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## Mitigating the shadow: Exploring taxes as solutions

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**Abstract.** Nations attempt to attract major enterprises to their territories by implementing lower tax rates while simultaneously enhancing tax collection efficiency within their jurisdictional boundaries. In this study, we scrutinize the correlation between the Baltic countries' tax systems and the levels of the shadow economy inherent to their respective economic landscapes. Our analysis indicates that tax reform can substantially influence diminishing the corporate shadow economy within a society. More specifically, our research delves into how economic growth can mitigate the corporate shadow economy, primarily driven by shifts in tax collections within Lithuania. Utilizing quarterly data from 2002 to 2022, we use panel regression and causality analyses as the overall analytical approach. The analyses uncover a complex relationship between various effective taxes and the extent of the shadow economy. Notably, we find that while an increase in the effective income tax rate is associated with a growing shadow economy, an uptick in the effective corporate income tax rate has the opposite effect, reducing its scale. Additionally, a rise in the effective VAT rate is linked to an expanded shadow economy. However, the influence of these effective taxes on imports has limited significance in regulating the scope of the shadow economy, likely due to increased tax evasion incentives. Overall, this study contributes to our understanding of how tax reform can impact the shadow economy and underscores the need for more comprehensive strategies to address this issue.

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## 1. INTRODUCTION

The shadow economy is a widely researched topic. Despite extensive research on this topic, the scientific literature often reaches a mutual understanding but not an agreement on the exact definition of the shadow economy (Ginevicius et al., 2020). Studies show that even within the same country, authorities use different shadow economy estimation methods, leading to significant differences in findings, even if the substantive focus is similar (Buszko, 2022; Gasparieniene & Remeikiene, 2016a, 2016b). Often, the definition of the shadow economy is exchanged with and reduced to interchangeable characteristics, such as unofficial, informal, underground, unobserved or non-observed, secondary, illegal, and illicit (Savickienė & Šitkauskienė, 2022).

The primary objective of this study is to elucidate how the tax systems in Baltic countries can impact the shadow economy level and to assume the possible potential for mitigating the shadow economy in these nations. Our central hypothesis posits that tax reform, as a strategy, may not be effective enough in reducing the corporate shadow economy despite existing theoretical expectations. In this paper we address the research aim and hypothesis through the following structure: 1) an overview of the research aim and the hypothesis; 2) an analysis of the theoretical underpinnings regarding tax reform's expected impact on the corporate shadow economy in the literature review; 3) methodology as an exposition of the research methods employed to investigate the empirical aspects of this study, including data collection and analysis techniques; 4) presentation of empirical results and their implications concerning the influence of tax reform on the corporate shadow economy in Baltic countries; 5) discussion of the empirical findings, considering

their alignment with or deviation from the main hypothesis; and, finally, a concluding summary of the paper's key findings and implications.

To test our hypothesis, we will proceed based on the following assumptions. Since there is no clear and universally accepted definition of all aspects of the shadow economy, we adopt the definition of F. Schneider, which includes both the illegal economy and the entire legal economy where non-payment, optimization, or tax evasion occurs on legal or illegal grounds. It should be noted that most countries avoid frequent changes in tax rates, focusing on improving tax administration. Therefore, the main indicator of fiscal policy is not the tax rate itself but the actual tax revenue to GDP. For this reason, we specifically investigate the impact of the effective tax rate on the shadow economy.

## **2. LITERATURE REVIEW**

One area of research delves into what determines the shadow economy, while another area focuses on the side effects of the shadow economy. The first is nicely reflected by the work of Savickienė and Šitkauskienė (2022). Their research considers the actual determinants that damage economic growth and instigate the shadow economy in the Baltic States. Employing correlation analysis and multi-regression analysis, they find that the annual net earnings and the tax burden are associated with the shadow economy, showing that the size of the shadow economy is influenced by the excise rate on alcohol, the rate of excise duty on tobacco, the corruption perception index, and household indebtedness. Dzemydaitė and Savilionytė (2017) also investigate the determinants of the informal economy, emphasizing the ethical and moral dilemma. By acknowledging the fact that the economy of Lithuania is expanding rapidly and there are continuous efforts by the Government to fight tax evasion, their shadow economy remains one of the largest among the EU states. A qualitative approach is applied in the paper, indicating that the larger size of the shadow economy and more people participating in it leads to higher perception rates of the shadow labor market. Furthermore, the primary economic relations and activities carried out by close social networks notably influence the formation of acceptable standards of individual behavior. The findings support the idea that moral norms act as a certain and significant form of social responsibility and define the desirable economic behavior of an individual. However, the participants' behavior in economic activities is complicated, and due to the lack of moral standards, the actions can only be related to the pursuit of personal well-being.

Rather than focusing on the determinants of the shadow economy, Gasparieniene and Remeikiene, (2021) investigate the conditions under which the informal economy is booming, focusing on economic downturns and the COVID-19 pandemic. They analyze survey data, and the sample is drawn from the working age (18-65) unemployment population in Lithuania. They find that the unemployed residing in the border municipalities (90 per cent) are more likely than the unemployed residing in non-border municipalities (87 per cent) to disclose their source of smuggled goods or persons who consume them on a daily basis. The unemployed residing in smaller municipalities are more likely to justify the consumption of smuggled goods than the unemployed residing in larger municipalities. And, the unemployed registered in smaller municipalities are more likely to earn or seek income from external short-term orders, for which they were paid in cash (informally) than the unemployed registered in larger municipalities. They conclude that during the pandemic, unemployment is closely linked to informal activities because the individuals are conditioned to survive the emergency and thus justify the growth of the shadow economy.

Baklouti and Boujelbene (2019) study how corruption levels in public administration affect economic growth and how this effect deepens the shadow economy. By analyzing data for 34 OECD countries over the period between 1995 and 2014 and using multiple estimation methods, they find that corruption is associated with an increased non-official activity, which in turn leads to lower tax revenues and subsequent

decline of economic growth. Therefore, corruption and the shadow economy act as complements. These results also indicate that the shadow economy magnifies the effect of corruption on economic growth.

According to the literature review and research studies, the most typical factors fostering the shadow economy are related to: level of taxation and tax morale (Buehn et al., 2012); inappropriate labor market regulations (Rosser et al., 2000; Mishchuk et al., 2018); complicated and contradictory legal system (Curti et al., 2015; Gaspareniene et al., 2022); unemployment rate (Maloney and Mendez, 2004); level of corruption (Dreher and Schneider, 2006; Al-Naser and Hamdan, 2021); quality of public institutions (Andersen et al., 2007); structure of the population's income (De Soto, 2000); inefficient market exit (Giuliano and Ruiz-Arranz, 2009; Tiutiunyk et al., 2022).

As already noted, while one body of research focuses on the the determinants of the shadow economy, another body instead analyzes its repercussions. For instance, using a large sample of nations, Capasso et al. (2023) examine the direct relationship between corruption and the shadow economy, focusing particularly on geographical spillovers. Using a spatial lag model (SLM), the authors examine how corruption and the shadow economy in any state can affect its neighboring states. They also rely on a spatial error model (SEM) to test how corruption (shadow economy) and neighboring corruption (shadow economy) establish certain links with each other. The results show that corruption and the shadow economy exhibit spatial dependence, which proves the hypothesis that activity in one state affects the activity in a neighboring state.

Gnangnon (2023) also focus on the negative effects of the shadow economy, particularly on international trade tax revenues. They examine the effect of the shadow economy on tax reform in developing countries, focusing on two types of tax reform, namely structural tax reform, which is characterized by large episodes of tax revenue mobilization, and tax transition reform, characterized by a reform of the tax revenue structure to reduce its dependence on international trade tax revenue (TTR). The analysis covered a sample of 40 countries (including 24 Low-Income Countries (LICs) and 16 Emerging Markets (EMs)) from 2000 to 2015. So, the analysis concerning the effect of the shadow economy on tax transition reform covered an unbalanced panel dataset of 114 countries from 1995 to 2015. They conclude that countries that have opened their economies less to international trade experience a negative effect of the shadow economy on the extent of TTR, and the lower the degree of trade-openness, the greater is the negative effect of the shadow economy on the extent of TTR. The core message conveyed by this analysis is that while the expansion of the shadow economy reduces the likelihood of a sustained increase in tax revenue, including across several tax policy and revenue administration areas, it could also enhance the implementation of the tax transition reform in countries that improve their participation in international trade.

According to the literature, there are multiple factors fostering the shadow economy. Buszko (2022) reveals that level of economic growth and unemployment rate are crucial ones. Whenever an improved economic situation is noticed, there is less space for shadow economy performance. Another is the level of criminal activity as the shadow economy goes hand-in-hand with illegal economic activity. Canh et al. (2021) research shows a strong negative impact of institutional quality and foreign direct investment inflows, and also a weak negative influence of trade openness on the shadow economy. Trade openness has a negative impact in both the short run and long run, while foreign direct investment inflows have a negative influence in the short run but it is positive in the long run. The influence of institutional quality is quite heterogeneous since the control of corruption and the rule of law have a significant negative impact in the short run, while political stability has a significant negative impact in the long run. Ivcheva (2021) identifies several causes of shadow activities such as low tax morale, high levels of unemployment, weak business environment and high poverty levels, lack of trust in the state and the public institutions, high perceptions of corruption, and high taxation levels. Szulc-Obloza (2020) argues that regulations are seen as a push factor into the shadow sphere and analyzes the relationship between labour market regulations related to wages and the shadow

economy. Buček (2017) investigates how labour marks and the burden of taxation might contribute to the existence of the shadow economy. As for the country’s particular regions, surrounding big cities, especially Prague, have, on average, a smaller shadow economy size, whereas regions in the borderlands (former Sudetenland) suffer from a larger shadow economy. González-Fernández and González-Velasco (2015) announced the Personal Income Tax has the greatest impact on the shadow economy.

In addition to the methodology, which describes F. Schneider's approach to calculating the shadow economy level there are some references for our research pillars (Table 1).

Table 1

The brief overview of the existing literature on the topic

Authors (publication year)	Period and Country(-ies) of study	Method	Results
(Abela et al., 2022)	2010-2019; Malta	Currency Demand Approach; Multiple Indicator Multiple Causes (MIMIC) model	Both methods suggest that it has remained relatively stable over the last decade, standing at just below 21% of the official GDP.
(Buček, 2017)	2005-2014; Czech Republic	Multiple Indicator Multiple Causes (MIMIC) model	The size of the shadow economy had always been between 15 % and 18 % of GDP and had decreased over the 2005- 2015 period.
(González-Fernández and González-Velasco, 2015)	1987-2010; Spanish Autonomous Communities	Currency Demand Approach	The results show that the size of the shadow economy ranges from 18% to 30% of regional GDP and an approximate mean value of 25% for the entire territory.
(Torosyan and Filer, 2014)	2003-2009; Tax reform on 2005; Georgia	Currency Demand Approach; Engel curve estimation; Consumption–income gap estimation	The amount of income underreporting decreased in the years following the reform. The biggest change is observed for households headed by a farmer.
Medina and Schneider (2017)	1991-2015, 158 countries	Multiple Indicators, Multiple Causes method	The average size of the shadow economy is 32.5% of official GDP, which was 34.82% in 1991 and decreased to 30.66% in 2015. The lowest size of the shadow economy is East Asian countries with a 16.77% average, then OECD countries with 18.7% and the highest value have Latin American and sub-Saharan African countries with values above 35%.
(Buehn et al., 2018)	1989-2009, 104 countries	Multiple Indicators, Multiple Causes method	Concealing the real tax burden, they find that an increase in taxation increases both shadow economic activities and fiscal illusion.
Schneider and Hassan, 2016	1976-2013, Egypt	Currency Demand Approach; Multiple Indicators, Multiple Causes method	The results indicate a decreasing trend in the size of the shadow economy from more than 50% in 1976 to 32% in 2013, yet it still comprises a large portion of the official GDP.
Lahlou et al., 2020	1988-2018, Maroko	Currency demand approach; Multiple Indicators, Multiple Causes method	The evolution of the shadow economy exhibits three distinct periods: over the 1988-1998 period, it is almost stagnant at around 40% of GDP; during 1999-2008, it decreased to 32% 34% of GDP; during 2009-2018, the declining trend is continuing but at a more moderate pace, to reach a level just below 30% of GDP.

Source: Authors’ compilation.

Using data from nearly 130 nations, Berdiev et al. (2021) find that both the incidence and the intensity of epidemics positively and significantly contribute to the spread of the informal sector. The informal sector undermines compliance with government regulations and lowers tax collections. Numerically, a ten per cent increase in the intensity of epidemics leads to an increase in the prevalence of the shadow economy by about 2.1 per cent. These findings have implications for economic policies during the COVID pandemic. In 2020, a strong increase in the shadow economy from 14.98% of GDP (2019) to 16.48% of GDP (2020) is observed; i.e., a 1.5 percentage points or 10% increase — the strongest increase of the average figure over the last 20 years. The main reason for this increase is the worldwide COVIDs pandemic and the resulting severe recession which has affected most countries (Schneider, 2022).

The literature review and our prior work (Giedraitis et al., 2023), let us to formulate following research hypothesis:

H1: An increase in the effective income tax rate is positively correlated with the expansion of the shadow economy, as higher taxes drive individuals to participate in informal economic activities.

H2: An increase in the effective corporate income tax rate is negatively correlated with the level of the shadow economy, as higher taxes reduce opportunities for funds to be siphoned abroad and thereby decrease tax evasion.

H3: An increase in the effective VAT rate is positively correlated with the expansion of the shadow economy, as higher VAT rates incentivize tax evasion through refund schemes and fictitious imports.

H4: The impact of various effective taxes on imports has little significance in regulating the scope of the shadow economy.

H5: There is no long-term stable relationship (cointegration) among the variables (effective income tax rate, corporate income tax rate, VAT rate, tax policy changes) and the shadow economy level in the Baltic countries.

H6: Changes in the effective personal income tax rate Granger cause changes in the shadow economy level.

H7: There is no significant Granger causality between the shadow economy level and the other tax variables tested, indicating the absence of a strong causal relationship.

H8: Factors such as the effective income tax rate, corporate income tax rate, and VAT rate do not have a consistent, long-term impact on the shadow economy level, as evidenced by the lack of cointegration.

H9: There is a one-way causality from the effective personal income tax rate to the shadow economy level.

H10: Economic downturns, such as those in 2009 and 2020, contribute to an increase in the extent of the shadow economy.

All stages of further analysis are designed according to the hypotheses.

### 3. METHODOLOGY

In prior work, we tested the hypothesis that the effective tax rate has a direct influence on the extent of the shadow economy. However, it became evident that specific tax rates themselves are not typically subject to frequent changes, often remaining unchanged for extended periods (Giedraitis et al., 2023).

Consequently, these static tax rates may not provide a relevant basis for assessing their impact on the shadow economy. To address this issue, we opted for a more informative indicator for this analysis: the effective tax rate. This metric is derived from the ratio of the actual tax revenue collected during a specific period to the Gross Domestic Product (GDP) of the country for the same duration. By utilizing effective tax rates for core taxes, we aim to better understand their correlation with shifts in the shadow economy.

Furthermore, for our examination of the shadow economy, we rely on the widely accepted measure introduced by F. Schneider, which is currently regarded as the most objective metric for gauging the extent of the shadow economy (Schneider and Kearney, 2013). This allows us to conduct a relatively comprehensive analysis of tax changes and their potential effects on the shadow economy, building upon the foundation established in previous work. The underlying assumptions guiding our research are as follows:

1 - The three countries we examine are interconnected synergistically, both in terms of government tax regulation and the movement of capital within their borders.

2 - If the corresponding coefficient in our model is statistically significant and demonstrates a negative relationship with the growth of the effective tax rate, it suggests that the government has been successful in collecting a substantial portion of taxes and reducing the size of the shadow economy proportionally.

3 - Conversely, if the corresponding coefficient is statistically significant and displays a positive relationship with the growth of the effective tax rate, it implies that the government has struggled to collect all potential taxes, leading some of them to remain in the shadow economy.

4 - When the coefficient of a specific tax in the model is found to be statistically insignificant, it may indicate that this particular tax does not serve as a conduit for businesses to engage in the shadow economy. In contrast, a significant coefficient underscores that this tax plays a primary role in channeling economic activities into the shadow sector and can be subject to regulatory measures by the government.

5 - Additionally, we hypothesize the presence of cointegration and bidirectional causality between tax levels and the extent of the shadow economy, suggesting that changes in one variable may lead to changes in the other and vice versa over time. This further enriches our understanding of the intricate relationship between taxation and the shadow economy in the selected countries.

6 - When the constant coefficient in the model holds statistical significance, it may serve as an indicator of the baseline level of the shadow economy, unaffected by the impact of government tax policies.

Based on the initial assumptions, we opted for a panel regression analysis, enabling us to assess the influence of each specific tax on the shadow economy independently, treating all three datasets as an integrated and interrelated system. It's noteworthy that we chose not to construct separate regression models for each country due to the substantial economic similarities among the states under consideration. The selection of the regression model is contingent upon the specific context and attributes of the research. Generally, a fixed-effects model is employed when the focus is on exploring the effects of variables that change over time - we consider the linear unobserved effects model for  $N$  observations and  $T$  time periods (Green, 2011):

$$y_{it} = X_{it}\beta + \alpha_i + u_{it} \text{ for } t=1, \dots, T \text{ and } i=1, \dots, N,$$

where:

$y_{it}$  - is the dependent variable observed for individual  $i$  at time  $t$ ;

$X_{it}$  - is the time-variant  $1 \times k$  (the number of independent variables) regressor vector;

$\beta$  - is the  $k \times 1$  matrix of parameters;

$\alpha_i$  - is the unobserved time-invariant individual effect. For example, the innate ability for individuals or historical and institutional factors for countries;

$u_{it}$  - is the error term.

Unlike  $X_{it}$ ,  $\alpha_i$  cannot be directly observed; however, unlike the random effects model where the unobserved  $\alpha_i$  is independent of  $X_{it}$  for all  $t=1, \dots, T$ , the fixed effects (FE) model allows  $\alpha_i$  to be correlated with the regressor matrix  $X_{it}$ .

Whereas a random-effects model is instead preferred when the interest lies in the overall impact across the entire sample: the random-effect model assumes that  $\alpha_i$  is uncorrelated with the explanatory variables, allowing for the inclusion of time-invariant variables.

The Hausman test is a common tool used to compare the suitability of fixed-effects and random-effects models. If the test results indicate that a fixed-effects model is superior, it suggests that the studied entities possess consistent characteristics that are crucial for modelling. Conversely, if the random-effects model performs better, it implies that the entities exhibit varying characteristics that cannot be adequately captured by fixed effects.

In addition to the panel regression analysis, we also employed the cointegration method to further enhance our understanding of the dynamics between tax levels and the shadow economy. Cointegration analysis helps us investigate the long-term relationships and potential equilibrium between these variables. It assesses whether changes in tax levels and the shadow economy tend to move together in the long run, suggesting a stable relationship.

Cointegration is particularly valuable in cases where we suspect a sustained connection between tax policies and the shadow economy, allowing us to explore the possibility of bidirectional causality. If cointegration is established, it signifies that changes in tax levels and the shadow economy are not merely coincidental but are intertwined in the long term, with one variable affecting the other and vice versa. This can offer valuable insights into the intricate interplay between taxation and the shadow economy in the context of the Baltic countries, enriching our analytical toolkit and providing a more comprehensive view of the dynamics at play.

In addition to panel regression and cointegration analysis, we also conducted causality analyses to delve deeper into the relationship between tax levels and the shadow economy in the Baltic countries. Granger causality tests, for instance, allow us to assess whether past values of tax levels can predict future changes in the shadow economy and vice versa. This analysis helps us discern the temporal sequence of events and provides insights into whether tax policies have a causal impact on the shadow economy or if the reverse is true. These causality analyses are instrumental in uncovering the underlying mechanisms at play and contribute to a more comprehensive assessment of the complex relationship between taxation and the shadow economy within the Baltic countries.

Thus, the panel regression model considers  $Y$  – the dependent variable as the shadow level of the  $i$ -th economy in the period  $t$ , factors: effective tax rate in the country  $i$  in the period  $t$ , and additional variable, describing crisis periods. Meanwhile, random cross-country effects are incorporated into the model as the most significant form of regression assessment.

Examining a single model encompassing all categories of effective tax rates appeared impractical, owing to the potential high degree of multicollinearity among indicators. The inclusion of the supplementary (dummy) variable  $X$  can be attributed to significant fluctuations in tax collection that transpired during two distinct periods: in 2009 following the global financial crisis, and in 2020 amidst the onset of the COVID-19 pandemic. We conduct an analysis of three countries that share significant economic similarities: Lithuania, Latvia, and Estonia (Ministry of Finance of Republic of Lithuania; Official statistics of Latvia; Statistics Estonia, 2023). These nations, all once part of the USSR, underwent profound economic transformations, subsequently becoming members of the European Union and adopting the euro as their national currency. Situated in close proximity to one another with coastal access, they exhibit a relatively uniform economic structure. The primary dataset for this study is based on data from the years 2002 to 2021 (60 Observations) (Table 2) (Eurostat, 2023). This temporal range allows for the construction of a weighted dated panel, which serves as the foundation for our analysis.



Table 2

Dataset					
Parameter	Variable title	Description	Mean	Normality test (prob JB)	Stationarity
SEL	Shadow economy level	Size of the shadow, calculated by F. Schneider, (in % of off. GDP), representing the extent of economic activities not reported to the authorities for tax purposes. This variable captures the extent of unreported economic activities. It is crucial for understanding the hidden economic activities that escape taxation and regulation.	0.27	0.17	$+(\Delta^1)$
EPTR	Effective personal income tax rate	Personal income tax in % of off. GDP, indicating the actual tax rate applied to personal income after accounting for deductions and exemptions. his rate reflects the true burden of personal income taxes after all legal adjustments. It is significant because high personal income taxes can drive individuals to engage in shadow economic activities.	0.06	0.13	$+(\Delta^2)$
CT	Corporate tax	Corporate tax in % of off. GDP, reflecting the tax rate imposed on corporate profits. The corporate tax rate affects businesses' decisions regarding formal reporting of profits. Lower corporate taxes might reduce incentives for businesses to hide income.	0.02	0.07	$+(\Delta^1)$
VAT	VAT	VAT in % of off. GDP, a consumption tax levied on the value added to goods and services at each stage of production or distribution. VAT affects consumer prices and can influence the shadow economy if high rates lead to underreporting of sales to avoid taxes.	0.08	0.09	$+(\Delta^1)$
TP	Taxes on products, except VAT and import taxes	Taxes on products, except VAT and import taxes, in % of off. GDP, including various other taxes imposed on goods and services. This variable includes various other product-related taxes that can also affect economic behavior and the shadow economy.	0.03	0.02*	+
CD	Customs duties	Customs duties in % of off. GDP, representing taxes imposed on imported goods. Import taxes can lead to smuggling and other forms of tax evasion, impacting the shadow economy.	0.001	0.02*	+

\* significance at the  $\alpha=0.01$ .

Source: Authors' compilation.

These variables are central to our empirical model, which aims to analyze the impact of different tax rates on the shadow economy in the Baltic countries. Each variable is carefully chosen to reflect different aspects of tax policy and its potential influence on the informal economy (Elgin, C., & Oztunali, O. (2012); Buehn, A., & Schneider, F. (2012); Alm, J., & Embaye, A. (2013); Schneider, F., & Buehn, A. (2018), Gokmenoglu, K. K., & Amir, A. (2023); Schneider, F. (2023)).

#### 4. EMPIRICAL RESULTS AND DISCUSSION

Based on the previous research analyses (Giedraitis et al., 2023), while most of the indicators display stationarity when examined in their first differences, it is noteworthy that the EPITR variable exhibits stationarity only upon conducting second differences. On the other hand, the TP and CD variables demonstrate stationarity when examined at their original levels.

Using the Hausman statistic, we selected a model version that incorporates random effects for countries while excluding effects for periods in our study. The presence of random effects for countries was validated through the Hausman test.

The examination of effects pertaining to periods was omitted due to significant fluctuations in 2009 and 2020, stemming from the repercussions of the global financial crisis and the pandemic. It was deemed more appropriate to account for these influences rather than introducing additional effects. In certain models, it was imperative to scrutinize the impact of the year 2020 (represented by variable Y20), while in others, both 2009 and 2020 were assessed concurrently (illustrated by variable Y\_09\_20). The selection of such a model was also influenced by the limited number of available observations, which precluded the construction of a regression model encompassing random effects across both countries and periods simultaneously. For estimation, the least squares method was employed in panel regression, and the comprehensive assessment results are presented in Table 3, indicating that all models are statistically adequate based on F-statistics (with a probability value of 0).

Table 3

Aggregated model evaluation results

Coefficient	Constant	Coefficient with tax	Y_09_20	Y20	Adj-R2
$\Delta^2$ EPITR	-0.0070*	0.1348***	0.0179*	-	0.652
$\Delta$ CT	-0.0059*	-0.4900*	-	0.0191*	0.517
$\Delta$ VAT	-0.0069*	0.2781**	0.0161*	-	0.607
TP	-0.0062*	-0.0177^	0.0158*	-	0.575
CD	-0.0088*	1.1632^	0.0160*	-	0.579

Source: Authors' results. \* significant at 1%, \*\* significant at 5%, \*\*\* significant at 10%, ^ - insignificant

Table 3 reveals that the impact of taxes on the shadow economy exhibits a multifaceted character. Notably, the null hypothesis (H0) is substantiated for all tax categories, except for TP and CD. Specifically, an escalation in the effective income tax rate is associated with an expansion of the shadow economy, suggesting that citizens within the country tend to engage in informal economic activities. Conversely, an increase in the effective corporate income tax rate has the opposite effect, leading to a reduction in the level of the shadow economy. Moreover, a positive uptick in the effective VAT rate is also correlated with an increase in the shadow economy.

Nonetheless, the outcomes of our models underscore that the influence of diverse effective taxes on imports holds little significance in terms of regulating the scope of the shadow economy. This outcome is not unexpected, as heightened payments to the treasury often serve as an incentive for the populace to explore various avenues to evade taxation. Consequently, an increase in the effective tax rate on citizens' incomes tends to foster tax evasion practices. A similar trend is observable in the realm of VAT payment, wherein various refund schemes for exporters and the presence of fictitious imports further exacerbate the issue.

Contrastingly, an uptick in corporate income tax tends to curtail opportunities for funds to be siphoned abroad, thereby reducing the prospects for tax evasion. Our models indicated that the years 2009 and 2020 had a relatively equivalent impact on the magnitude of the shadow economy, contributing to an increase of slightly over one and a half per cent in its extent.

Next, we applied the Johansen cointegration test in the form: {Pedroni Residual Cointegration Test, Sample: 2002 2021; Obs 60; Cross-sections: 3; Null hypothesis: No cointegration; Trend Assumption: No deterministic intercept or trend; Use d.f. corrected Dickey-Fuller residual variances; Automatic lag length selection based on SIC with a max lag of 3; Newey-West automatic bandwidth selection and Bartlett Kernel}. EViews facilitates VAR-based cointegration tests by employing the methodology established in Johansen's (1991, 1995) work. These tests can be executed using a Group object or an estimated Var object. Trace test denotes no cointegration at the 0.05 level (Fig. 1)

Alternative hypothesis: common AR coefs. (within-dimension)				
	Statistic		Weighted	
	Statistic	Prob.	Statistic	Prob.
Panel v-Statistic	-1.831379	0.9665	-1.809194	0.9648
Panel rho-Statistic	0.993445	0.8398	0.644826	0.7405
Panel PP-Statistic	-0.048891	0.4805	-0.735117	0.2311
Panel ADF-Statistic	-0.890475	0.1866	-1.289105	0.0987
Alternative hypothesis: individual AR coefs. (between-dimension)				
	Statistic	Prob.		
Group rho-Statistic	1.199154	0.8848		
Group PP-Statistic	-0.717310	0.2366		
Group ADF-Statistic	-1.186899	0.1176		

**Figure 1. Eviews calculations for VAR object**

*Source:* Authors' results.

It implies that there is no long-term or stable relationship among the variables we have tested. When cointegration is not found, it suggests that the variables do not move together in the long run or do not have a stable, predictable relationship. So, from the practical point of view, the tax policy change in one of the selected states would not cause any shifts in the rest analysed states. It might as well suggest that factors (see Table 2) do not have a consistent, long-term impact on the shadow indicator.

The next applied Pairwise Granger causality test (Table 4) reveals that we cannot reject all hypotheses (at the level of 0.05), meaning that there is evidence suggesting the absence of a causal relationship between some of the variables under examination. In other words, the test did not find sufficient statistical support to conclude that one variable Granger causes another.

Table 4

## Granger causality test (lag 2; obs 54)

Null hypothesis	F-stat	prob
EPITR does not Granger cause SEL	<b>2.49</b>	<b>0.09</b>
SEL does not Granger cause EPITR	2.05	0.14
TP does not Granger cause SEL	0.41	0.66
SEL does not Granger cause TP	1.36	0.27
CD does not Granger cause SEL	0.58	0.56
SEL does not Granger cause CD	2.38	0.10
CT does not Granger cause SEL	0.31	0.73
SEL does not Granger cause CT	0.21	0.81
VAT does not Granger cause SEL	0.32	0.73
SEL does not Granger cause VAT	2.03	0.14

*Source:* Authors' results.

However, at level 0.1 we can reject the hypothesis that EPITR does not GRANGER cause SEL, suggesting there is a one-way causality EPITR  $\rightarrow$  SEL for the analyzed. When we say that EPITR Granger causes SEL, it means that past values of EPITR contain valuable information for predicting or forecasting changes in the shadow economy level (SEL). More simply, changes in EPITR appear to influence or precede changes in SEL. This finding suggests that changes in the effective personal income tax rate can affect the behavior of individuals or businesses in the shadow economy. For instance, a higher income tax rate might incentivize individuals or businesses to engage more in informal economic activities or tax evasion, leading to an increase in the shadow economy level.

## 5. CONCLUSION

In conclusion, our results reveal a nuanced relationship between different tax categories and the shadow economy. So, an uptick in the effective VAT rate was correlated with an increase in the shadow economy. Importantly, the study found that changes in effective taxes on imports had little impact on regulating the scope of the shadow economy. Cointegration analysis did not establish long-term relationships between tax levels and the shadow economy, suggesting that tax policy changes in one country may not significantly affect the others. Furthermore, the pairwise Granger causality test indicated that there was a one-way causality from the effective personal income tax rate (EPITR) to the shadow economy level (SEL). Alterations to the effective personal income tax rate have the potential to influence the conduct of individuals or businesses within the shadow economy. For example, an elevated income tax rate may encourage greater involvement in informal economic activities or tax evasion, thereby contributing to a rise in the level of the shadow economy.

Overall, this research suggests that there is no synergy between countries in their activities regarding the shadow economy and tax system. Therefore, it can be concluded that from a long-term perspective, one should not expect convergence towards a country that will be the first to take successful steps in adapting the tax system to reduce the "shadow." Overall, this study contributes to our shared understanding of the intricate dynamics between taxation and the shadow economy in the Baltic countries. It highlights the

importance of considering effective tax rates and their differential impacts on informal economic activities. The findings emphasize that tax policies can play a role in influencing the shadow economy, but their effects vary across different tax categories. Ultimately, this study provides valuable insights for policymakers aiming to address the challenges posed by the shadow economy and its potential impact on government revenue and economic stability.

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