock in spending.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Latvia, direct taxes (pp)

b. Latvia, indirect taxes (pp)
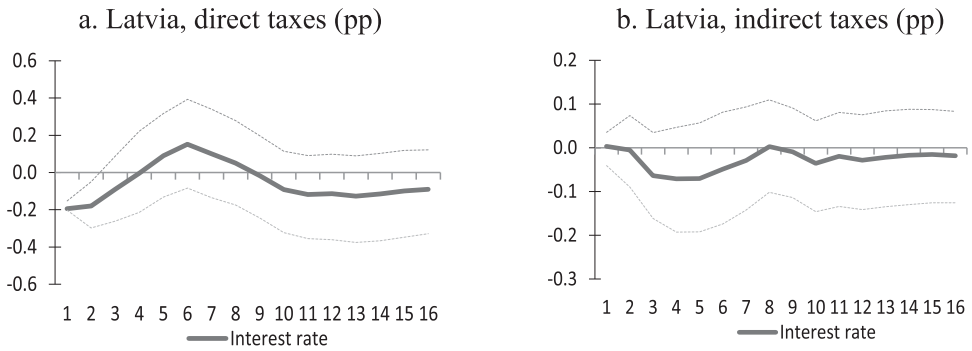
Figure 13. Accumulated response of interest rate to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Lithuania, direct taxes (pp)

b. Lithuania, indirect taxes (pp)
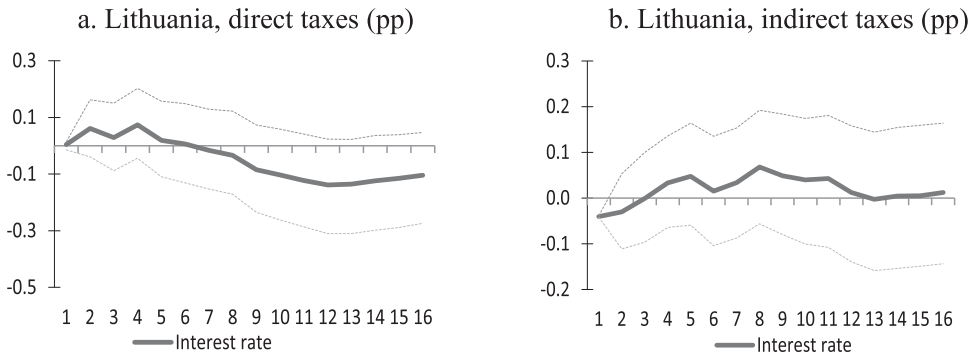
Figure 14. Accumulated response of interest rate to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Estonia, direct taxes (pp)

b. Estonia, indirect taxes (pp)
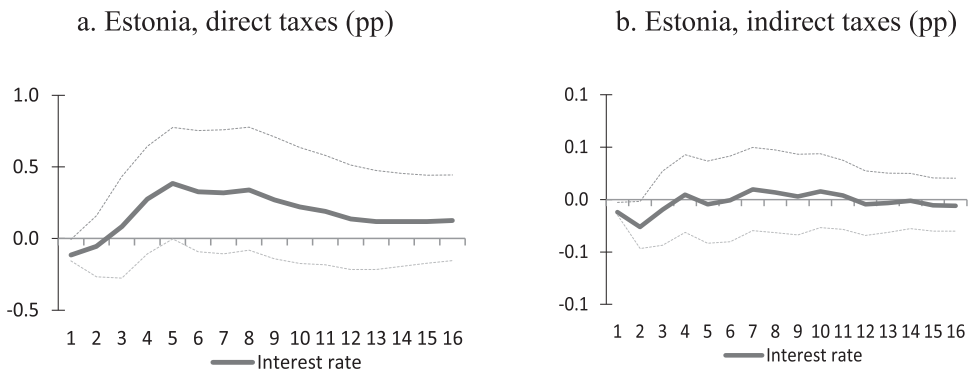
Figure 15. Accumulated response of interest rate to a 1% shock in tax variables.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Latvia, consumption (pp)

b. Latvia, investment (pp)
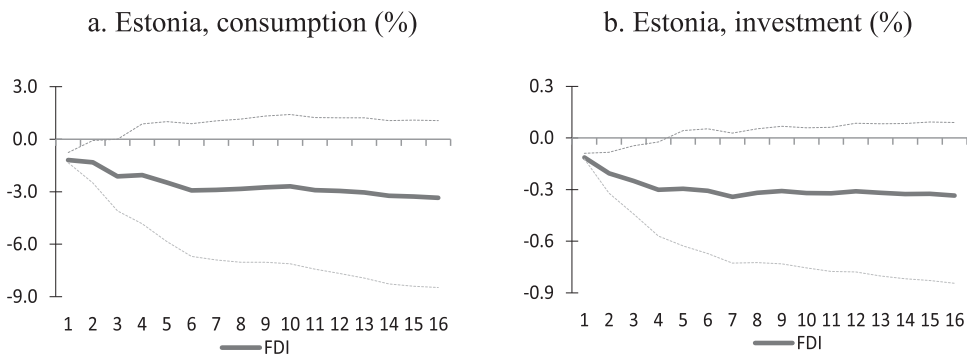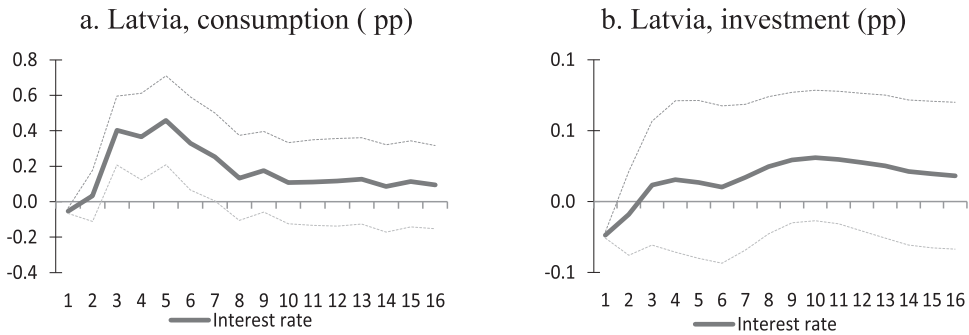

Figure 16. Accumulated response of interest rates to a 1% shock in expenditures.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

a. Lithuania, consumption (pp)

b. Lithuania, investment (pp)
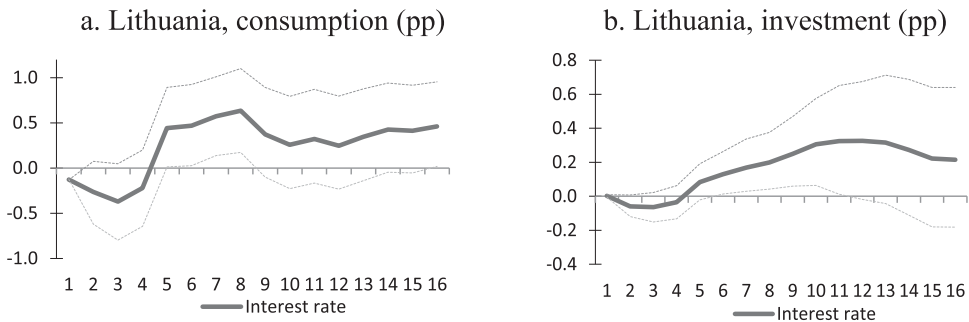
Figure 17. Accumulated response of interest rates to a 1% shock in expenditures.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).

short run, while in the long run it turns negative. The effect of indirect taxation shock is the opposite: i.e. the impulse response is negative in the short run and positive or zero in the long run. However, this impact is very small and statistically insignificant.

Meanwhile, interest rates show a more persistent reaction to shocks in government spending, especially for government consumption in the long run (see Figures 16–18). An increase in government consumption in the case of Latvia triggers a negative reaction in the first quarter while from the second quarter it turns positive and remain significant until the seventh quarter. The public investment impulse responses are very similar, although remain, very small and insignificant. In the case of government spending in Lithuania, the shocks cause an immediate negative reaction to interest rates while, on the other hand, it turns positive in the long run. In Estonia, the results for government consumption are similar to estimates for other peers, while the response of public invest-ment is almost negligible and insignificant starting from the third quarter.

Overall, the results of the impact of expenditure variables reveal small negative responses to public consumption shocks in the short run (from the first quarter to the second quarter for Latvia and Estonia, and to the fourth quarter for Lithuania). Meanwhile, the reactions become positive in the long run in all three countries. This implies that an

Figure 18. Accumulated response of interest rates to a 1% shock in expenditures.

The two lines on each side of the impulse response give one standard error bands, computed by Monte Carlo simulations based on 1000 simulations (5% significance level).
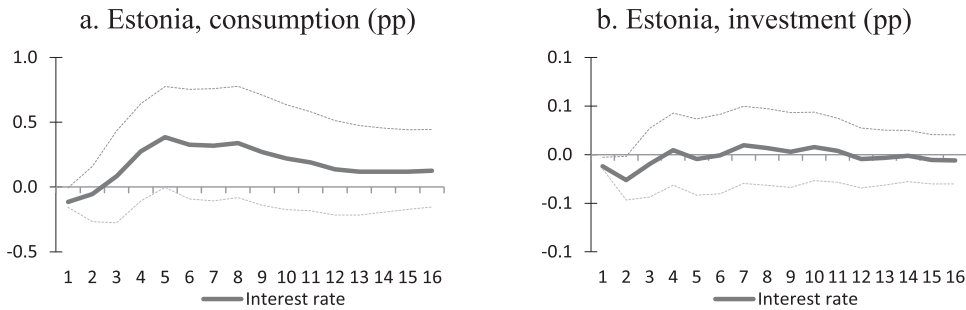
expenditure based deficit increase followed by decreasing interest rates is expected only in for the short run, although expansionary spending measures might trigger an increase in interest rates in the long run.

In most cases, the effects of taxes and public investment on interest rates remain small, unstable and insignificant over the estimation horizon. This could mask some omitted variable bias or might be related to the fact that long-term interstate rates are better suited for such type of analysis.

5.4 Robustness checks

A number of robustness checks were performed with regard to the baseline SVAR model, as specified in Section 4, including whether the ordering of the variables in the restrictions might alter the results. The results show that a change in ordering does not affect our estimates. As expressed in Perotti (2002), an explanation for this could be the fact that the correlation between the different reduced forms of fiscal shocks is relatively low.

Jordà (2005) advocated local projections (LPs) as an alternative to VARs as LPs tends to be more robust to model misspecification. LPs do not constrain the shape of the impulse response function like VARs, and, therefore, are less sensitive to model misspecification. In addition, the VAR approach may fail to account for the anticipation effect as some policy decisions could have already been expected in previous quarters, so the estimated multiplier would be smaller than it actually is (Ramey, 2011).

A basic static local projections can be modelled as follows:

$$Y_{t+h} = \mu_h + \beta_h X_t + \sum_k \delta_{y,h,k} \omega_{t-k} + \varepsilon_{h,t} \tag{15}$$

for each $h = 0, 1, 2, \ldots$, where μ_h *is constant*, $\varepsilon_{h,t}$ is the projection residual $\delta_{h,k}$ – projection coefficients and ω is a vector of control variables. The impulse response function of Y_t (one of the macro variables), with respect to X_t (one of the fiscal variables) is constructed as a sequence of $\{\beta_h\}1_{h \geq 0}$. Local projections do not need to be estimated as a system of equations, so they can be easily adapted to handle state dependence or asymmetry.

Table 2 presents the fiscal multipliers calculated according to the local projections method. Local projections multipliers for taxes display mainly the same sign for Latvia

Table 2. Cumulative Fiscal multipliers.

Latvia				
Quarters	1	2	3	4
Direct taxes	−0.01*	−0.39*	−0.80	−0.90
Indirect taxes	−0.06*	−0.72*	−0.23	−0.70
Public consumption	−0.25*	−0.27	−0.99	−1.07
Public investment	0.54*	1.45*	1.57*	1.82*
Lithuania				
Direct taxes	−0.19*	−1.7*	−2.26*	−2.50*
Indirect taxes	0.42*	−0.49*	−0.69	−0.84
Public consumption	1.04*	2.07*	2.67*	2.67*
Public investment	2.26*	2.93*	3.00*	3.70*
Estonia				
Direct taxes	−0.01*	−0.47	−0.78	−0.70
Indirect taxes	0.64*	0.52*	0.89	1.30
Public consumption	1.30*	1.05*	0.77	1.10
Public investment	−0.62*	0.18	0.27	0.10

Note: table shows the reaction of GDP (in euro) to a one euro change in fiscal variables.
* indicates that 0 is outside the region between the two-standard error bands and represents the significance level of 5%.

and Lithuania, but they are somehow larger and significant only in the first quarter. For Estonia, tax multipliers are persistently negative and have larger values and, in the case of indirect taxes, they display an opposite sign than those obtained by the SVAR estimation. Government consumption multipliers are similar only in Lithuania, reaching a value of 1.4 in the second quarter compared to 2.1 in the case of the SVAR. However, results for government consumption in the cases of Latvia and Estonia deviate significantly. Finally, for all countries, investment multipliers in most cases are larger but significant only in the first quarter.

Overall, in Lithuania both methods (Table 3 and Table 3) yield negative responses to increases in direct and indirect taxes and large positive responses to greater government consumption and investment. SVAR responses appear to be quite similar to the results of local projections method, particularly in the second and third quarters, but they deviate much more in fourth quarter. In Latvia, we also find negative responses to increases in both tax groups. On the other hand, a negative government consumption multiplier was not confirmed by the local projections approach. However, in both countries, results based on local projections are significant only up to the second quarter. According to the local projections method, for Estonia, the signs of direct taxes and public investment multipliers have the same sign and are broadly consistent with the SVAR method. At the same time, the multiplier of indirect taxes and government consumption tend to be negative according to the local projections approach and contradict initial estimations. However, in the case of Estonia, most responses are insignificant.

For all countries, SVAR based tax multipliers are lower as compared to the ones calculated by the LPs which is in line with most studies (Ramey & Zubairy, 2018). However, in terms of public spending, the SVAR approach results, in most cases, the higher multiplier estimates, except in Lithuania, where the first year public investment multiplier based on local projection is almost twice the SVAR multiplier. A reason for this higher multiplier could be due to the fact that the Blanchard-Perotti approach fails to account for the anticipation effect of fiscal policy and the initial government spending effect on output might be overestimated (Ramey, 2016). As regards FDI and interest rate impulse responses, the estimates using local projections yielded erratic and mostly insignificant results; hence, response coefficients are not reported in this paper.

Table 3. Cumulative fiscal multipliers based on the local projections.

Quarter	1	2	3	4
Latvia				
Direct tax	−1.28*	−1.90	−2.48	−3.06
Indirect tax	−0.06*	−1.24	−2.71	−2.81
Public consumption	0.93*	0.75	2.02	2.36
Public investment	2.05*	2.34*	0.64	1.65
Lithuania				
Direct tax	0.85*	−2.95	−3.35	−3.53
Indirect tax	−4.0*	−4.9*	−1.01	−1.40
Public consumption	1.36*	1.38*	0.10	0.21
Public investment	4.95*	4.66	3.46	6.63
Estonia				
Direct tax	−1.77	−2.79	−1.53	−1.13
Indirect tax	−2.61	−2.34	−1.18	−1.28
Public consumption	−0.66	−2.13	−1.89	−1.46
Public investment	2.11*	2.01	0.04	0.62

Note: table shows the reaction of GDP (in euro) to a one euro change in fiscal variables.
* indicates that 0 is outside the region between the two-standard error bands and represents the significance level of 5%.

In addition to the aforementioned robustness checks, we also ran some tests to see whether the estimates are sensitive to the period selected. The period under examination (1995–2018) contains a severe economic and financial crisis episode, which might significantly affect the fiscal policy transmission channels, particularly the size of fiscal multipliers. In order to address the potential effect of a cyclical downturn, we performed the same analysis using the Blanchard-Perotti approach for the sub-sample, excluding a significant downturn episode, i.e. 1995Q1-2008Q3 for Lithuania, 1997Q1–2008Q2 for Latvia and 1997Q1-2007Q4 for Estonia. In this case, a one-lag equation system was selected to perform the estimation (See Appendix B). Given the even more limited amount of observations, the results obtained may not be very robust and would need to be considered with caution (see Table 3).

Table 4 shows that simulation results for the shorter period for Latvia and Lithuania are broadly consistent with the results for 1995–2018 as far as direct taxes and expenditure multipliers are concerned. In the case of Latvia, the concept of negative public consumption multiplier and positive public investment multiplier was confirmed for the entire period. However, the results for indirect taxes contradict estimations according to the baseline SVAR for both countries. For Lithuania, both types of government expenditure have a smaller impact than estimated for the entire period. This could possibly be explained by the fact that spending fiscal multipliers tend to be larger during recession periods (Auerbach & Gorodnichenko, 2012a, 2012b). For Estonia, the sub-set period exercise yielded broadly consistent results as for 1997–2018 as far as the signs are concerned, however, the size of the multipliers tend to be higher for the shorter period. This suggest that the economic crisis could lower the effectiveness of public investment in Estonia.

Overall, the analysis of shorter data series seems to confirm that increases in direct taxes have a negative impact on all three Baltic economies, while more spending on public investment is expected to boost GDP. The results obtained in the baseline model seem to be strongly resistant to the ordering of the variables and acceptably resistant to the exclusion of the period of the economic and financial crisis. The inclusion of the latter is found to have a larger effect on government consumption, investment and indirect taxes and a weaker effect on direct taxes on output in Lithuania. In the case of Latvia,

Table 4. Cumulative fiscal multipliers, short period.

Quarter	1	2	3	4
Latvia				
Direct taxes	−0.03*	−1.02*	−1.72*	−1.99*
Indirect taxes	0.78*	0.50	1.39	1.27
Public consumption	−0.46*	−0.30	−0.47	−0.56
Public investment	0.19*	1.37*	1.61*	2.27*
Lithuania				
Direct taxes	−0.07*	−1.99*	−3.15*	−3.15*
Indirect taxes	−0.29*	−0.49*	−0.27*	−0.18*
Public consumption	0.31*	1.18*	1.66*	1.80*
Public investment	0.29*	0.99*	1.22*	1.54*
Estonia				
Direct taxes	−0.08*	−2.73*	−3.62*	−4.94*
Indirect taxes	0.81*	0.79	1.03	1.26
Public consumption	1.91	1.63	1.46	1.30
Public investment	5.20*	4.10*	3.00*	2.24*

Note: table shows the reaction of GDP (in euro) to a one euro change in fiscal variables.
* indicates that 0 is outside the region between the two-standard error bands and represents the significance level of 5%.

changes to taxes and public investment tend to have a stronger effect if we include the period of the economic crisis. For Estonia, there is a significant result deviation with respect to direct taxes and public investment multipliers. At the same time, given a more limited amount of observations in the simulation for Estonia, the obtained results would need to be considered with caution.

6. Conclusions

In this paper, we analyse the responses of some macroeconomic variables to various fiscal shocks in Latvia, Lithuania and Estonia. This is done by using a structural VAR model and local projection method, which has become one the most popular tools for investigating the effects of fiscal and monetary policy on growth. The results of our research provide some insights as regards the choice for a consolidation strategy for small open economies. This is especially pertinent in case fiscal consolidation is necessary once the COVID-19 pandemic is tamed and economies restart close to normal functioning. Despite the fact that the three Baltic countries display similarities in terms of their geography, size, economic structure and development, their differences can still significantly affect the simulation results. Therefore, 'one size fits all' solutions do not apply as is the case in some other empirical studies (Poissonnier, 2017).

Though not all simulation results are homogenous for all three countries, we find that disposable income is an important channel of the transmission mechanism from fiscal policy to economic growth, particularly in Lithuania. The results are less reliable regarding public consumption impact multipliers for Latvia and Estonia as the two approaches applied yield the opposite signs. Our analysis also finds that, in almost all cases, effects of changes to indirect taxation are smaller compared to direct taxes, which might be explained by the relatively inelastic nature of private consumption in the Baltic states. Thus, a consolidation strategy could tilt more towards indirect taxation rather than direct taxation to the extent that increases in indirect taxes would have a smaller negative effect on output. Government investment expenditure has had a strong positive effect on domestic demand as well, particularly in Latvia and Lithuania. A possible explanation is a significant crowding-in effect,

which is also related to the use of EU funds. Reducing public investment is therefore far from the optimal strategy for consolidating public finances, although from a social point of view, this may seem reasonable. Due to a possible crowding-in effect of investment expenditure, output losses can be much higher than expected and at the same time only aggravate the public finances crisis. The results for Estonia are ambiguous and warrant further research.

In addition, we find that an increase in tax burden dampens FDI in all countries. The results for Estonia and Lithuania are less conclusive as they mostly relate to indirect taxes. The results are similar to those found regarding GDP and confirm interdependency between the two variables. Simulation of FDI response to public expenditure shocks shows differences throughout the Baltic region. In Estonia, the impact of government spending is negative and might point to a possible crowding-out effect, while in Latvia and Lithuania, increases in public consumption and investment have a mostly positive impact on FDI, which is in line with output response and points to a possibility of the crowding-in effect. However, the FDI response analysis largely finds insignificant impacts of changes to public expenditure except for public consumption in Lithuania. The difference in the fiscal policy transmission mechanism to FDI among the three Baltic countries could be explained by a diverse profile of foreign investors.

Relatively stable results were obtained in regards to interest rates for only one type of fiscal shocks, i.e. increases in government consumption. Nevertheless, these changes in results tend to be the opposite when different periods (short versus long) are considered. This can be explained by the fact that investors are likely to care about the country's financial position only from the long-term perspective. Then again, these results could mask some omitted variable bias or might be related to the fact that long-term interest rates are better suited to this type of analysis.

Despite the fact that some of our results are consistent with other studies, it is clear that there is need for further research. The SVAR approach is extremely sensitive to the size of the sample which can affect the value, sign and significance of the results. Explicit modelling of the effects of disaggregated government expenditure and other groups of taxes by using other methods might be a suggestion for further investigation.

Notes

1. Annual macro-economic database of the European Commission's Directorate General for Economic and Financial Affairs
2. The restriction that taxes and government spending are integrated (Blanchard & Perotti, 2002).
3. Although it met the selection criteria, we declined to select a 5th-order VAR, seeking to avoid over-parametrisation.
4. This exercise also allowed to test stability of the selected SVAR. A broad stability was found in the coefficients under the different SVARs specifications (consumption vs. investment), at least as far as output estimates are concerned.
5. Calculated as a weighted average based on annual data

Disclosure statement

No potential conflict of interest was reported by the author(s).

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Appendices

Appendix A. Elasticities

Tax base elasticities

	Employment elasticity to GDP	Real average wages elasticity to employment	Operating surplus vs. output	Elasticity of private consumption output
Latvia	0.48	0.89	0.96	0.98
Estonia	0.50	0.60	1.20	0.88

Sources: authors' estimates.

Tax and expenditure elasticities

Elasticities with respect to:	Tax base (OECD)	GDP gap (OECD)	GDP (authors' calculation)
Latvia			
Personal income tax	1.29	1.32	1.03
Social insurance contributions	1.00	0.73	0.91
Corporate income tax	1.79	1.63	1.81
Total direct taxes[5]	1.04	1.04	1.05
Indirect taxes	1.0	1.0	0.98
Government consumption	–	–	0.0
Government investment	–	–	0.0
Lithuania			
Personal income tax	N/A	N/A	0.80
Social insurance contributions	N/A	N/A	1.10
Corporate income tax	N/A	N/A	1.98
Total direct taxes	N/A	N/A	1.06
Indirect taxes	N/A	N/A	0.78
Government consumption	N/A	N/A	0.0
Government investment	N/A	N/A	0.0
Estonia			
Personal income tax	1.46	1.56	0.71
Social insurance contributions	1.36	1.39	0.69
Corporate income tax	1.79	1.80	2.10

Continued.

Elasticities with respect to:	Tax base (OECD)	GDP gap (OECD)	GDP (authors' calculation)
Total direct taxes	1.40	1.62	0.72
Indirect taxes	1.0	1.0	0.88
Government consumption		0.0	0.0
Government investment		0.0	0.0

Sources: Lithuanian coefficients are estimated based on quarterly data (Jakaitienė & Klyviene, 2013), Estonian and Latvian coefficients are based on the annual OECD tax elasticities (Price et al., 2015).

Appendix B. VAR lag length selection criteria

SVAR with government consumption

	Lag length	1	2	3	4	5	6
Lithuania	AIC	10.6387	10.9970	10.8311	10.0985	10.2323	9.6855*
	HQ	11.150*	11.9467	12.2191	11.9248	12.4969	12.3885
	SC	11.917*	13.3713	14.3012	14.6643	15.8939	16.4430
Latvia	AIC	11.194	10.953	10.831	10.555	10.067	9.121*
	HQ	11.706*	11.903	12.219	12.382	12.331	11.82
	SC	12.473*	13.328	14.301	15.121	15.728	15.88
Estonia	AIC	11.716	10.738	9.802	9.504	9.124	7.986*
	HQ	12.252	11.733	11.257	11.418	11.498	10.819*
	SC	13.065*	13.243	13.464	14.323	15.099	15.117

SVAR with government investment

	Lag length	1	2	3	4	5	6
Lithuania	AIC	14.22*	14.50	14.82	14.53	14.59	14.35
	HQ	14.73*	15.45	16.21	16.35	16.86	17.05
	SC	15.49*	16.88	18.29	19.09	20.26	21.10
Latvia	AIC	14.482	14.610	14.379*	14.693	14.591	14.379
	HQ	14.994*	15.560	15.767	16.519	16.855	17.082
	SC	15.761*	16.984	17.849	19.258	20.253	21.136
Estonia	AIC	16.406	15.802	14.818	14.685	14.753	14.232*
	HQ	16.946	16.804	16.282*	16.612	17.143	17.084
	SC	17.766*	18.328	18.509	19.542	20.776	21.420

Note: * represents the best lag length suggested by each criterion.

VAR lag length selection criteria, for period 1995-2008.
SVAR with government consumption

	Lag length	1	2	3	4	5
Lithuania	AIC	11,34	11,63	11,69	10,42	8,26*
	HQ	11,97	12,81	13,42	12,69	11,08*
	SC	13,07*	14,85	16,40	16,62	15,95
Latvia	AIC	11,85	11,922	12,262	11,246	8,5523*
	HQ	12,48*	13,105	13,991	13,521	11,373
	SC	13,59*	15,149	16,978	17,452	16,248
Estonia	AIC	13,39	12,75	11,965	10,947	8,5695*
	HQ	14,02	13,933	13,694	13,221	11,39*
	SC	15,12*	15,977	16,682	17,152	16,265

SVAR with government investment

	Lag length	1	2	3	4	5
Lithuania	AIC	13,989	14,260	15,001	12,939	11,056*
	HQ	14,626	15,443	16,729	15,213	13,877*
	SC	15,727*	17,487	19,717	19,145	18,751
Latvia	AIC	15,308	15,515	15,535	15,309	12,678*
	HQ	15,445*	16,698	17,263	17,584	15,498
	SC	17,045*	18,742	20,251	21,515	20,373
Estonia	AIC	17,669	17,392	16,769	15,766	14,440*
	HQ	18,306	18,575	18,498	18,040	17,261*
	SC	19,407*	20,619	21,485	21,972	22,135

Note: * represents the best lag length suggested by each criterion.