Different modelling approaches of tax revenue performance: The case of Baltic countries

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Abstract: *Tax revenue performance represents one of the most essential issues to every government when creating and profiling fiscal policy according to the macroeconomic framework of each country. In particular, this issue comes to the fore in extraordinary circumstances and unstable trends when governments are exposed to greater costs of financing budget deficits and public debts. Tax revenue mobilization shows the government's ability to collect sufficient revenue to finance government expenditures, as well as cover public needs. By using static and dynamic panel approaches, this research investigates the effect of tax revenue performance in Baltic countries (Estonia, Latvia and Lithuania) for the period 1995–2020. The main objective of this paper is to identify which determinants are crucial for improving tax revenue performance in the Baltic region. Namely, this research identifies how the main macroeconomic determinants affect the tax revenue performance in Baltic countries, which enables these economies to adjust to their favorable and unfavorable effects from the aspect of tax revenue mobilization. The empirical results show that gross domestic product per capita, industry value added, trade, and government expenditures have positive effects on tax revenue performance, while inflation, gross government debt, and exchange rate volatility negatively affect the tax revenue performance in these economies. Furthermore, the joining of Baltic countries to the European Union upgraded the tax revenue performance of this region in the short-run and long-run. Precisely, Baltic countries should focus on a higher level of economic growth, greater industry share and trade of GDP, as well as lower inflation rate, lesser exchange rate volatility, and smaller government gross debt.*

Keywords: Tax revenue, performance, determinants, panel models, Baltic countries.

Introduction

In a condition of steady public finance, generally because of the great level of debts and deficits, there is a large and expanding debate on the impacts of taxation on GDP growth and level (Baiardi et al., 2019). Tax revenue

mobilization represents one of the most important issues for every economy and its relevance becomes greater in extraordinary circumstances. It means that tax revenue mobilization manifests the government's capability to collect enough revenue to finance government expenditures and cover public needs. Namely, taxation has a significant role of state building in post-conflict states (Boogard et al., 2018). The current pandemic COVID-19 has manifested that state budgets are faced with problems of revenue mobilization due to large restrictions and limitations around the world. The previous economic crisis from 2008 had a significant effect on tax revenue collection in the European Union. EU member states recovered after two-three years in terms of revenue collection and reached revenue level from the year previous to the beginning of the crisis (Ţibulcă, 2021).

After the outbreak of COVID-19 pandemic, the Baltic states and the EU used various approaches as compared to the global financial crisis. Different fiscal measures and instruments have been put forward to rest economies and all countries plan to raise transfers to households, keep public consumption at levels before the pandemic, as well as increase public investment by using the support of EU funds (Klyvienė & Jakaitienė, 2022). Governments around the world responded to this crisis by aggressively implementing fiscal policy to increase health expenditure, income transfers and boosted welfare payments plus wage subsidies to companies to retain employees and reduce unemployment in the short-run (Makin & Layton, 2021). Current projections about COVID-19 and the impending security crisis in Europe, show that sources of financing and covering budget deficits and debts become one of the questions in defining macroeconomic framework and policy. The fiscal policy remains a valuable tool with various instruments of taxation and government spending that should be focused on the aggregate supply (Mihajlović & Marjanović, 2020). The revenues that move in relation to output enables fiscal policy sustainability in the long-run, as well as they are very responsive to changes in output in the short-run due the tax system functions are good automatic stabilizer (Dudine & Jalles, 2018).

The issue of revenue collection depends on many elements such as economic factors, social factors, cultural and demographic factors. For example, Timmons and Garfias (2015) argue that public opinion about government behaviour partially clarifies the fulfilment of public revenue. Indisputably, tax revenue mobilization is a central issue of economic policy-making in many countries (Akitoby et al., 2019), where governments have to be able to increase revenue to cover the expenditure needs to successfully implement fiscal policy (Mawejje & Odhiambo, 2020). Similarly, tax collection manifests as an essential instrument of enabling economic stability and development (Majerová, 2016). According to that, policymakers have to deal with the challenges of modest revenue collections despite of high tax rates and the reforms in tax systems (Junquera-Varela et al., 2019). In terms of adjusting to economic trends, Urban et al. (2019) indicate that countries introduce greater or smaller changes to their tax systems to realize the optimal combination of tax indicators and adapt to internal and external circumstances. The volatility of tax revenue is costly due to taxes being distortionary and creating reductions in output that raises non-linearly with the tax-to-output indicator (Casalin et al., 2020).

The structure of the paper is as follows. After the introduction, there is a literature review where similar research about tax revenue performance and determinants is reflected. The third segment is methodology and data which identifies variables and all econometric procedures, as well as preconditions for appropriate panel regression models. The fourth segment is an empirical analysis of tax revenue determinants in Baltic countries (Estonia, Latvia and Lithuania) for the period 1995–2020. This segment includes descriptive analysis, cross-dependence tests and second-generation unit roots, as well as static and dynamic panel modelling to identify which determinants are significant for tax revenue performance. The last segment summarizes the findings and conclusions with recommendations for future research.

1. Theoretical background

Tax revenue performance is mostly measured by tax-GDP ratio and reflects the capacity of tax collection in an economy by the government (Neog & Gaur, 2021). Gross domestic product (GDP) is considered an important economic indicator because it best manifests the performance of each economy (Ivanová & Masárová, 2018). For example, GDP per capita is a reliable indicator of success, manifesting in the level of

economic development reached in the country (Ginevičius et al., 2020). Consequently, tax revenue performance, as a percentage of gross domestic product, has made prudent improvements across many economies over the last decade (Mawejje & Sebudde, 2019). Besides tax importance at the national level, Guziejewska and Walerysiak-Grzechowska (2020) determine the relevance of local revenues and argue that during economic crises, local revenues sensitive to GDP fluctuations can cause hard budget restrictions. Liu and Liu (2020) highlight that the tax to GDP ratio has been low in developing economies and this indicators is usually between 10% and 20% in these countries compared to developed economies where it is more than 40% of GDP. The empirical study of Gnangnon and Brun (2019b) shows that higher development aid flows and their smaller volatility enable tax reform to reach larger tax revenue to GDP ratio and lower tax revenues instability. Mardan and Stimmelmayr (2020) highlight that advanced economies can achieve a higher level of tax revenues relative to GDP compared to developing countries. Based on mentioned above, the revenue level should be an appropriate level to finance expenditures and cover public needs. Therefore, Jaén-García (2019) cites that the optimum level of revenue sources to finance expenditures depends on its relative costs. Gnangnon and Brun (2019a) indicate that the mobilization of tax revenues is still a central issue in the world. As the tax collection increases, it allows the government to make maximum development projects for the public interest and to upgrade the infrastructure of health, and education, as well as the quality of people life (Streimikiene et al., 2018). Accordingly, tax revenues should enable adequate infrastructure, health, education, culture, employment, social income distribution, and public safety (Dobrovič et al., 2021).

Revenue mobilization is especially vital for poor countries to finance development projects related to infrastructure, debt management, agriculture, education, health, water sanitation (Bastiaens & Rudra, 2016). When we investigate the effects of tax ratio, Teera and Hudson (2004) analyzed tax revenue performance measured by the average tax ratio for 120 countries over the period 1975–1998 and determined the positive effect of gross domestic product per capita (GDP_{pc}), export-import ratio, as well as the share of the manufacturing sector on tax revenue performance, where their changes of 1% improve tax revenue performance for 0.34, 0.75 and 0.13%. Contrary, their results showed the negative effect of agriculture sector share and debt on tax revenue performance, which implies that their growth of 1% decreases tax revenue by 0.31% and 0.0003% in observed countries. Bekoe et al. (2016) point out that the aim of tax reforms is focusing on revenue sufficiency, equity, simplicity and economic efficiency. Boschi and d'Addona (2019) point out that estimating a change in tax revenues caused by a change in income is a basic issue for the forecast of the government revenues. Morrissey et al. (2016) investigated tax revenue performance and vulnerability in developing countries from 1980 to 2010. Their findings confirmed a negative nexus between manufacturing exports and revenue in lower-income countries. Pilinkiene (2016) highlighted the strong impact of globalisation cause the changes in economic growth. Specifically, trade liberalization can positively or negatively affect the gross domestic product and cause further implications on tax revenue level in the economy. Ofori et al. (2018) investigated the relationship between exchange rate volatility and tax revenue in Ghana using annual data from 1984 to 2014. Their empirical study included the auto regressive distributed lag (ARDL) technique that identified a harmful effect of exchange rate volatility on tax revenue in the short-run and long run in Ghana. Piancastelli and Thirlwall (2020) analyzed tax revenue determinants of fifty-nine developed and developing countries for the period 1996–2015. They confirmed positive and significant effects of GDP_{pc}, trade ratio, broad money, and the shares of agriculture and services in GDP. On the other hand, their results showed that share of industry positively affects the tax revenue, but without significance. Arif and Rawat (2018) found a positive linkage between tax revenue and inflation, as well as positive nexus between tax revenue and trade openness in EAGLE countries (Bangladesh, Brazil, Egypt, India, Malaysia, Mexico, Pakistan, Phillippines, Russia and Turkey) for the period 2001–2015.

Using feasible generalised least square (FGLS) and panel-corrected standard errors (PCSE) estimate techniques on the sample of 42 countries in Sub-Saharan Africa, Alabede (2018) found that agriculture share in GDP and per capita income negatively affect the tax

revenue performance for the period 2005–2012. Furthermore, this study confirmed that property rights freedom, freedom from corruption and investment freedom have positive effects on tax revenue countries. These results showed that countries with a greater degrees of economic freedom have a higher TAX-GDP ratio compared to countries with a lesser levels of economic freedom. The empirical analysis of Chigome and Robinson (2021) found that financial deepening, economic development and trade openness affect the tax capacity, while corruption and inflation influence tax effort on the sample of thirteen countries (Angola, Botswana, Eswatini, Lesotho, Malawi, Mauritius, Mozambique, Namibia, Seychelles, South Africa, Tanzania, Zambia and Zimbabwe) from 2002 to 2016. Celikay (2020) investigated determinants of tax burden of thirty-four Organisation for Economic Co-operation and Development (OECD) members for the period 1993–2016. The result of this empirical analysis shows that variables such as income per capita, unemployment, employment capacity, share of industry share and foreign trade volume have statistically significant and positive impact on tax burden. Shrestha et al. (2021) analyzed the relationship between trade openness and government revenue in 13 countries from 1996 to 2014. Their findings revealed a negative long-run relation among these variables and concluded that resource-abundant countries which promote trade liberalization tend to break down the government revenue structure based on the resource. Oz-Yalaman (2019) investigated the factors related to changes in tax revenues in 137 countries for the period 2011–2017. Applying different panel models, empirical research found that agriculture, industry and government debt negatively affect the tax revenue, while inflation had a positive impact on tax revenue. In the context of inflation and debt, Salhi and El Aboudi (2021) highlighted that good inflation and productive debt revive economic activity and consequently increase tax revenue mobilization. Minh Ha et al. (2022) analyzed tax revenue determinants in Southeast Asian countries for the period 2000–2016 using static and dynamic panel models. Their results show that trade openness, the ratio of foreign debt to GDP, the share of value added in industry to GDP have a positive effect on tax revenue in these countries.

An adequately created fiscal rule such as a revenue-expenditure relationship has a significant role in avoiding undesired outcomes arising from uncoordinated fiscal policy (Karakas & Turan, 2019). Similarly, Bertolotti and Marcellino (2019) cite that in the case of a tax increase, the rise in tax revenues is intensive but often temporary in the high-uncertainty regime and mild in the low-uncertainty regime. Cloyne and Surico (2016) argue that tax changes may affect consumption and other macroeconomic component, whereas Darvas (2020) highlights that the level and composition of expenditures and revenues have effects on economic development. Accordingly, the policymakers should keep the optimal relationship between revenue and expenditure, where Moździerz (2015) indicates government can increase revenue or reduce expenditure, as well as increase revenue and reduce expenditure at the same time. Empirical findings of Wang (2018) manifest that when government uses a tax policy with an appropriate level of expenditure decentralization, then countries could reach an effectively allocation of fiscal resources and greater production efficiency. Kliponen et al. (2019) confirmed that a reduction in government consumption negatively affects the real GDP in Estonia. Mawejje and Odhiambo (2022) confirmed that tax-to GDP ratio and government expenditures are positively related to GDP per capita in East African Community (EAC) countries for the period 1980–2020.

2. Research methodology

The main objective of this paper is to investigate the impact of tax determinants that includes macroeconomic variables such as gross domestic product per capita (GDP_{pc}), inflation rate (INF), industry value added of GDP (IND), trade of GDP (TRD), government expenditure (GE), and gross government debt (DBT). The joining to European Union was considered as a dummy variable, where Baltic countries were divided into two periods: 0 – Baltic countries before joining to European Union and 1 – Baltic countries after joining to European Union. The empirical study has analyzed annual data series from International Monetary Fund for Baltic countries (Estonia, Latvia and Lithuania) for the period 1995–2020. The variable description is presented in Tab. 1.

The empirical study involves static models such as RE (random-effect) model and FE (fixed-effect) model and dynamic PMG model. Pesaran and Smith (1995), as well as

Tab. 1: **Variable selection**

Variable	Notation	Calculation
Tax revenue	TR	% of GDP
Gross domestic product per capita	GDP_{pc}	Constant prices; PPP: 2017 international dollars
Inflation rate	INF	Consumer price index
Industry value added	IND	% of GDP
Trade	TRD	% of GDP
Government expenditure	GE	% of GDP
Gross government debt	DBT	% of GDP
Exchange rate volatility	EXC_{rate}	EUR/USD
Joining to European Union	EU_{join}	0 – before joining to European Union; 1 – after joining to European Union

Source: own

Pesaran et al. (1999) reflected two various estimators as MG (mean group) and PMG (pooled mean group) to undertake the heterogeneity bias. Pooled mean group (PMG) specification is a very useful and widely accepted model to analyze the dynamic behavior of explanatory variables. This model is very powerful as it can explore variables that are I (0) and I (1) in a single autoregressive distributive lag (ARDL) model setup (Neog & Gaur, 2020). This estimator is appropriate for investigating dynamic panels with large time and cross-section dimensions (Jalles, 2021). This methodological approach is suitable for computing both pooled and country-specific policy, while controlling for the common long-run nexus between the observed countries (Asandului et al., 2021). PMG model starts from the equality of the long-term coefficients and assumptions about the short-term coefficients variation and variance of errors.

$$Y_{it} = \sum_{j=1}^{p} \lambda_{ij} Y_{i,t-j} + \sum_{j=0}^{q} \delta'_{ij} X_{i,t-j} + \mu_i + u_{it} \quad (1)$$

where: λ_{ij} – a coefficient with dependent variable with delay δ'_{ij}; $k \times 1$ – a vector of heterogeneous regression parameters; μ_i – individual effects.

Based on the research's objective, we developed several hypotheses as follows:

H1: GDP_{pc} positively affects the tax revenue performance in Baltic countries.

H2: Inflation negatively affects the tax revenue performance in Baltic countries.

H3: Industry value added positively affects the tax revenue performance in Baltic countries.

H4: Trade positively affects the tax revenue performance in Baltic countries.

H5: Government expenditures positively affect the tax revenue performance in Baltic countries.

H6: Gross government debt negatively affects the tax revenue performance in Baltic countries.

H7: Exchange rate volatility negatively affects the tax revenue performance in Baltic countries.

H8: Joining to the European Union positively affects the tax revenue performance in Baltic countries.

3. Research results

To determine the tax performance of Baltic countries (Estonia, Latvia and Lithuania), there is a tabular view of TAX-GDP ratio for the period 1995–2020. Tab. 2 shows the ratio TAX-GDP in Baltic countries where this ratio is manifested as tax revenue as a percentage of the gross domestic product. The average value of this indicator is 30.36% for the Baltic region, where Latvia and Lithuania recorded a similar value around of 29.3%, while Estonia recorded an average value of 32.33%.

This is an interesting fact due the value of TAX-GDP ratio increased in Latvia and Lithuania by 2.18 and 3.59 in the gross domestic product from 1995 to 2020, although the share of tax revenue decreased in GDP in Estonia

Tab. 2: TAX-GDP ratio in Baltic countries

Year	Estonia	Latvia	Lithuania
1995	34.998	29.732	27.652
1996	33.824	29.197	27.264
1997	33.553	30.283	31.248
1998	33.622	31.291	32.761
1999	32.370	30.285	32.662
2000	31.087	29.085	30.822
2001	30.321	28.158	29.357
2002	30.982	27.849	29.028
2003	30.771	27.464	28.663
2004	30.985	27.612	29.025
2005	29.756	27.878	29.234
2006	30.437	28.647	30.165
2007	30.984	28.242	30.061
2008	31.238	27.891	30.611
2009	34.952	28.167	30.214
2010	33.196	28.643	28.285
2011	31.494	28.210	27.166
2012	31.701	28.952	26.919
2013	31.666	29.206	26.711
2014	32.135	29.768	27.477
2015	33.322	29.861	28.677
2016	33.517	30.805	29.656
2017	32.548	31.201	29.644
2018	33.046	31.144	30.227
2019	33.526	31.244	30.279
2020	34.512	31.913	31.250

Source: own

by 0.49. The maximum value of 35% is identified in Estonia in 1995, while the smallest value of 26.71% was recorded in Lithuania in 2013. Analyzing the period before accession to the European Union, the average value of the indicator was 30.38%, while after 2004 these countries achieved a lesser level of 29.72%. It implies that gross domestic product increased faster than tax revenue in these economies. Besides ensuring external security, this is the second motive that Baltic states joined to the EU to maintain the economic policy and catch up with the rest of the countries in the European Union (Vilpišauskas, 2021). Since we identify which determinants are crucial for tax revenue performance, there is a descriptive approach of selected variables gross domestic product per capita (GDPpc), inflation (INF), industry value added (IND), trade (TRD), government expenditure (GE) and gross government debt (DBT) for Baltic countries (Estonia, Latvia and Lithuania) from 1995 to 2020.

Tab. 3: Descriptive analysis

Country	TR	GDP$_{pc}$	INF	IND	TRD	GE	DBT
Estonia							
Mean	32.33	25,630.42	5.34	25.13	142.41	38.15	7.40
Std. dev.	1.49	7,195.44	6.39	1.26	14.34	3.17	3.08
Min	29.76	12,761.00	−0.63	22.65	116.77	33.44	3.77
Max	34.99	36,488.00	29.01	27.38	170.76	45.85	18.46
Latvia							
Mean	29.34	20,532.08	4.99	21.67	102.54	36.87	25.26
Std. dev.	1.34	6,851.77	6.07	2.71	18.09	2.73	14.58
Min	27.46	9,451.00	−1.22	18.52	73.86	32.95	8.09
Max	31.91	30,774.00	25.00	27.95	128.23	42.82	46.69
Lithuania							
Mean	29.43	23,260.85	4.37	27.24	119.22	35.47	28.27
Std. dev.	1.65	8,409.09	6.43	1.49	25.20	3.41	10.26
Min	26.71	10,652.00	−1.07	24.98	74.82	31.96	14.58
Max	32.76	37,133.00	25.10	30.03	155.89	43.71	47.13
Total							
Mean	30.36	23,141.12	4.91	24.68	121.39	36.83	20.31
Std. dev.	2.04	7,707.57	6.23	2.99	25.49	3.27	13.87
Min	26.71	9,451.00	−1.22	18.52	73.86	31.96	3.77
Max	34.99	37,133.00	29.01	30.03	170.76	45.85	47.13

Note: For further information, see Tab. 1.

Source: own

Results from the descriptive analysis (Tab. 3) show that Baltic countries achieved tax revenue of 30.36% of GDP at the average level from 1995 to 2020. The highest mean value of tax revenue (TR) was 32.33% in Estonia which is more than Latvia (29.34%) and Lithuania (29.43%). Analyzing tax determinants by Baltic region, we can see that selected countries had average gross domestic product per capita (GDPpc) of 23,141.00 international dollars with the average inflation rate (INF) of 4.91% in the observed period. If we compare the share of industry value in GDP, the contribution of industry value added of GDP (IND) was 24.68% which the largest value identified in Lithuania (27.24% of GDP). Further, the mean share of trade is 121.39% of GDP where Estonia recorded the most average trade share (TRD) of 142.41% compared to Latvia and Lithuania. Finally, the average government expenditures (GE) were 36.83% of GDP in the Baltic region, while the mean gross government debt (DBT) level was 20.31% which is far less than most countries in the world. It implies that these economies currently do not have problems with debt. Countries should adequately manage debt levels to avoid negative implications to their economic growth, specifically gross domestic product (Snieška & Burksaitiene, 2018).

Tab. 4 shows the results of cross-sectional dependence and the unit root tests. LM test detects cross-sectional dependence and it is based on the average of the squared pairwise sample correlation coefficients of the residuals (Halunga et al., 2017). Based on Breusch-Pagan LM

Tab. 4: Cross dependence tests and unit root tests

Variable	TR	GDP$_{pc}$	INF	IND	TRD	GE	DBT
Breusch–Pagan LM	146.070*	108.33*	92.78*	65.50*	54.86*	88.93*	82.04*
Pesaran-scaled LM	26.590*	21.34*	16.20*	12.66*	9.65*	15.95*	14.77*
CADF (level)	−2.278	−1,416.00	−2.24	−2.24	−1.37	−2.61	−1.53
CADF (first difference)	−3.512*	−2,580.00*	−4.18*	−2.88*	−3.65*	−5.65*	−2.27*
CIPS (level)	−1.851	−2.04	−2.01	−2.33	−1.87	−3.25	−1.27
CIPS (first difference)	−3.662	−4.42*	−5.95*	−4.68*	−5.14*	−5.46*	−3.22*

Note: *Significance of 0.05.

Source: own

and Pesaran-scaled LM tests, we can confirm the cross sectional dependence. It implies that spatial spillover consequences are possible in these economies, where shock in one country can influence other countries. Because of the existence of cross-sectional dependence in the variables, we used the second-generation panel unit root tests of Pesaran (2007) to explore the variable stationarity (Durusu-Ciftci et al., 2018). Results of the second generation unit root tests CADF and CIPS manifest that all variables are not stationary at the level, but after the first difference, selected variables become stationary.

Tab. 5 reflects two different panel approaches (static and dynamic) to precisely estimate the effect of selected determinants on tax revenue performance in Baltic countries. Firstly, we can see that random-effects model is an appropriate constructed model compared to fixed-effects model (value of Hausman test = 0.1383). The results of the chosen model show a significant impact of explanatory variables (GDP$_{pc}$, INF, GE, DBT, EXC$_{rate}$ and EU$_{join}$)

Tab. 5: Different panel estimation

Model variable	Static modelling		Dynamic modelling (PMG)	
	RE	FE	Short-run	Long-run
GDP$_{pc}$	0.0022***	0.0056***	0.0029***	**0.0018***
INF	−0.0763***	−0.0714***	−0.0951***	**−0.1849***
IND	0.0324*	0.1693*	0.2788*	**0.7163***
TRD	0.0087*	0.0102*	0.0039*	0.0148**
GE	**0.3084***	**0.2561***	0.0531*	0.4681*
DBT	**−0.7195***	**−0.0453***	−0.1498*	−0.0803*
EXC$_{rate}$	**−1.6739***	**−1.8710***	−0.3512**	−2.7528**
EU$_{join}$	**0.5776***	0.2315**	0.4230**	0.1965**
C	**2.0389***	**2.8102***	**0.8271***	
ECT			**−0.5238***	
R-squared	0.6929	0.5295		
Prob > Chi2	0.0000	0.0000		
Hausman test	11.01 (0.1383)			

Note: ***Significance of 1%; **significance of 5%; *significance of 10%.

Source: own

on tax revenue performance in selected countries at the significance level of 1%. Precisely, GDP_{pc} has a positive effect on TR, where a 1% increase in GDP_{pc} enables a higher TR for 0.0022%, so hypothesis *H1* can be accepted. Further, INF negatively affects the TR, where a 1% growth of this predictor enables lower TR for 0.0763%. Therefore, hypothesis *H2* can be confirmed. The predictors GE and DBT have significant, but different effects on TR. It implies that a higher level of GE by 1% enables a greater value of TR for 0.3084%, while DBT has a negative impact on TR. The results show that if the debt level of Baltic countries increases by 1% will decline TR by 0.7195%. It means that hypotheses *H5* and *H6* can be confirmed. The predictor EXC_{rate} has a harmful effect on tax revenue performance in Baltic countries, where a 1% change of this variable inversely affects the TR for 1.6739%. Finally, the joining of Baltic countries to the European Union had positive implications on TR in the observed economies. Based on mentioned, we can conclude that hypotheses *H7* and *H8* can be accepted. The variables IND and TRD have a significant and positive effects on TR, but at the significance level of 10%. It implies that hypotheses *H3* and *H4* can be confirmed.

The reliability and validity of these empirical findings can be confirmed by a very high value of *R*-squared 0.6929. Secondly, based on Hausman test, PMG estimator is an adequate model to identify the impact of tax determinants in short-run and long-run. The speed of adjustment (ECT) is negative and significant and confirms long-run equilibrium nexus between selected variables. The value of ECT is 0.53 indicates that there was 53% of adjusting occurred in the previous period toward the equilibrium, while 47% is in disequilibrium. The empirical findings show that selected variables are significant for TR in Baltic countries for both periods, while the effects of most predictors are greater in long-term. Namely, variable EU_{join} has larger impact on TR in short-run compared to other variables. It means that Baltic countries had the benefits of joining of European Union, but over time these positive effects will be smaller. Similarly, a higher level of debt causes greater change TR in the short-run, where a 1% increase in DBT declines value of TR (−0.14%).

Based on the results from Tab. 6, we can conclude the presence of dynamic stability between selected variables (value of ECT is negative). It implies that long-run equilibrium exists

Tab. 6: Pooled mean group (PMG) estimator by countries

Variables	Estonia	Latvia	Lithuania
ΔGDP_{pc}	0.072*** (0.000)	0.003*** (0.000)	0.001*** (0.000)
ΔINF	−0.014** (0.008)	−0.048** (0.003)	−0.183*** (0.000)
ΔIND	0.177* (0.063)	0.003** (0.039)	0.084*** (0.000)
ΔTRD	0.008** (0.061)	0.026* (0.085)	0.064** (0.018)
ΔGE	0.309*** (0.000)	0.252** (0.006)	0.245** (0.000)
ΔDBT	−0.134* (0.092)	−0.481** (0.076)	−0.127*** (0.000)
EXC_{rate}	−2.553*** (0.000)	−2.478** (0.000)	−3.305*** (0.000)
EU_{join}	1.262** (0.008)	1.441** (0.003)	0.347*** (0.000)
ECT	−0.879	−1.022	−0.461

Source: own

among tax revenue and macroeconomic determinants in these countries. After presenting the results of the group and particular analysis, it is necessary to point out that gross domestic product, inflation, industry added value, trade, government expenditure, debt and exchange rate volatility are significant determinants for improving tax revenue performance.

Conclusions

Tax revenue mobilization is one of the most essential issues for every government, especially in extraordinary circumstances. The pandemic COVID-19 has shown that state budgets have to be prepared to withstand the pressure of low revenue as a result of the rigorous closure of the economy. Tax revenue performance depends on economic development level and identifying factors that affect revenue is an important step in profiling tax policy and determining tax structure.

We have estimated tax revenue performance in Baltic countries (Estonia, Latvia and Lithuania) from 1995 to 2020. The empirical analysis has included static and dynamic panel approaches which imply random-effects model and fixed-effect model, pooled mean group, as well as second-generation panel unit root tests. These econometric procedures were implemented in order to determine which tax revenue determinants are crucial for tax system of Baltic countries. Empirical models have included macroeconomic indicators (gross domestic product per capita, inflation, industry value added share, government expenditures, gross government debt and exchange rate volatility) which can be related to tax revenue performance. The results of chosen RE model show a significant effect of explanatory variables (GDP_{pc}, INF, GE, DBT, EXC_{rate} and EU_{join}) on tax revenue performance in selected countries at the significance level of 1%. Specifically, GDP_{pc} positively affects the TR, where a 1% increase in GDP_{pc} enables a higher TR of 0.0022%. Further, INF negatively affects the TR where 1% growth of this predictor enables lower TR for 0.0763%. The predictors GE and DBT have significant, but various effects on TR. It implies that a higher level of GE by 1% enables a greater value of TR for 0.3084%, while DBT has a negative impact on TR. The results show that if the debt level of Baltic countries increases by 1% will declines TR by 0.7195%. The predictor EXC_{rate} has a harmful effect on

tax revenue performance in Baltic countries, where a 1% change of this variable inversely affects the TR for 1.6739%. At last, the joining of Baltic countries to the European Union had positive implications to TR in the observed economies. The variables IND and TRD have a significant and positive effects on TR, but at the significance level of 10%. These findings show that selected determinants significantly affect the tax revenue in Baltic region, where hypotheses *H1, H2, H5, H6, H7* and *H8* can be accepted at significance level of 1%, where *H3* and *H4* can be accepted at the significance level of 10%. The results of a dynamic approach based on PMG estimator confirmed significant and long-run equilibrium nexus between selected variables.

Finally, the empirical findings show that selected variables are significant for TR in Baltic countries for both periods, while the effects of most predictors are greater in long-term. The accession to the European Union has a larger impact on TR in short-run compared to other variables. It means that Baltic region had the benefits of joining of the European Union, but over time these positive effects will be less. In addition, a higher level of gross government debt causes greater change TR in the short-run, where 1% increase of DBT declines value of TR (−0.14%). The empirical study enables information support to policymakers in Baltic countries in order to identify which determinants are favourable for tax revenue performance. Bearing in mind that cross sectional dependence is confirmed, it is necessary for some coordination between these economies in terms of defining the macroeconomic framework. This coordination implies monetary and fiscal harmonized actions to provide positive implications to the Baltic region. In addition to expanding the theoretical opus that has analyzed tax revenue determinants, the contribution of these findings is manifested in fact that empirical models give a certain guidelines to governments of Baltic region about improving tax revenue performance and creating a favourable macroeconomic framework. Precisely, Baltic countries should focus on a higher level of economic growth, greater industry share and trade of GDP, as well as lower inflation rate, lesser exchange rate volatility and smaller government gross debt. In that way, macroeconomic variables will stimulate and improve tax revenue performance in Baltic countries.

One of the most visible contributions is that this paper expands the theoretical background of tax revenue performance with focus on Baltic region, where there is no similar paper that has analyzed this region to the authors' knowledge. The limitation of conducted empirical research is using certain macroeconomic determinants that can influence tax revenue, but there are no institutional factors such as governance stability, corruption, tax evasion and similar components that can affect the tax revenue level. Future empirical research will expand the list of potential determinants as non-economic determinants such as social and institutional factors that influence tax revenue performance, as well as a country groups such as Nordic countries and Benelux countries.

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