SSE RIGA

Shadow Economy Index for the Baltic Countries 2009–2023

Authors of the study

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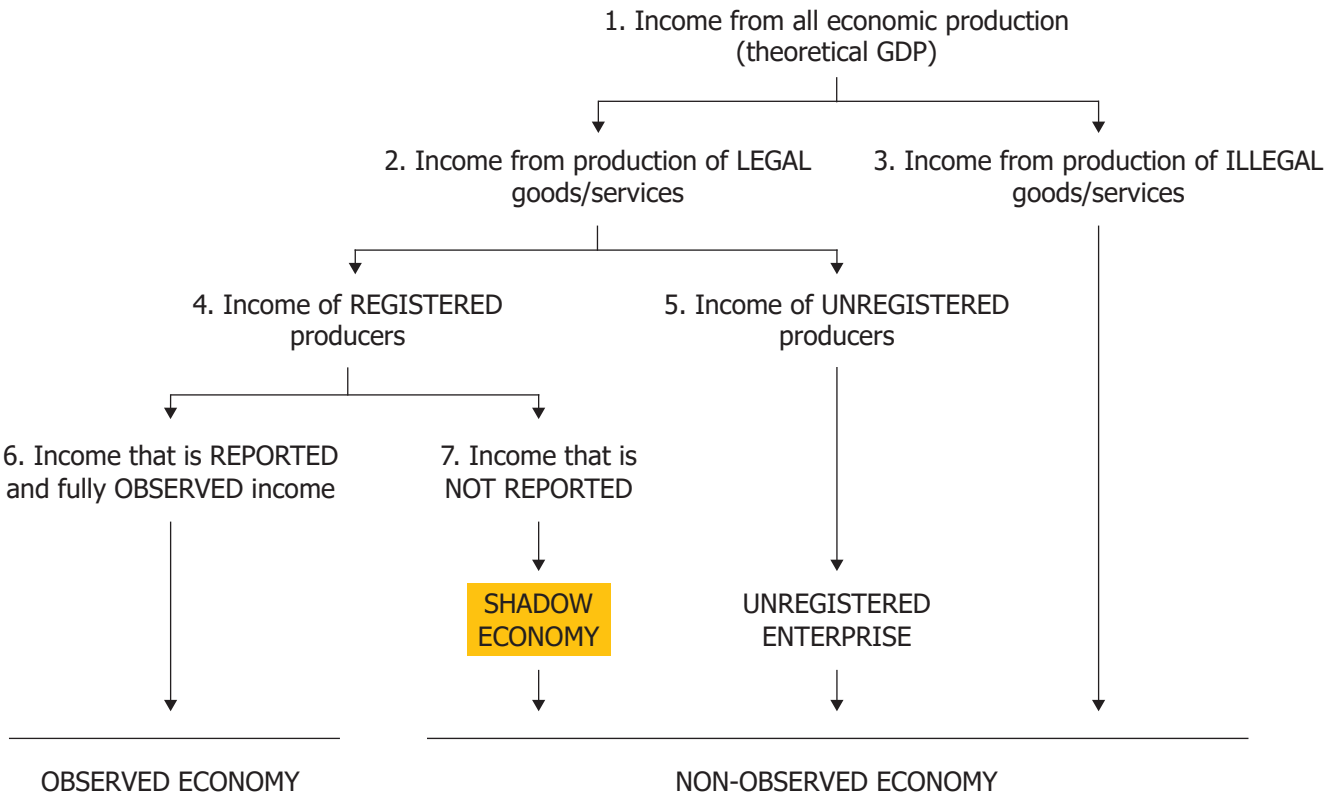
SSE RIGA

Since 2009:

- What is the size of the shadow economy in Latvia, Lithuania, and Estonia?
- What are the main determinants of the shadow economy?
- What can be done to reduce the shadow economy?

Observed and non-observed components of GDP



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Measuring the shadow economy using company managers

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Study

- "Direct survey method": interviews with company owners/managers in the Baltic countries
- Entrepreneurs as experts
- In 2024 about 2023 and 2022
- 505 telephone interviews in Latvia, 503 in Lithuania, 500 in Estonia (the 2024 survey)
- Random sampling, Orbis database
- Interviews performed by Norstat Latvija
- The Index is based on the income approach in measuring GDP

Key components of the shadow economy

- Underreporting of business income (profits)
- Underreporting of the number of employees
- Envelope wages
- % of revenue spent on payments 'to get things done': bribery
- % of the contract value paid to secure a contract with the government: corruption

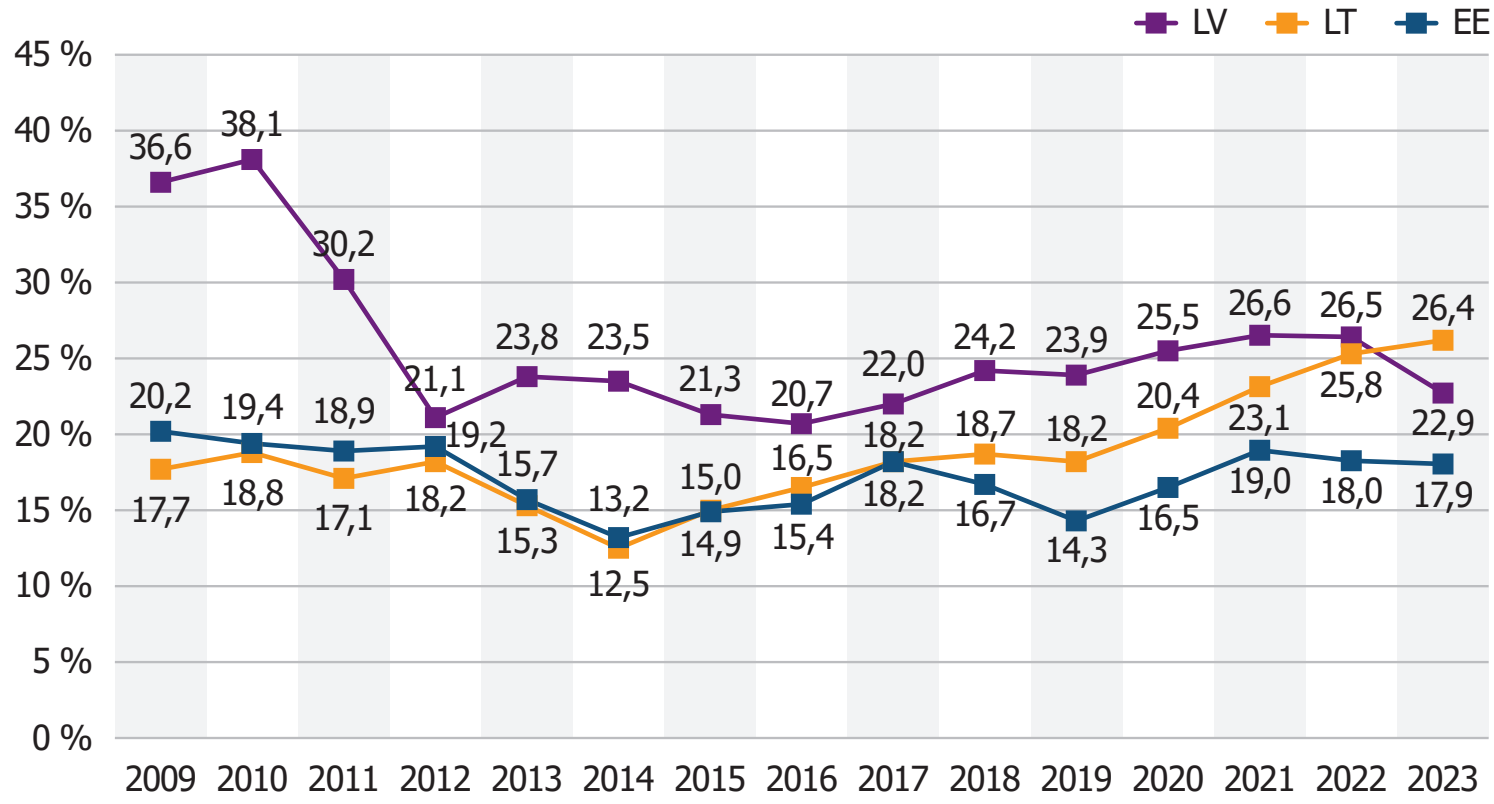
Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2023
Results

Shadow Economy Index for the Baltic countries (% of GDP), 2009–2023

	2023–2022	2023	2022	2021	2020	2019	2018	2017
LV	-3,6 (-5,6 -1,6)	22,9 (20,2 25,5)	26,5 (24,5 28,5)	26,6 (24,9 28,3)	25,5 (23,6 27,4)	23,9 (21,4 26,3)	24,2 (21,5 26,8)	22,0 (19,6 24,5)
LT	+0,6 (-2,3 3,5)	26,4 (23,1 29,7)	25,8 (22,2 29,5)	23,1 (20,6 25,7)	20,4 (18,4 22,3)	18,2 (16,5 19,9)	18,7 (17,0 20,4)	18,2 (16,1 20,4)
EE	-0,1 (-2,2 2,0)	17,9 (15,6 20,2)	18,0 (15,3 20,7)	19,0 (16,1 21,9)	16,5 (14,3 18,8)	14,3 (12,3 16,3)	16,7 (14,5 18,8)	18,2 (16,1 20,3)

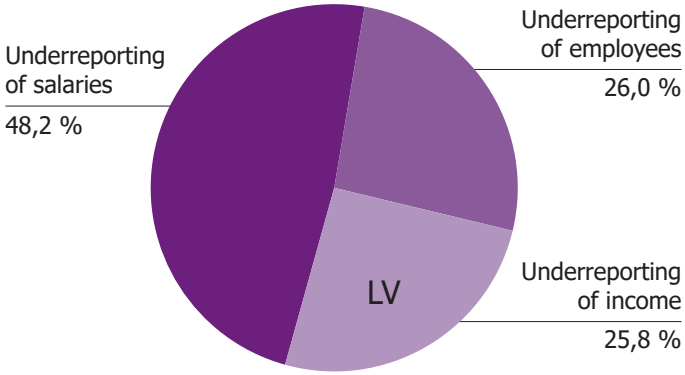
	2016	2015	2014	2013	2012	2011	2010	2009
LV	20,7 (18,0 22,6)	21,3 (19,0 23,7)	23,5 (20,5 26,6)	23,8 (20,7 26,9)	21,1 (18,5 23,6)	30,2 (27,6 32,7)	38,1 (35,9 40,3)	36,6 (34,3 38,9)
LT	16,5 (14,8 18,3)	15,0 (13,8 16,3)	12,5 (11,0 13,9)	15,3 (13,6 17,1)	18,2 (16,4 20,1)	17,1 (15,2 19,0)	18,8 (16,9 20,6)	17,7 (15,8 19,7)
EE	15,4 (13,1 17,8)	14,9 (12,4 17,4)	13,2 (11,3 15,1)	15,7 (13,5 17,9)	19,2 (16,6 21,9)	18,9 (16,8 20,9)	19,4 (18,0 20,8)	20,2 (18,7 21,7)

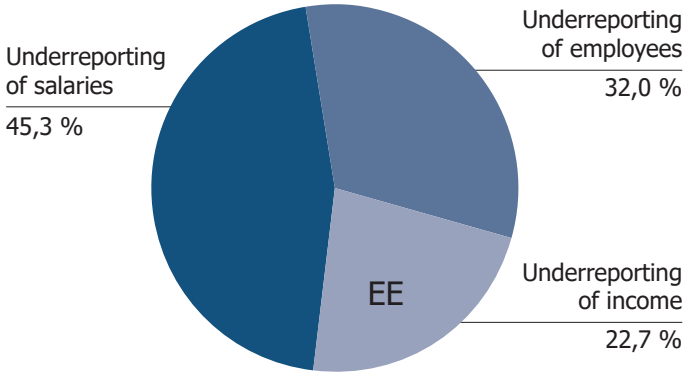
Dynamics of the shadow economy in the Baltic countries (% of GDP), 2009–2023

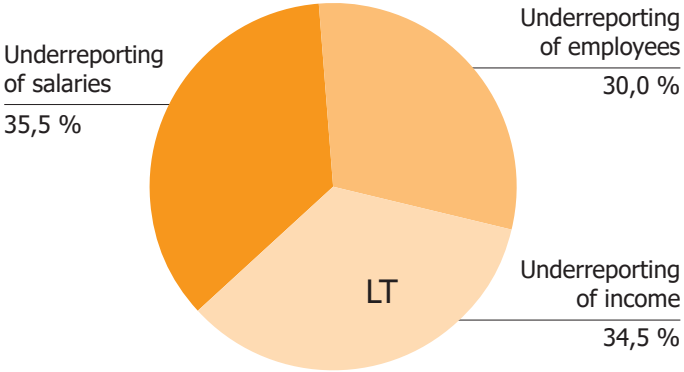


Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2023

Components of the shadow economy in 2023

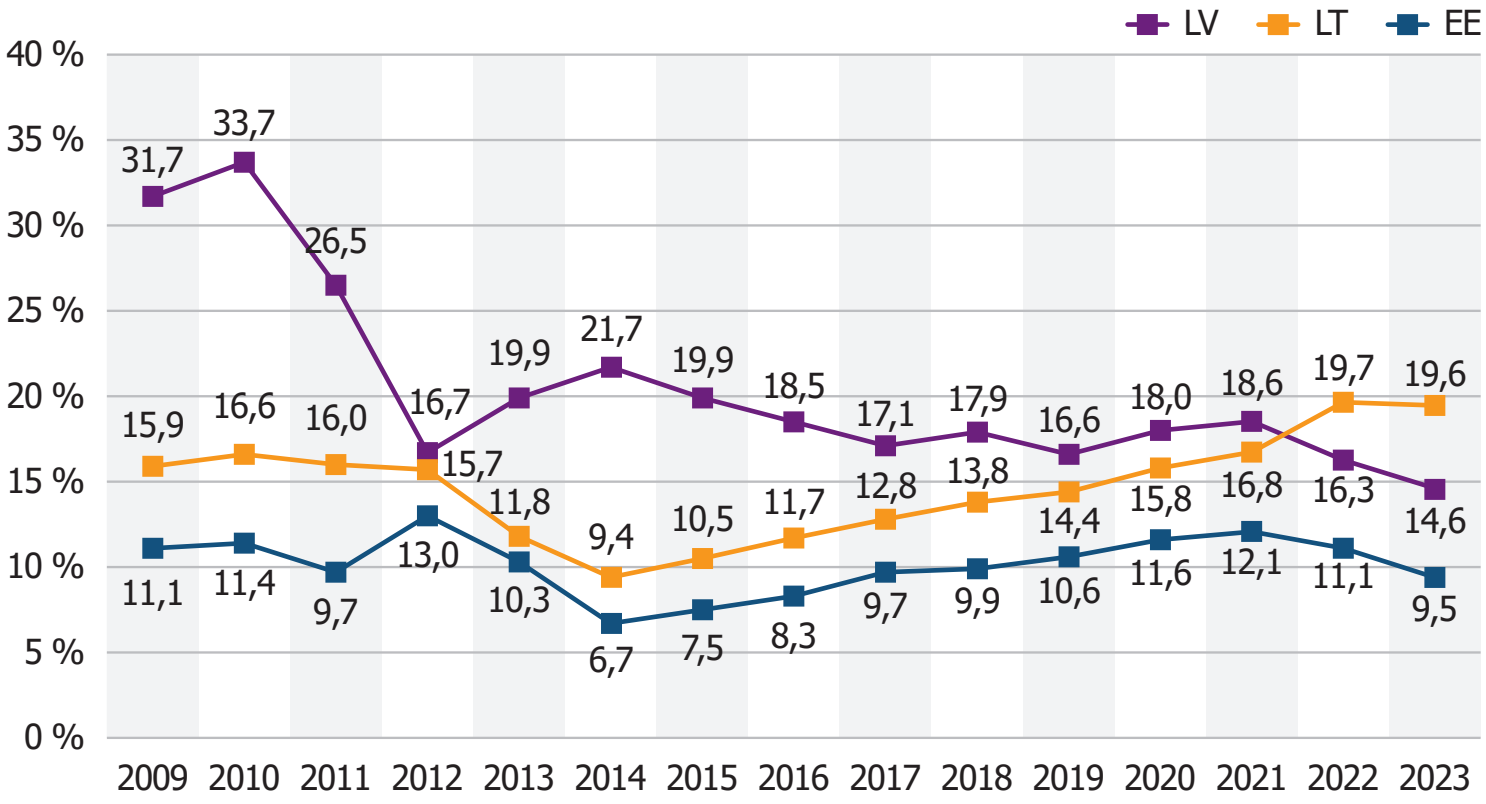




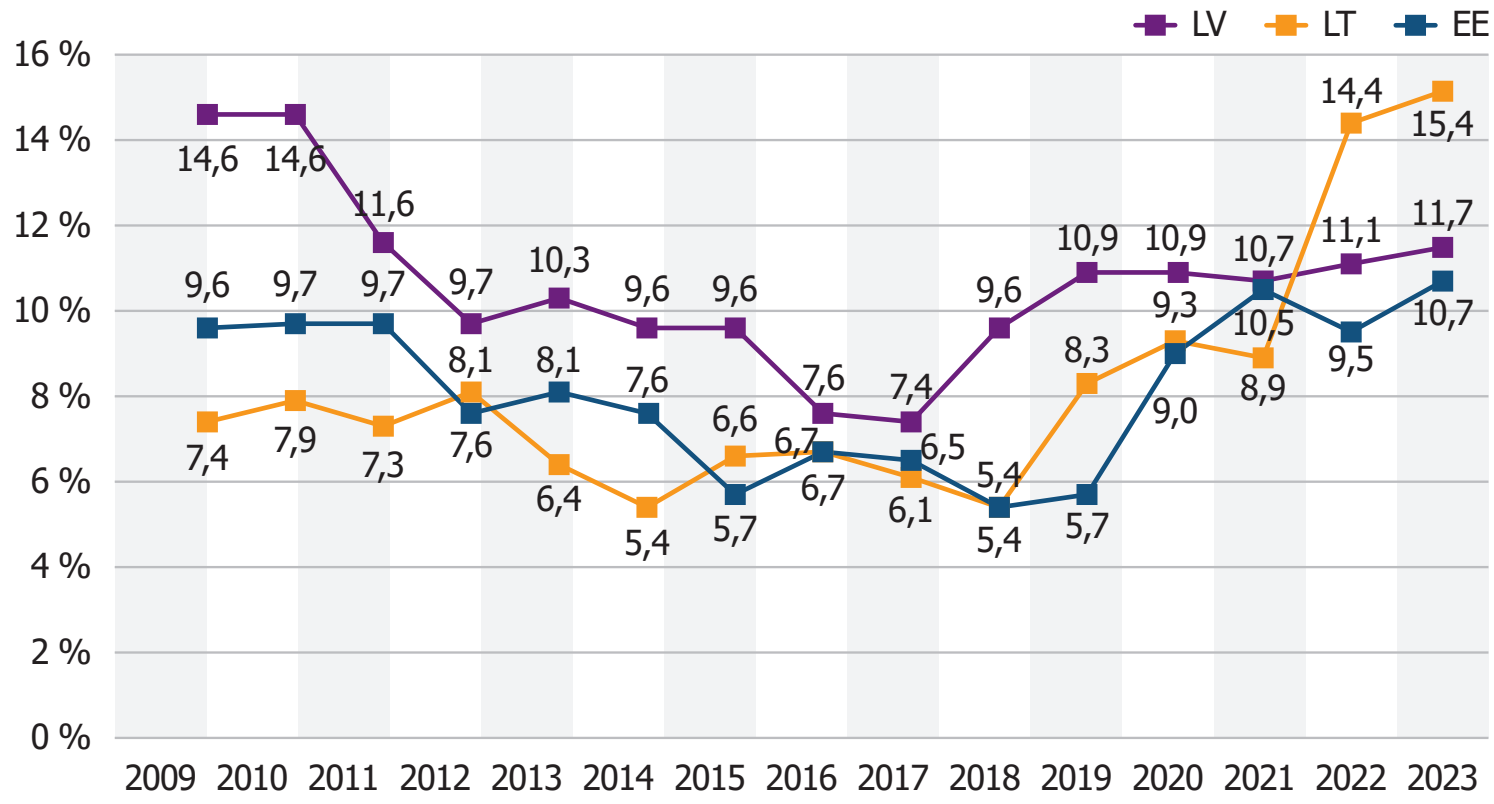


Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2023

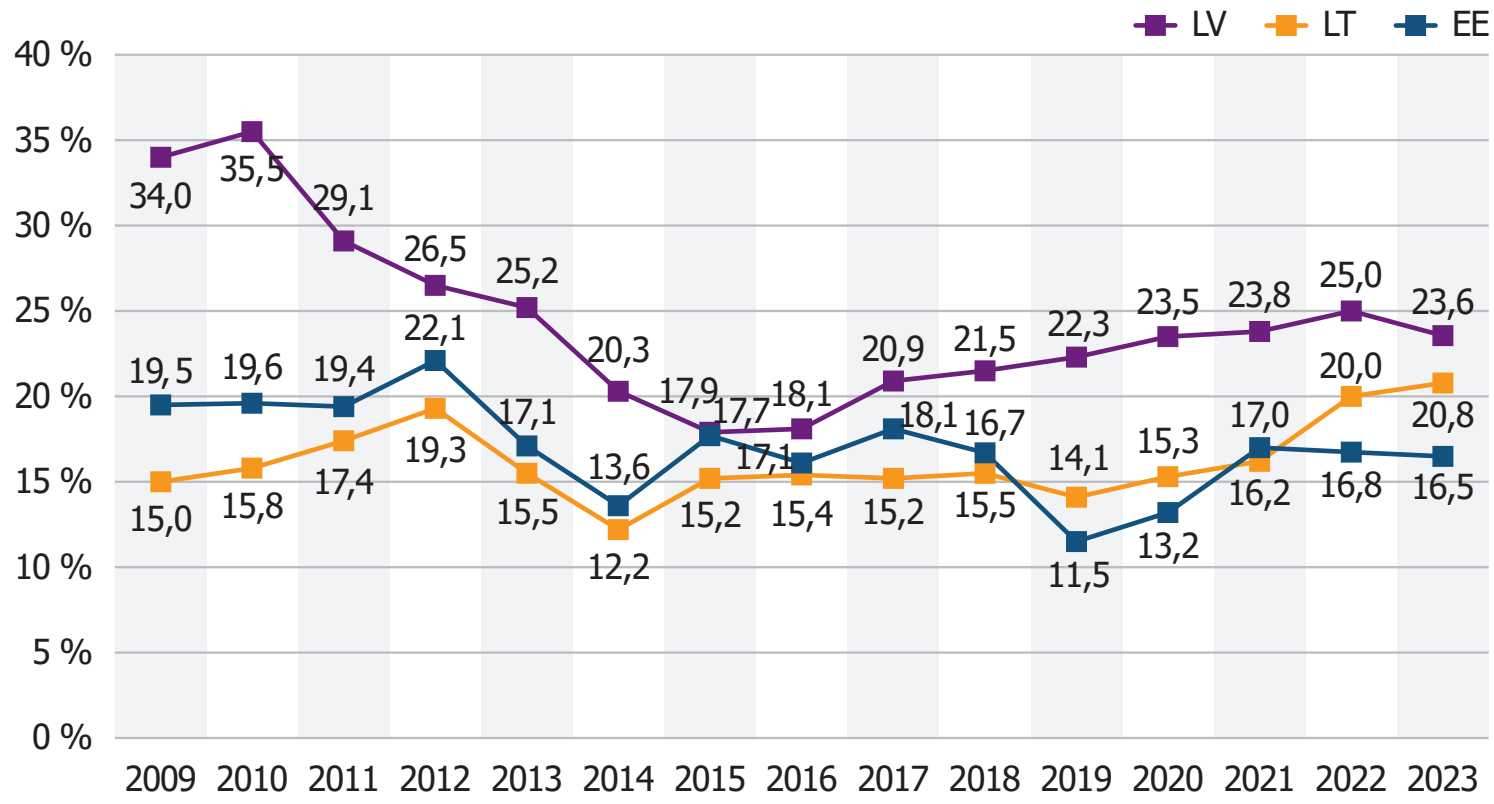
Underreporting of business income 2009–2023 (average share of revenue in % that companies conceal from the government)



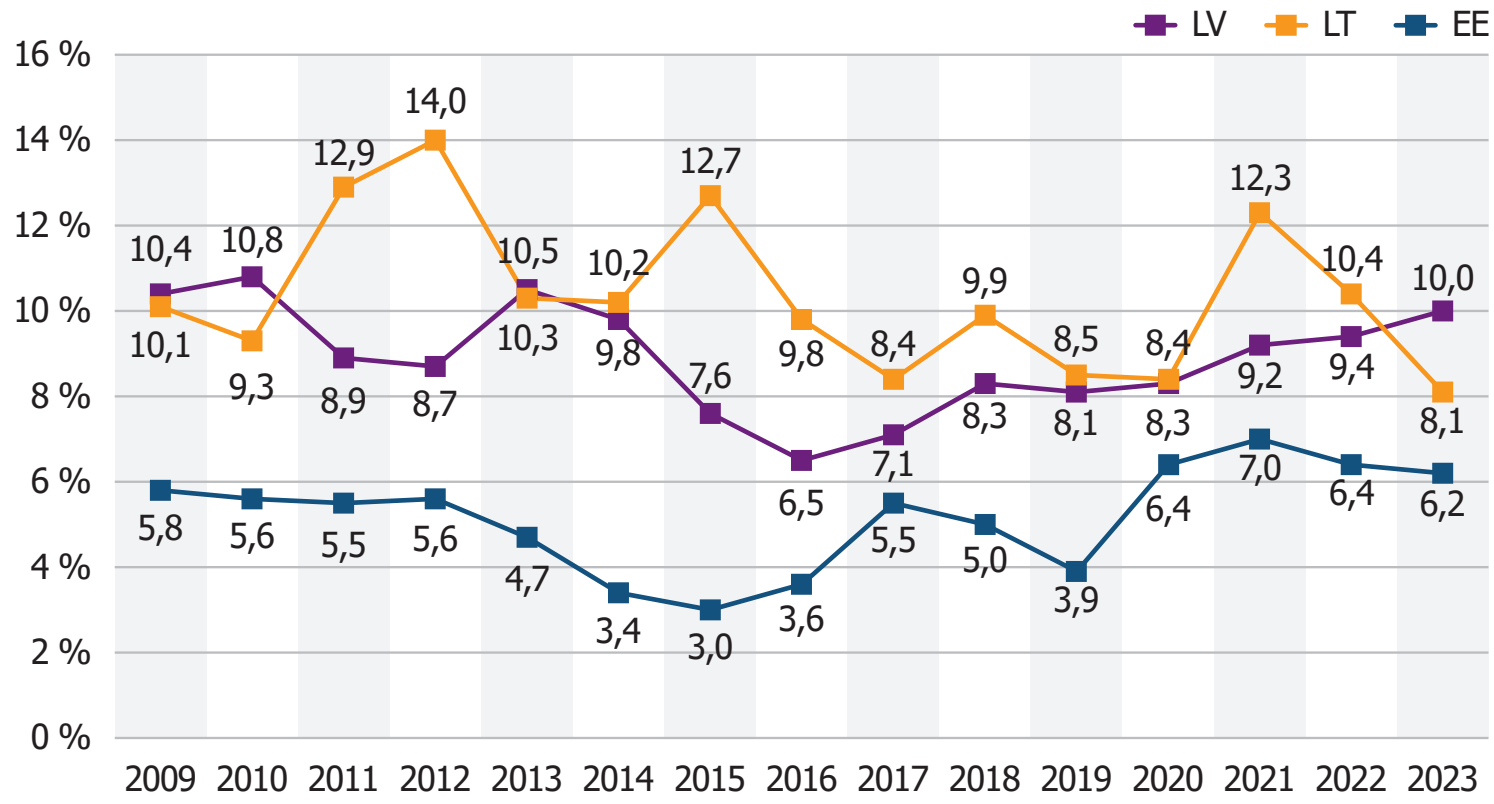
Underreporting of the number of employees, 2009–2023 (average share of the employees in % working without a contract)



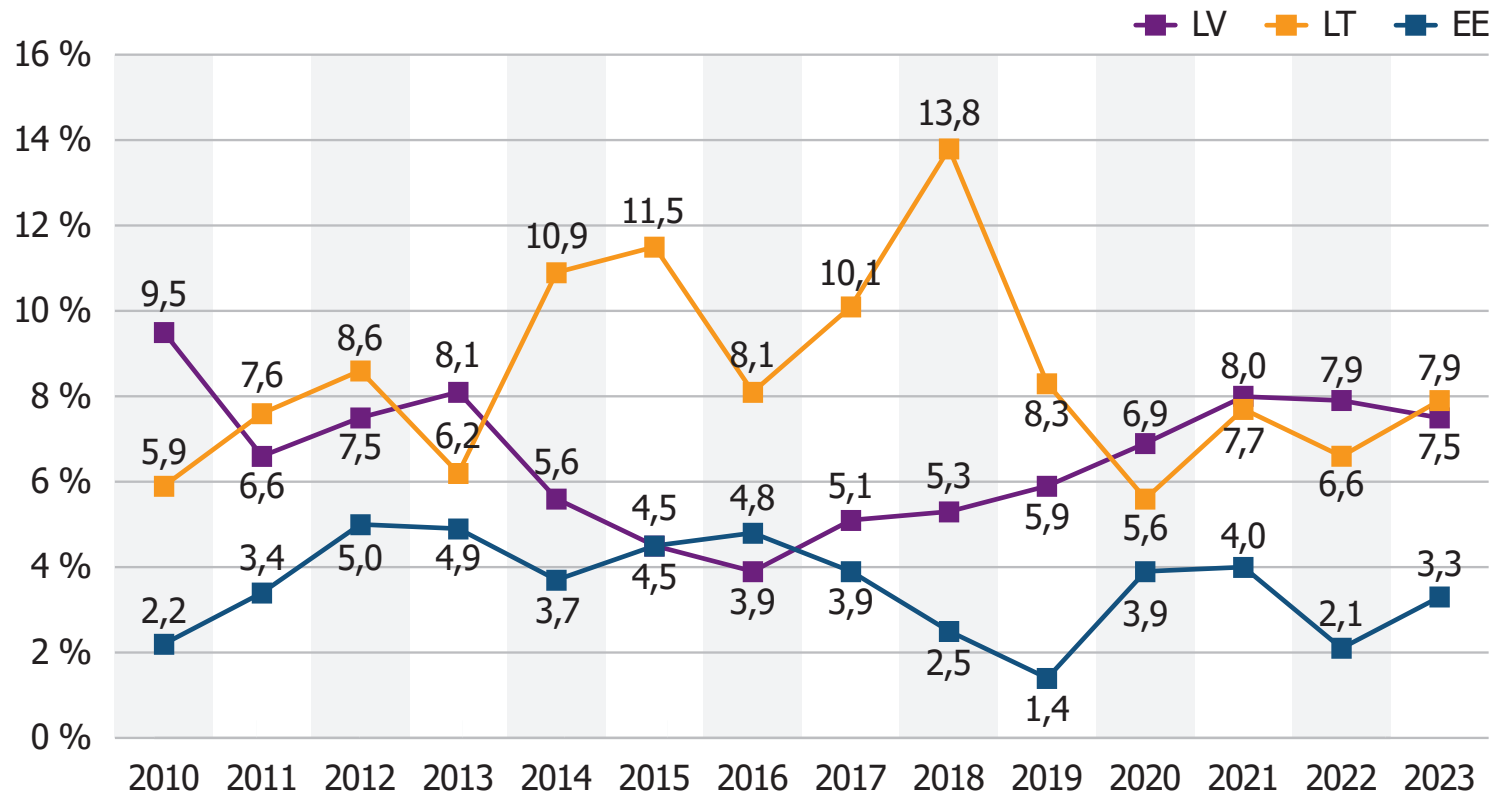
Envelope wages, 2009–2023 (average share of salaries in % which is paid by the employers, but concealed from the government)



% of payments 'to get things done', 2009–2023 (average percentage of revenue paid as 'bribes')



% of the contract value paid to secure contracts with the government, 2010–2023

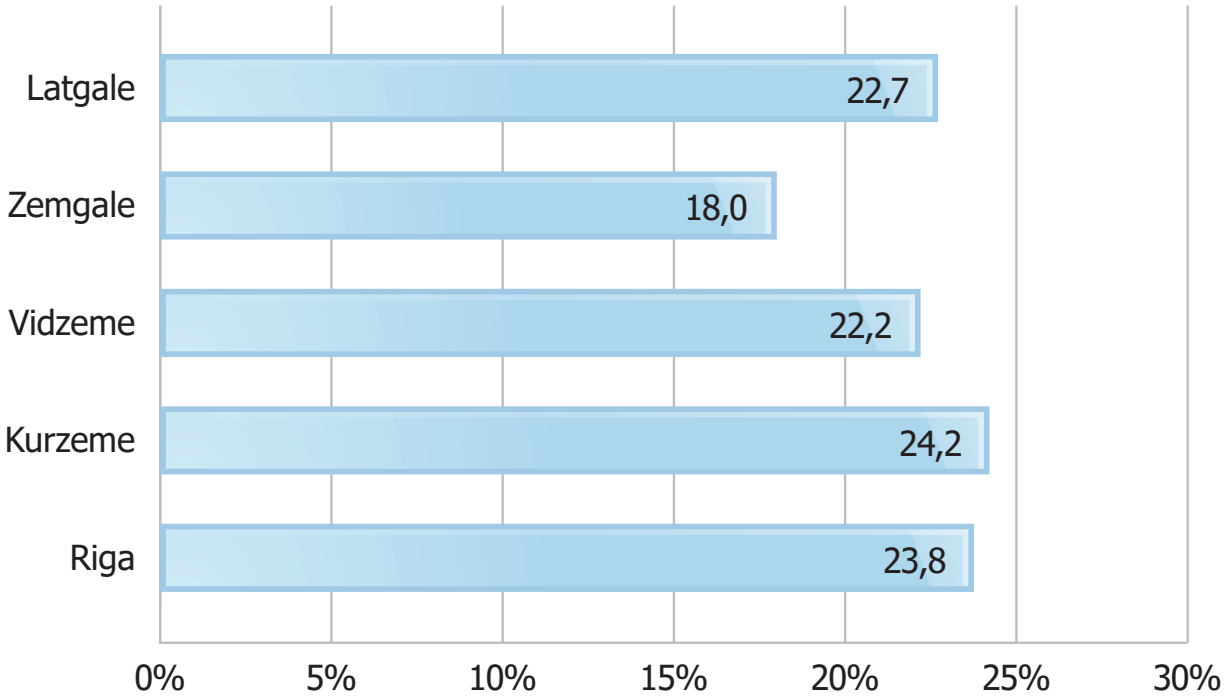


The proportion (%) of goods or services provided by unregistered companies in the Baltic countries, 2013–2023

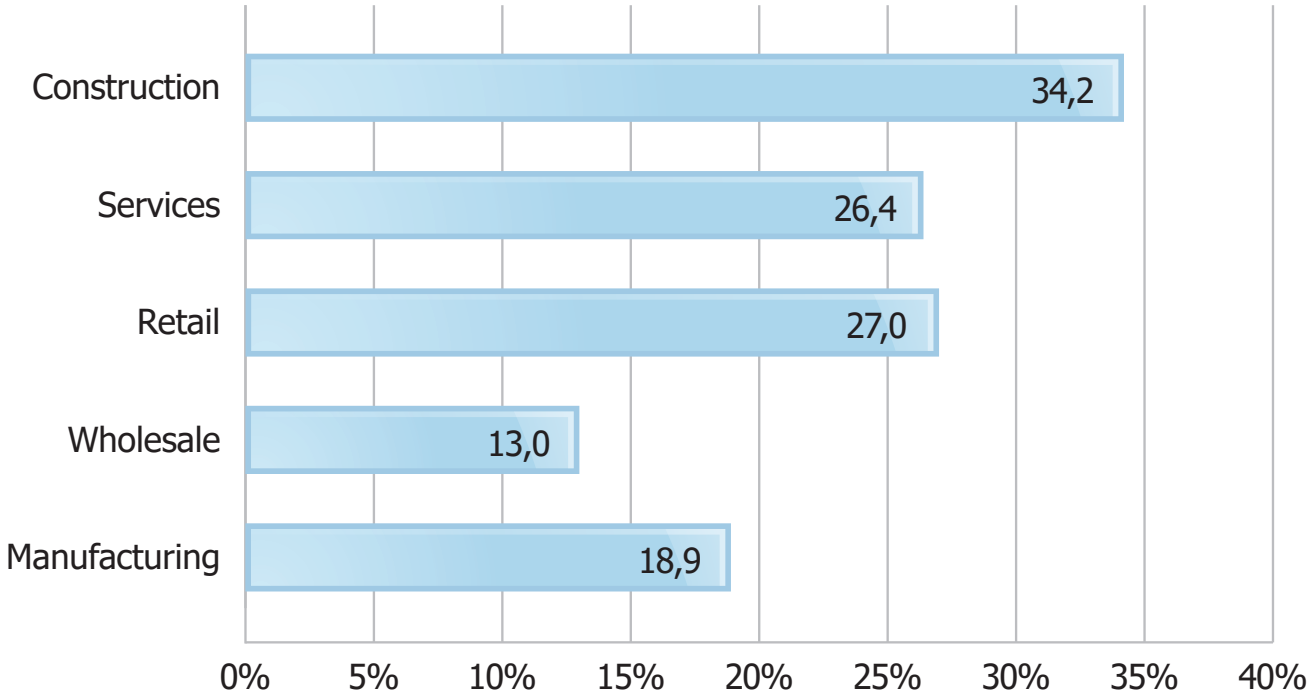
	Latvia	Lithuania	Estonia
2023	8,8 (7,3 10,4)	8,4 (6,9 9,9	6,5 (5,3 7,8)
2022	8,5 (7,2 9,9)	9,5 (7,8 11,2)	6,3 (5,0 7,6)
2021	8,6 (7,5 9,7)	9,0 (7,5 10,6)	6,7 (5,4 8,0)
2020	8,4 (6,7 9,2)	6,2 (4,9 7,4)	4,0 (3,1 5,0)
2019	8,0 (6,7 9,2)	9,2 (7,8 10,6)	4,0 (3,0 5,1)
2018	8,6 (7,3 10,1)	10,0 (8,8 11,3)	6,4 (5,0 7,9)
2017	6,5 (5,3 7,8)	8,6 (7,5 9,8)	7,0 (5,7 8,5)
2016	5,3 (4,1 6,5)	8,4 (7,5 9,4)	6,1 (5,1 7,1)
2015	5,2 (4,1 6,3)	7,3 (6,5 8,1)	5,8 (4,5 7,1)
2014	5,6 (4,5 6,7)	5,2 (4,5 6,0)	6,3 (4,5 8,2)
2013	5,4 (4,2 6,6)	6,2 (5,3 7,1)	7,6 (5,4 9,9)

Size of the shadow economy in the regions, sectors, companies of different sizes

Size of the shadow economy (% of GDP) by region in Latvia (2023)



Size of the shadow economy (% of GDP) by sector in Latvia (2023)



Involvement in the shadow economy

- Smaller firms (e.g., those with fewer employees) engage in more shadow activity than larger firms
- Younger firms engage in more shadow activity than older firms

Main determinants of the shadow economy

Statistically significant determining factors (using regression analysis)

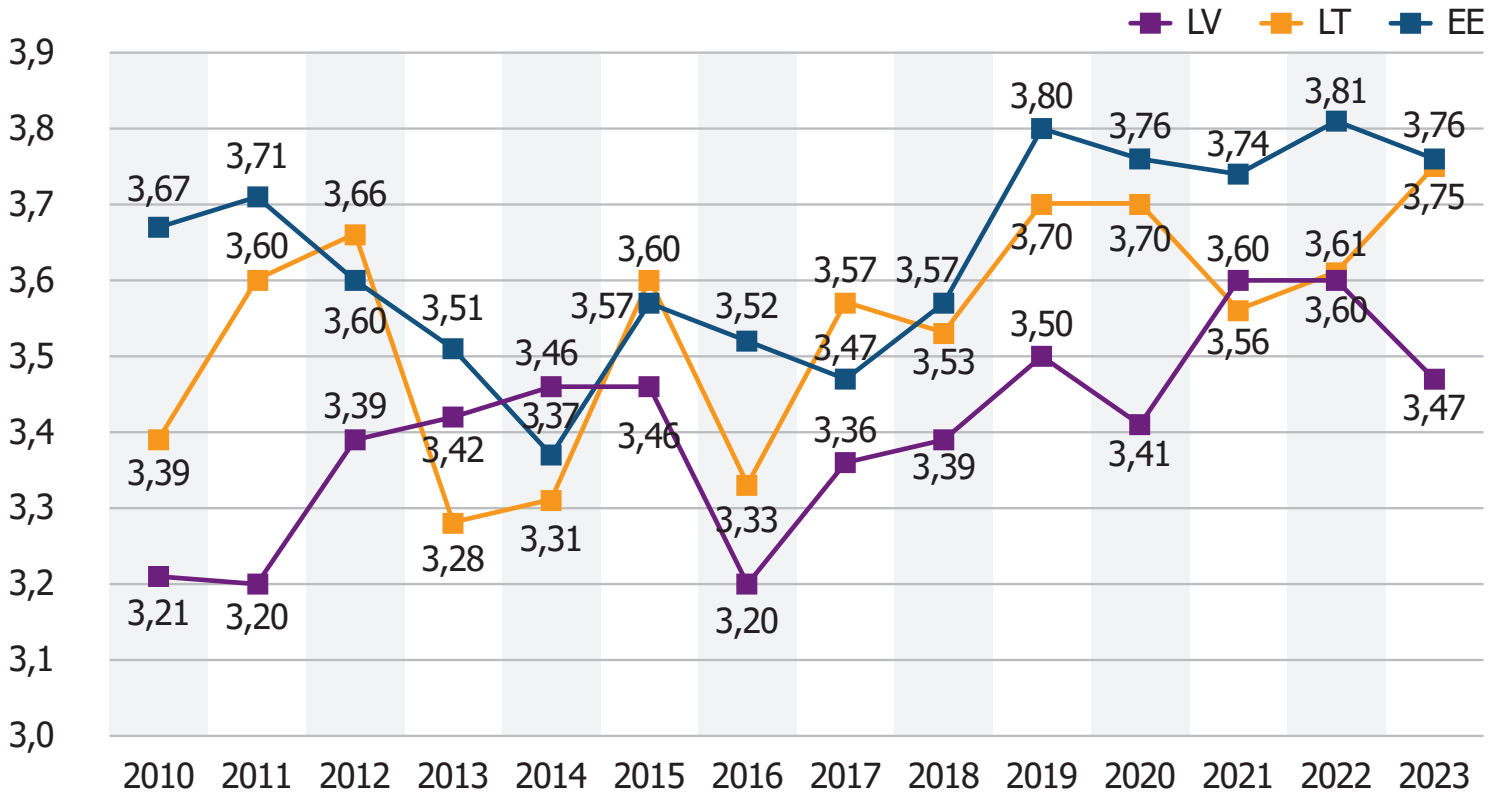
- Greater probability of being caught not paying taxes and more serious consequences ➔ fewer entrepreneurs getting involved in shadow economy activities

Statistically significant determining factors (using regression analysis)

- Dissatisfaction ➔ more shadow activity
- Involvement in shadow economy is greatly determined by dissatisfaction with:
  - Business legislation (greatest effect)
  - Performance of SRS
  - Tax policy
  - Government support (least effect)

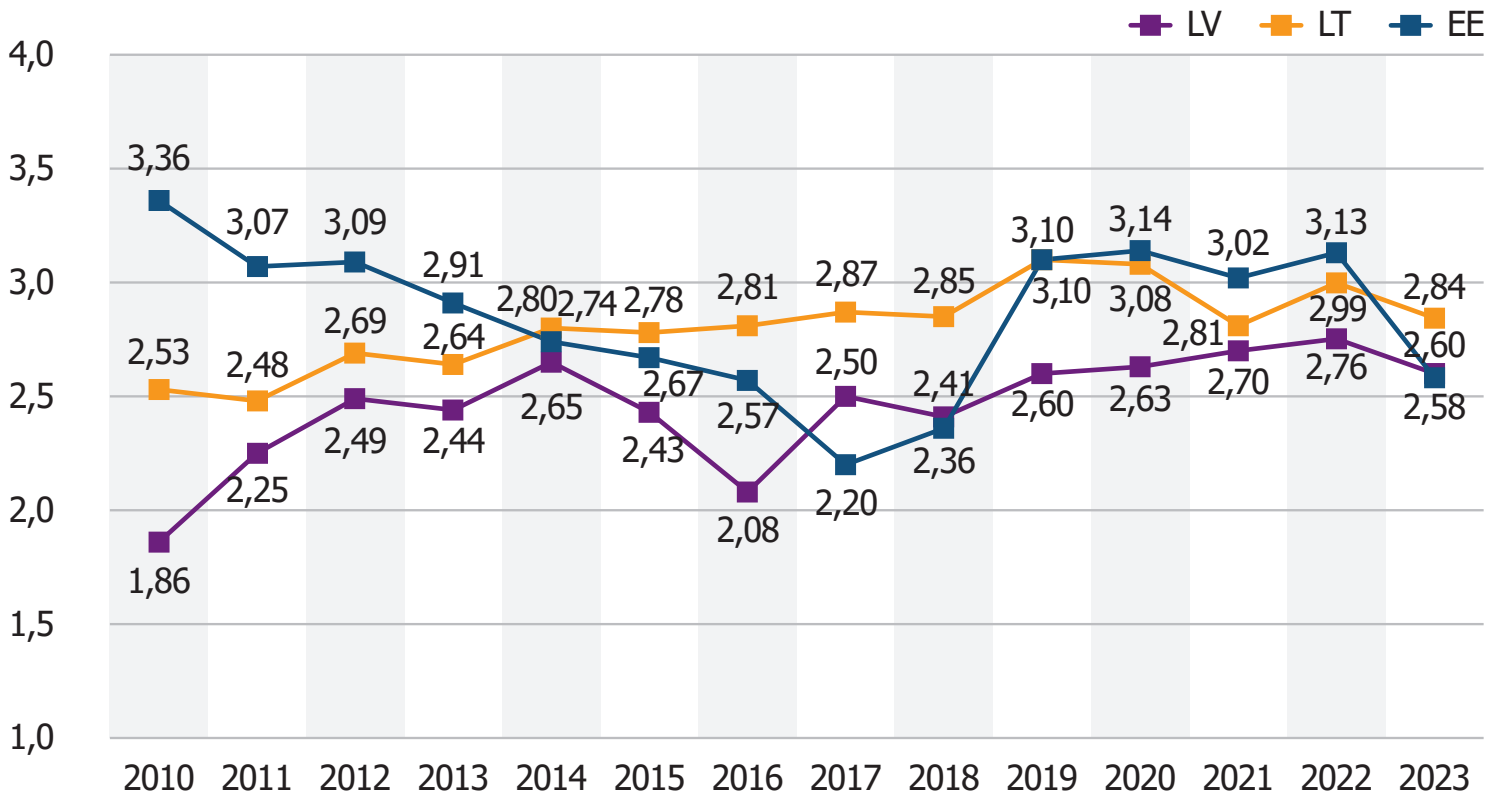
Satisfaction with the performance of the State Revenue Service, 2010–2023

(Average. '1'- very low satisfaction, but '5'- very high satisfaction)



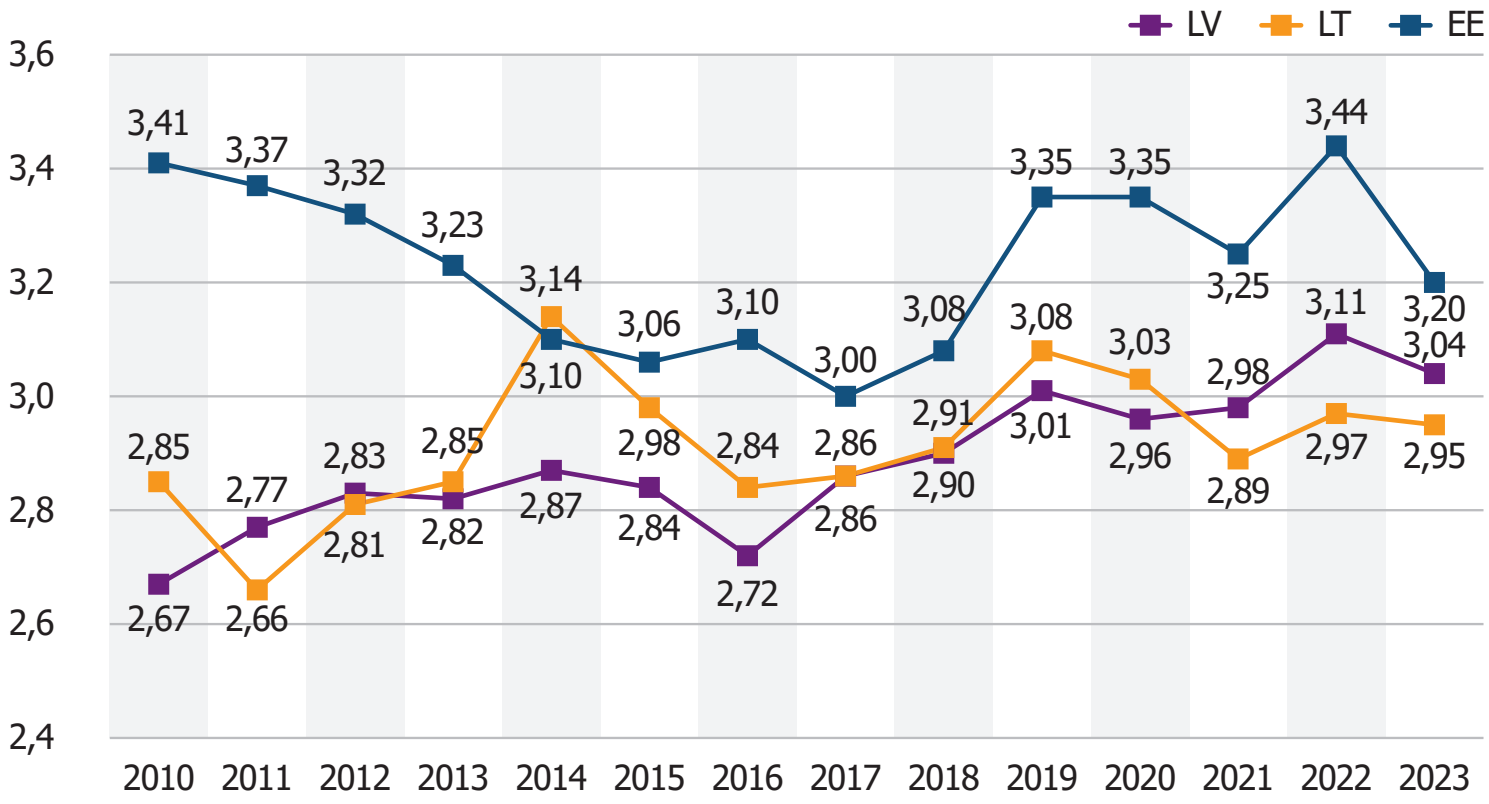
Satisfaction with the tax policy, 2010–2023

(Average. '1'- very low satisfaction, but '5'- very high satisfaction)



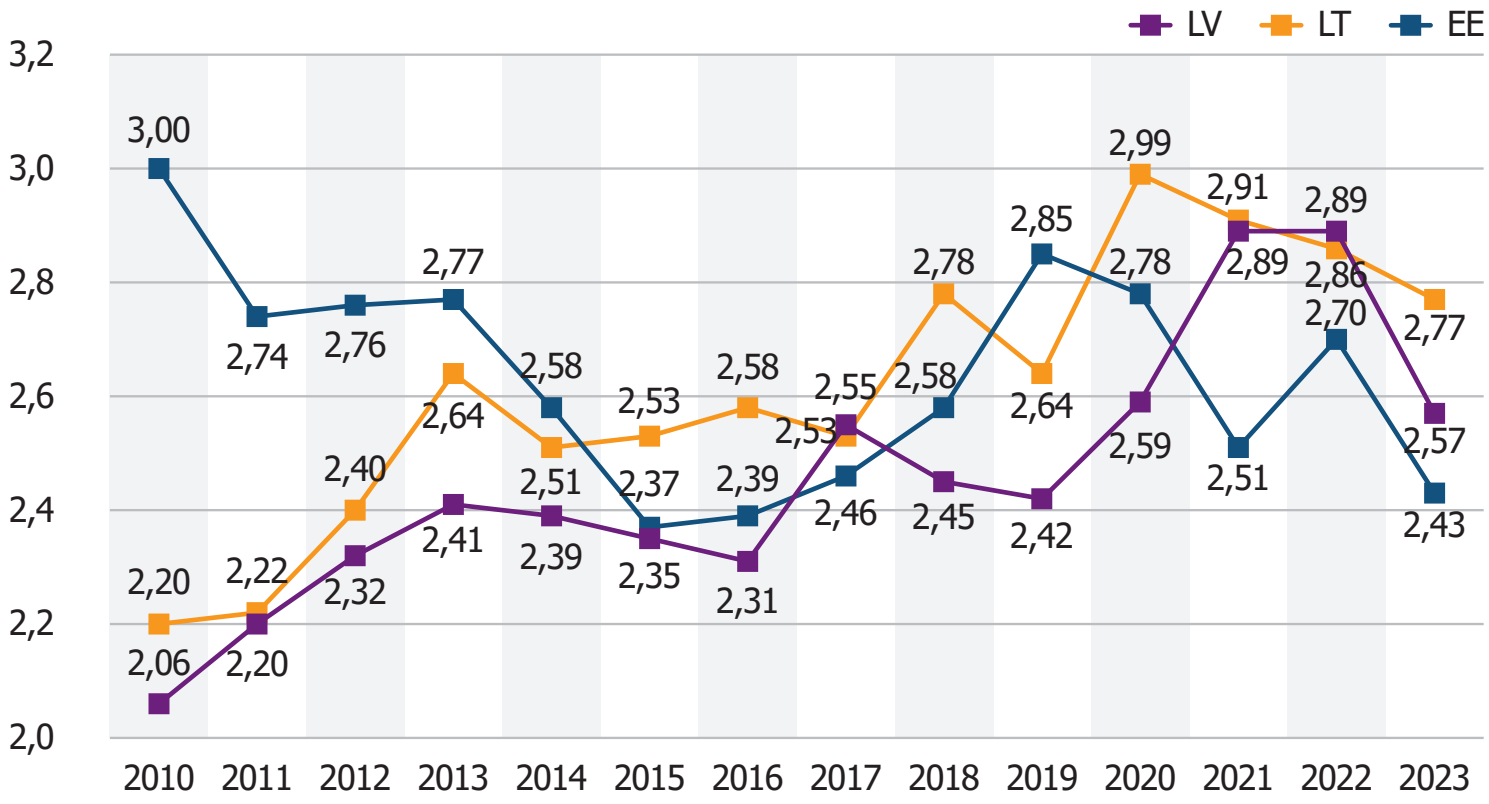
Satisfaction with the quality of business legislation, 2010–2023

(Average. '1'- very low satisfaction, but '5'- very high satisfaction)



Satisfaction with the government's support to entrepreneurs, 2010–2023

(Average. '1'- very low satisfaction, but '5'- very high satisfaction)



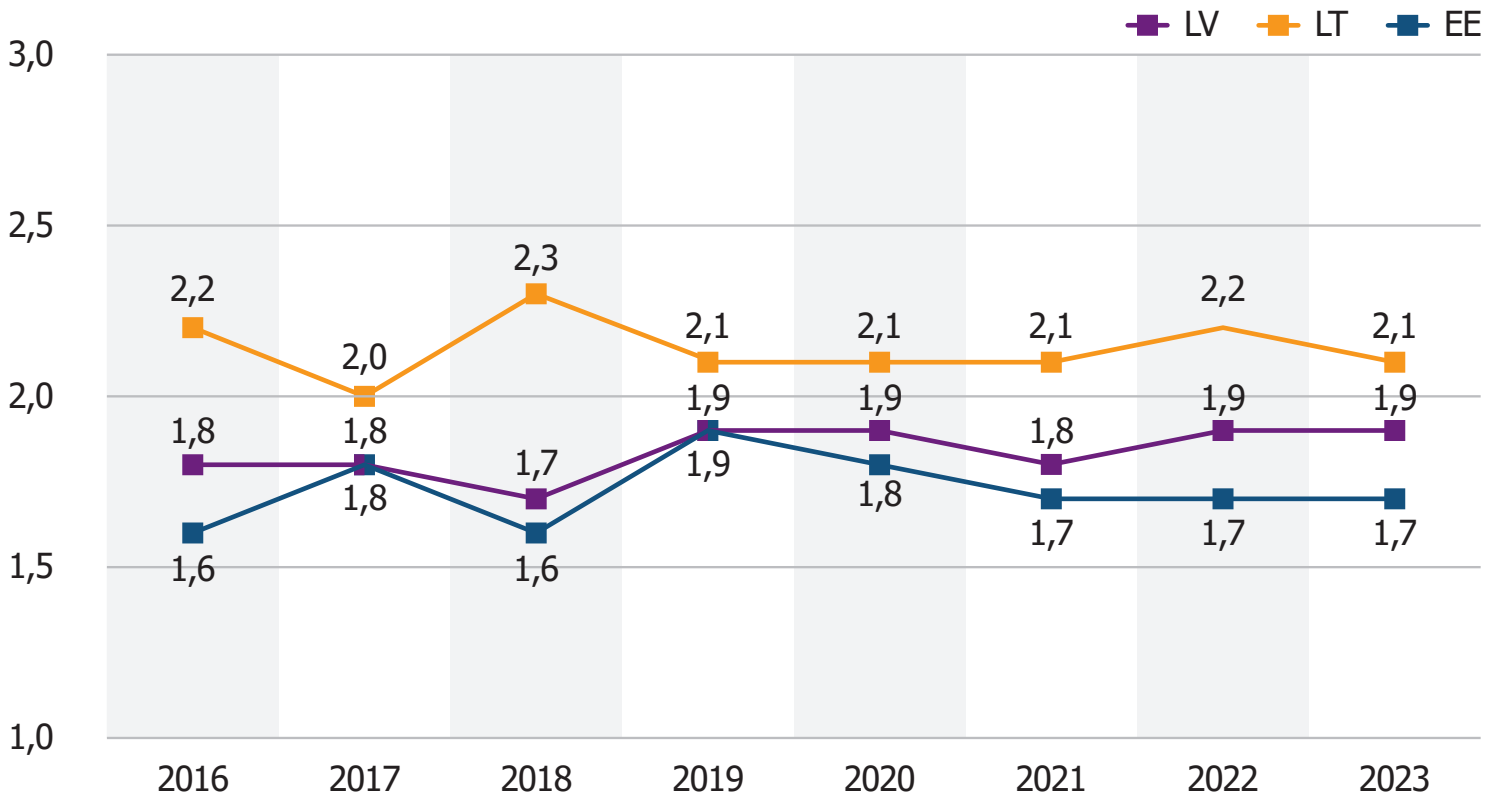
Statistically significant determining factors (using regression analysis)

- Greater tolerance towards involvement in shadow economy ➔ greater involvement in shadow economy

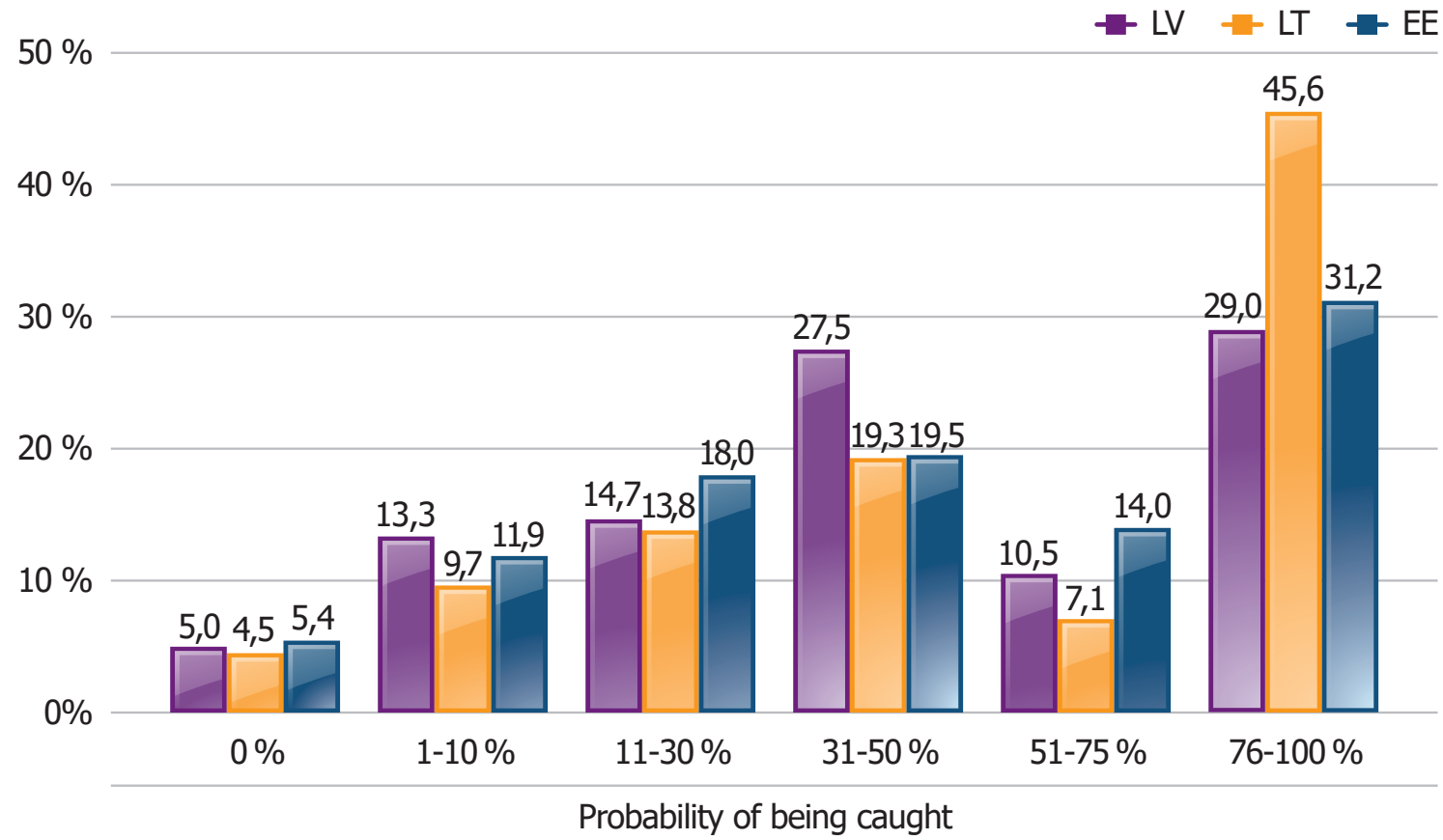
Tax morale

It is always justified to cheat on tax if there is a chance.

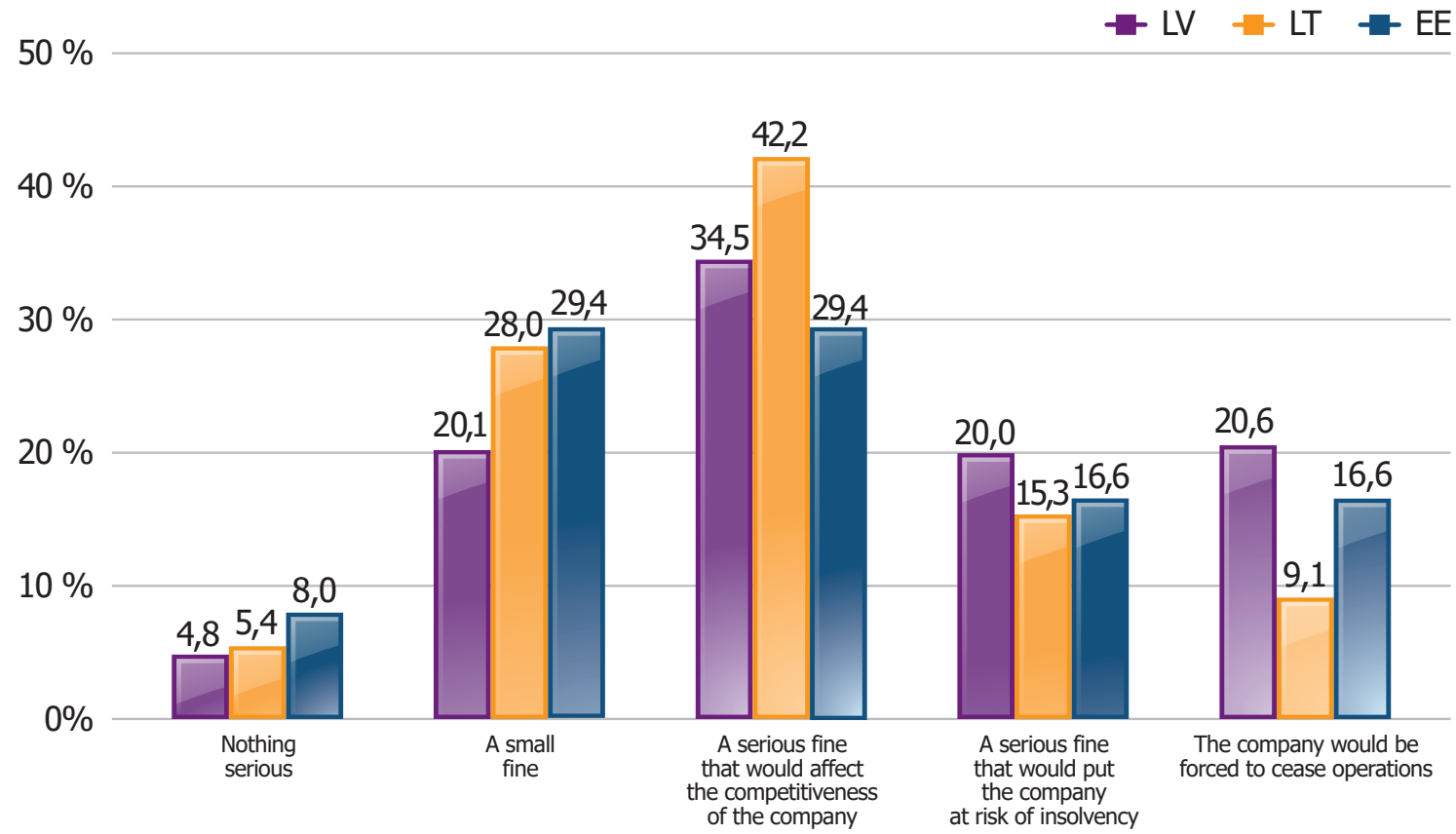
(Scale of 1 to 5, where 1 means – completely disagree (high tax morale), 5 means – completely agree).



Probability of being caught if the company pays envelope wages, 0–100%, 2023



If a company in your industry was caught for deliberate misreporting, what would typically be the consequence to that company?



New combined method for calculating shadow economy

- None of the methods for calculating the shadow economy are perfect – no agreement has been reached on the most reliable approach to measure the size of the shadow economy.
- Within the framework of the national research project RE:SHADE, we developed a combined methodology for calculating the shadow economy.
- The purpose of using the combined methodology is to make the measurement of the size of the shadow economy more accurate. By combining the two methods, we retain the advantages of both for calculating the shadow economy.
- This methodology combines two leading approaches to measure the size of the shadow economy: The direct micro-method developed by Putniņš and Sauka, and the indirect macro-level method MIMIC (Schneider).
- These calculations should be interpreted with caution as the new methods (MIMIC recalibration and combined method, see below) are not properly peer-reviewed.

Approach to the combined method for calculating the shadow economy in the Baltic states

We use data from the Putniņš and Sauka (2015) direct micro-method: shadow economy index, methods developed in a peer-reviewed study.

We use data from the MIMIC (Schneider) indirect macro-level method, also called the dynamic multiple-indicator multiple-cause model.

- According to this method, data on the possible causes and indicators of the shadow economy are used to calculate the size of the shadow economy.
- These relative estimates are calibrated to calculate the size of the shadow economy. Calibration is often underestimated – the method itself does not provide an estimate of the size of the shadow economy.
- In most cases, data from countries other than Latvia, Lithuania or Estonia are used as a basis for calibration – or relatively indirect approaches, such as the demand for a currency.
  This ismore convenient when calculating the shadow economy across many countries, but reduces the accuracy of the method on a country-by-country basis.

Approach to the combined method for calculating the shadow economy in the Baltic states

- This approach has been developed within the State Research Programme RE:SHADE (Putniņš and Sauka, 2022), using the microdata
  (Putniņš and Sauka, 2015) approach to calibrate MIMIC estimates (Schneider and colleagues) for the Baltic states.
- We calibrated the MIMIC method specifically for the Latvian, Lithuanian and Estonian economies using micro-data.
- Thus, the MIMIC approach is adapted to the conditions of Latvia, Lithuania and Estonia – rather than calibrated to the data of another country, as is usually done when calculating the shadow economy according to the MIMIC method.

In the combined method, estimates of the shadow economy in the Baltic countries are obtained by combining the calibrated MIMIC method (Putniņš and Sauka, 2022) and the method of Putniņš and Sauka (2015) according to the model average calculations.

Calculations of the shadow economy in the Baltic States (% of GDP) 2009–2023, using various approaches

Latvia

Method	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Putniņš un Sauka (2015)	36,6	38,1	30,2	21,1	23,8	23,5	21,3	20,7	22,0	24,2	23,9	25,5	26,6	26,5	22,9
MIMIC (Schneider)	27,1	27,3	26,5	26,1	25,5	24,7	23,6	22,9	21,3	20,2	19,8	20,9	20,2	20,6	20,6
Calibrated MIMIC	33,8	34,0	33,0	32,5	31,8	30,8	29,4	28,5	26,5	25,2	24,7	26,1	25,2	25,6	25,7
Combined	35,2	36,1	31,6	26,8	27,8	27,1	25,4	24,6	24,3	24,7	24,3	25,8	25,9	26,1	24,3

Calculations of the shadow economy in the Baltic States (% of GDP) 2009–2023, using various approaches

Lithuania

Method	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Putniņš un Sauka (2015)	17,7	18,8	17,1	18,2	15,3	12,5	15,0	16,5	18,2	18,7	18,2	20,4	23,1	25,8	26,4
MIMIC (Schneider)	29,6	29,7	29,0	28,5	28,0	27,1	25,8	24,9	23,8	23,0	21,9	23,1	22,9	22,9	23,1
Calibrated MIMIC	36,9	37,0	36,1	35,5	34,9	33,8	32,2	31,0	29,7	28,6	27,3	28,8	28,5	28,6	28,8
Combined	27,3	27,9	26,6	26,9	25,1	23,1	23,6	23,8	23,9	23,7	22,8	24,6	25,8	27,2	27,6

Calculations of the shadow economy in the Baltic States (% of GDP) 2009–2023, using various approaches

Estonia

Method	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021	2022	2023
Putniņš un Sauka (2015)	20,2	19,4	18,9	19,2	15,7	13,2	14,9	15,4	18,2	16,7	14,3	16,5	19,0	18,0	17,9
MIMIC (Schneider)	29,6	29,3	28,6	28,2	27,6	27,1	26,2	25,4	24,6	23,2	22,1	23,6	23,1	23,9	24,3
Calibrated MIMIC	36,9	36,5	35,6	35,2	34,4	33,8	32,7	31,7	30,7	28,9	27,5	29,4	28,7	29,8	30,2
Combined	28,5	28,0	27,3	27,2	25,1	23,5	23,8	23,5	24,4	22,8	20,9	23,0	23,9	23,9	24,1

Summary and conclusions

The aim of the SSE Riga Shadow Economy Index for the Baltic countries is to measure the size of the shadow economies in Estonia, Latvia and Lithuania, as well as to explore the main factors that influence participation in the shadow economy. We use the term "shadow economy" to refer to all legal production of goods and services that is deliberately concealed from public authorities. The Index has been published annually since 2010 to provide policy makers with information for making justified policy decisions, as well as to foster a deeper understanding of entrepreneurship processes in the Baltic countries.

The SSE Riga Shadow Economy Index for the Baltic countries is calculated dannually based on a methodology developed by Putniņš and Sauka (published in the Journal of Comparative Economics in 2015) and using surveys of company managers in the Baltic countries: Latvia, Lithuania and Estonia. This method makes use of a number of surveying and data collection techniques shown in previous studies to be effective in eliciting more truthful responses. The Index combines estimates of misreported business income, unregistered or hidden employees, as well as unreported "envelope" wages to obtain estimates of the shadow economies as a proportion of GDP. This methodology has been also applied to estimate the size of the shadow economy in other countries such as Ukraine, Moldova, Romania, Poland, Kyrgyzstan, Russia and Kosovo.

Summary and conclusions

In this study, the main focus is on estimates of the shadow economy in 2023 and trends covering the period 2009–2023. It also provides evidence about the main factors that influence entrepreneurial involvement in the shadow economy as well as some policy recommendations.

According to our calculations, the size of the shadow economy in Latvia has had an increasing trend since 2016, with a small exception in 2019: 20.7% of GDP in 2016, 22.0% in 2017 and 24.2% of GDP in 2018, and 23.9% of GDP in 2019. In 2020, the shadow economy in Latvia grew to 25.5% of GDP and in 2021 to 26.6% of GDP, while in 2022 to: 26.5% of GDP. Lithuania has also seen an increase in the size of the shadow economy almost every year since 2014: In 2014, it was 12.5% of GDP, rising to 18.2% in 2019 and 20.4%, 23.1% and 25.8% of GDP in 2020, 2021 and 2022 respectively. While in Estonia, according to our data, the size of the shadow economy has been variable, growing and shrinking. In 2014, the size of the shadow economy in Estonia was 13.2% of GDP, and in 2015: 14.9% of GDP, in 2017: 18.2% of GDP, in 2020: 16.5% of GDP, and in 2022: 18.0% of GDP.

Summary and conclusions

According to the latest Shadow Economy Index, the size of the shadow economy in Latvia has fallen significantly to 22.9% of GDP in 2023, down 3.6 percentage points compared to 2022. Estonia sees a slight decline in the shadow economy in 2023: 17.9% of GDP, compared to 18.0% in 2022. However, in Lithuania, the shadow economy has grown by 0.6 percentage points to 26.4% of GDP in 2023 compared to 2022. In Lithuania, this is the highest level of the shadow economy since 2009, when we started measuring the shadow economy in the Baltic countries. This is also the first time since 2009 that the size of the shadow economy in Lithuania is larger than in Latvia.

The results of the Shadow Economy Index survey show that in Latvia, Estonia and Lithuania the most significant component of the shadow economy in 2023 was "envelope wages" (average share of salaries in % which is paid by the employers, but concealed from the government), which account for 48.2% (46.7% in 2022) of the total shadow economy in Latvia and in Estonia: 45.3% (44.5% in 2022), and in Lithuania 35.5% (34.0% in 2022). In 2023, underreporting of income (average share of revenue in % that companies conceal from the government) made up 25.8% (29.0% in 2022) of the total shadow economy in Latvia, and underreporting of the number of employees (average share of the employees in % working without a contract) accounted for 26.0% (24.3% in 2022). Underreporting of employees in Estonia, in 2023, account for 32.0% (28.0% in 2022) of the total shadow economy, but underreporting income: 22.7% (27.5% in 2022). However, in Lithuania, underreporting of income account for 34.5% of the total shadow economy in 2023 (36.5% in 2022), but the component of underreporting employees: 30.0% (29.5% in 2022).

Summary and conclusions

In 2023, compared to 2022, in Latvia, the share of average wages (%) that companies hide from the state, or "envelope wages", decreased by 1.4 percentage points to 23.6%. Estonia also sees a slight decrease in the share of "envelope wages" in 2023 compared to 2022: from 16.8% to 16.5%. However, in Lithuania, the share of "envelope wages" has risen to 20.8% in 2023 (+0.8 percentage points compared to 2022). Thus, although there are no longer very large differences in the share of average wages (%) that companies hide from the state between the Baltic countries, Latvia still has higher levels of "envelope wages" than Lithuania and Estonia.

In the area of underreporting income (profits), there is a decrease in all three Baltic countries in 2023 compared to 2022, but the largest decrease is in Latvia, where non-reporting decreases from 16.3% to 14.6% (-1.7 percentage points compared to 2022). Underreporting of income in Estonia decreased to 9.5% in 2023 (11.1% in 2022), while in Lithuania it is the highest among the Baltic countries: 19.6% (19.7% in 2022). Meanwhile, according to the latest Shadow Economy Index, all three countries see an increase in the level of underreporting of employees in 2023 compared to 2022. Namely, the rate of underreporting of employees reached 11.7% in Latvia in 2023 (+0.6 percentage points compared to 2022), in Lithuania: 15.4% (+1.0 percentage points), while in Estonia: 10.7% (+1.2 percentage points). Thus, according to the latest Shadow Economy Index results, the rate of underreporting of employees in 2023 is also higher in Lithuania than in Latvia.

Summary and conclusions

Given the relatively high proportion of "envelope wages" in the shadow economy in all three Baltic states, we asked company managers "What is the approximate probability (0-100%) of being "caught" by a typical company in your sector if the company pays "envelope wages"?". According to the results, the highest proportion of entrepreneurs believe that there is a "76–100%" probability of being caught: 45.6% of Lithuanian entrepreneurs, 31.2% of Estonian entrepreneurs and 29.0% of Latvian entrepreneurs surveyed answered this way. Accordingly, 7.1% of Lithuanian, 14.0% of Estonian and 10.5% of Latvian entrepreneurs answered that the probability of being caught ranged from "51–75%", while 19.3% of Lithuanian, 19.5% of Estonian and 27.5% of Latvian entrepreneurs answered that the probability of being caught ranged from "31–50%". Finally, 4.5% of Lithuanian, 5.4% of Estonian and 5.0% of Latvian entrepreneurs believe that the probability of being caught paying "envelope wages" is "0%", i.e., companies cannot be caught.

We also asked the respondents "If a company in your industry was caught for deliberate misreporting, what would typically be the consequence to that company?". 4.8% of respondents in Latvia, 5.4% in Lithuania and 8.0% in Estonia answered "nothing serious", 34.5% of respondents in Latvia, 42.2% in Lithuania and 29.4% in Estonia answered "a serious fine that would affect the company's competitiveness". However, 20.6% of Latvian, 9.1% of Lithuanian and 16.6% of Estonian company managers surveyed said "the company would be forced to close down".

Summary and conclusions

In addition to measuring the involvement of registered businesses in the shadow economy, we also calculate the share of unregistered businesses in the Baltic countries. According to our estimates, the share of goods or services provided by unregistered entrepreneurs in Latvia, Lithuania and Estonia in 2023 (2022) was 8.8% (8.5%), 8.4% (9.5%) and 6.5% (6.3%) respectively.

According to our results, the overall level of bribery (% of revenue spent on informal payments "to get things done") has increased in Latvia (by +0.6 percentage points) to 10.0% in 2023 compared to 2022. The overall level of bribery decreased in Lithuania (by -2.3 percentage points) and slightly in Estonia (-0.2 percentage points): 8.1% and 6.2% respectively. The results of our study also show that in Lithuania and Estonia, the average % of the contract value paid to secure contracts with the government has increased in 2023 compared to 2022: from 6.6% to 7.9% in Lithuania, and 2.1% to 3.3% in Estonia. In Latvia, this component has decreased from 7.9% in 2022 to 7.5% in 2023.

Summary and conclusions

The highest level of the shadow economy in Latvia in 2023 is observed in Kurzeme (24.2%), followed by the Riga region (23.8%), Latgale (22.7%), Vidzeme (22.2%) and Zemgale (18.0%). In terms of sectors, the highest share of the shadow economy in Latvia is still in the construction sector: 34.2% (-0.3 percentage points compared to 2022). The size of the shadow economy in Latvia's retail sector reached 27.0% in 2023 (30.5% in 2022), in the service sector: 26.4% (28.6% in 2022), in manufacturing: 18.9% (23.9% in 2022), and in wholesale trade: 13.0% (20.5% in 2022).

In terms of attitudes, companies in the Baltic countries remain relatively satisfied with the performance of the State Revenue Service (SRS), which, according to the latest data, is rated slightly higher in Lithuania and Estonia. Specifically, on a scale of 1–5, where 5 means very high satisfaction, satisfaction with the SRS in Latvia in 2023 is 3.47 (3.60 in 2022), in Lithuania: 3.75 (3.61 in 2022) and 3.76 (3.81 in 2022) in Estonia.

Summary and conclusions

The results of the study show that in 2023, compared to 2022, business satisfaction with government tax policy has worsened in all Baltic countries: from 2.76 in 2022 to 2.60 in 2023 in Latvia; from 2.99 to 2.84 in Lithuania; from 3.13 to 3.58 in Estonia. In particular, with a relatively sharp decline in business satisfaction with tax policy in 2023, Estonia's satisfaction is lower than in the other Baltic states for the first time since 2020.

Satisfaction of entrepreneurs with the quality of business legislation has also decreased in 2023: in Latvia: from 3.11 in 2022 to 3.04 in 2023; in Lithuania: from 2.97 to 2.95; and in Estonia: from 3.44 to 3.20. Satisfaction with the government support for entrepreneurs in Latvia has decreased to 2.57 in 2023 (2.89 in 2022), in Lithuania to 2.77 (2.86 in 2022) and in Estonia to 2.43 (2.70 in 2022).

Summary and conclusions

Since 2016, we have also been measuring the "tax morale" of entrepreneurs in the Baltic states, asking entrepreneurs whether "It is always justified to cheat on tax if there is a chance.". The survey data show that in 2023, tax morale is higher in Estonia, where, on a scale of 1–5, where 1 is strongly disagree and 5 is strongly agree, the average score in 2023 was 1.7. In Latvia, the score is 1.9, and in Lithuania: 2.1, following a similar trend since 2016.

We use regression analysis to identify the statistically significant determinants of firms' involvement in the shadow economy. For the regressions, we use pooled data from the past 13 survey rounds (years), which gives a panel that spans the years 2010-2023 and has a cross-section of approximately 1,500 firms per year. The dependent variable in all regressions is the level of the firm's involvement in the shadow economy. The independent variables are various firm-level characteristics, attitudes, sector dummy variables, region and year fixed effects.

Summary and conclusions

The regression coefficients indicate that the effect of perceived detection probabilities and penalties on the tendency for firms to engage in deliberate misreporting is consistent with the predictions of rational choice models, i.e., the higher the perceived probability of detection and the larger the penalties, the lower the amount of tax evasion and misreporting. The effect of detection probability in particular stands out as being a particularly strong deterrent of shadow activity. This evidence suggests a possible policy tool for reducing the size of the shadow economies, namely increasing the probability of detection of misreporting. This could be done via an increased number of tax audits, whistle-blower schemes that provide incentives to report information to authorities about non-compliant companies, and investment in tax evasion detection technology.

The regression results show that tolerance towards tax evasion is positively associated with the firm's stated level of income/wage underreporting, i.e., entrepreneurs that view tax evasion as a tolerated behaviour tend to engage in more informal activity. The measures of tolerance also serve an important role as control variables for possible understating of the extent of shadow activity due to the sensitivity of the topic.

Summary and conclusions

The regression results also indicate that a firm's satisfaction with the tax system and the government is negatively associated with the firm's involvement in the shadow economy, i.e., dissatisfied firms engage in more shadow activity, satisfied firms engage in less. Analysing each of the four measures of satisfaction separately we find that shadow activity is most strongly related to dissatisfaction with business legislation and the State Revenue Service, followed by the government's tax policy and support for entrepreneurs.

Another strong (and statistically significant) determinant of involvement in the shadow economy is firm size, with smaller firms (e.g., those with fewer employees) engaging in more shadow activity than larger firms, although the descriptive statistics suggest the relation may be non-monotonic. The statistically significant coefficient on firm age suggests that younger firms engage in more shadow activity than older firms. A possible explanation for these two relations is that small, young firms use tax evasion as a means of being competitive against larger and more established competitors. The sector dummy variables suggest that firms in the construction sector tend to engage in more shadow activity than firms in other sectors.

Methods used in constructing the Index

Survey of entrepreneurs

The SSE Riga Shadow Economy Index is based on an annual survey of company owners/managers in Estonia, Latvia, and Lithuania, following the method of Putniņš and Sauka (2015). The surveys are conducted between February and April of each year and contain questions about shadow activity during the previous two years. For example, the survey conducted in January–March 2024 collects information about shadow activity during 2023 and 2023. The overlap of one year in consecutive survey rounds, e.g., collecting information about 2022 shadow activity in both the 2023 and 2024 survey rounds, is used to validate the consistency of responses.

We use random stratified sampling to construct samples that are representative of the population of firms in each country. Starting with all active firms in each of the three Baltic countries (obtained from the Orbis database maintained by Bureau Van Dijk), for each country we form size quintiles (using book value of assets) and take equal sized random samples from each size quintile. In total a minimum of 500 phone interviews are conducted in each of the three Baltic countries in each survey round. More specifically, in 2024 survey we interviewed 503 respondents in Lithuania, 500 respondents in Estonia and 505 respondents in Latvia. 2024 survey was implemented in cooperation with Norstat Latvija.

Methods used in constructing the Index

Calculation of the Index

The Index measures the size of the shadow economy as a percentage of GDP. There are three common methods of measuring GDP: the output, expenditure, and income approaches. Our Index is based on the income approach, which calculates GDP as the sum of gross remuneration of employees (gross personal income) and gross operating income of firms (gross corporate income). Computation of the Index proceeds in three steps:

(i) estimate the degree of underreporting of employee remuneration and underreporting of firms' operating income using the survey responses;

(ii) estimate each firm's shadow production as a weighted average of its underreported employee remuneration and underreported operating income, with the weights reflecting the proportions of employee remuneration and firms' operating income in the composition of GDP;

(iii) calculate a production-weighted average of shadow production across firms.

Methods used in constructing the Index

In the first step, underreporting of firm *i*'s operating income $UR_i^{Operating\ Income}$, is estimated directly from the corresponding survey question. Underreporting of employee remuneration, however, consists of two components: (i) underreporting of salaries, or 'envelope wages' (question 11); and (ii) unreported employees. Combining the two components, firm *i*'s total unreported proportion of employee remuneration is:

$$UR_i^{EmployeeRemuneration} = 1-(1- UR_i^{Salaries})(1- UR_i^{Employees})$$

In the second step, for each firm we construct a weighted average of underreported personal and underreported corporate income, producing an estimate of the unreported (shadow) proportion of the firm's production (income):

$$ShadowProportion_i = \alpha_c UR_i^{EmployeeRemuneration} + (1- \alpha_c) UR_i^{OperatingIncome}$$

where α_c is the ratio of employees' remuneration (*Eurostat* item D.1) to the sum of employees' remuneration and gross operating income of firms (*Eurostat* items B.2g and B.3g). We calculate α_c for each country, *c*, in each year using data from *Eurostat*. Taking a weighted average of the underreporting measures rather than a simple average is important to allow the Shadow Economy Index to be interpreted as a proportion of GDP.

Methods used in constructing the Index

In the third step we take a weighted average of underreported production, $ShadowProportion_i$, across firms in country *c* to arrive at the Shadow Economy Index for that country:

$$INDEX_C^{Shadow\ Economy} = \sum_{i=1}^{N_c} w_i\, ShadowProportion_i$$

The weights, w_i, are the relative contribution of each firm to the country's GDP, which we approximate by the relative amount of wages paid by the firm. Similar to the second step, the weighting in this final average is important to allow the Shadow Economy Index to reflect a proportion of GDP.

As a final step, we follow the methodology of the *World Economic Forum* in their *Global Competitiveness Report*, and apply a weighted moving average of $INDEX_C^{Shadow\ Economy}$ calculated from the most recent two survey rounds. There are several reasons for doing this, including: (i) it increases the amount of available information and hence precision of the Index by providing a larger sample size; and (ii) it makes the results less sensitive to the specific point in time when the survey is administered.

Methods used in constructing the Index

The weighting scheme comprises two overlapping elements:

(i) more weight is given to the more recent survey round as that contains more recent information (past information is "discounted");

(ii) more weight is placed on larger sample sizes as they contain more information.

Following the approach of the *World Economic Forum*, for years in which there are no previous surveys (the 2009 and 2010 results, which are based on the first survey round conducted in 2011) the Index is simply based on the one survey round. Consequently, the first two annual Index estimates (2009 and 2010) are more prone to sampling error than subsequent annual estimates, which benefit from larger samples via the moving average. To allow comparisons across countries we apply consistent methodology in calculating the Shadow Economy Index for each of the Baltic countries.

Combined method for estimating the shadow economy in the Baltic states

Calculating the size of the shadow economy is a complex task. While various approaches have been proposed in previous studies, no method is perfect and, despite decades of research, there is still no agreement in the academic community on the most reliable method for measuring the shadow economy. To address at least part of this problem, we developed a combined methodology for calculating the shadow economy as part of the national research project RE:SHADE.

This methodology combines two leading approaches to measuring the size of the shadow economy: the direct micro-method developed by Putniņš and Sauka and the indirect macro-level method MIMIC, developed and popularised by Schneider and colleagues (e.g., Schneider and Enste, 2000). There is also a third broad category of methods that can be used to estimate the shadow economy: the "statistical discrepancies" approaches in measuring the national accounts (e.g., MacAfee, 1980; Thomas, 1992; OECD, 2002). According to the communication with the Central Statistical Bureau of Latvia and the State Revenue Service (Latvia) within the framework of the RE:SHADE national research programme, this approach has not been systematically applied to calculate the shadow economy in Latvia, nor are the necessary data inputs available for recent years. We therefore focus on a combination of the above two methods.

Combined method for estimating the shadow economy in the Baltic states

Each of these two methods has its strengths and weaknesses. The purpose of using a combined methodology is to make the measurement of the shadow economy more accurate, as compared to when only one method is used. By combining the two methods, we retain the advantages of both for calculating the shadow economy. Within this context, it is important to stress that these calculations should be interpreted with caution as the new methods (MIMIC recalibration and combined method, see below) are not yet properly peer-reviewed.

For the combined method of calculating the shadow economy in the Baltic countries, we use the following approach:

We use data from the Putniņš and Sauka (2015) direct micro-method (Shadow Economy Index): an established methodology developed in a peer-reviewed study.

- The method is based on carefully designed surveys of entrepreneurs with econometric corrections to deal with response bias. This approach provides micro-data on shadow economy activity at a business level, calculating the size of the shadow economy as a % of GDP.

We use data from the MIMIC (Schneider et al.) indirect macro-level method, also known as the Dynamic Multiple Indicators Multiple Causes Model.

- According to this method, data on the possible causes and indicators of the shadow economy are used to calculate the size of the shadow economy.

Combined method for estimating the shadow economy in the Baltic states

- To arrive at an estimate of the actual size of a shadow economy the relative estimates are usually calibrated using an absolute measure of the shadow economy known or assumed to be correct. This calibration step is often underestimated – the method itself does not produce an estimate of the size of the shadow economy.
- In most cases, data from countries other than Latvia, Lithuania or Estonia are used as a basis for calibration – or rather indirect approaches, such as currency demand. This is more convenient when calculating the shadow economy across many countries, but reduces the accuracy of the method on a country-by-country basis.

Recalibrating the MIMIC method. This approach has been developed within the State Research Programme RE:SHADE (Putniņš and Sauka, 2022), using the microdata (Putniņš and Sauka, 2015) to recalibrate MIMIC (Schneider and colleagues) shadow economy estimates in the Baltic states.

- We calibrated the MIMIC method specifically for Latvian, Lithuanian and Estonian economies using micro-data.
- Thus, the MIMIC approach is adapted to the conditions of Latvia, Lithuania and Estonia – rather than calibrated to the data of another country, as is usually done when calculating the shadow economy according to the MIMIC method. The advantage of this is that the calibration does not have to rely on strong assumptions made by the currency circulation approach, and we get a more accurate estimate of the shadow economy for a given country.

Combined method for estimating the shadow economy in the Baltic states

We perform model averaging – in past and subsequent years, taking averages of the estimates from the survey approach (Putniņš and Sauka, 2015) and the recalibrated MIMIC approach (Putniņš and Sauka, 2022) to produce a combined shadow economy estimate.

Our results show that the size of the shadow economy in Latvia in 2023 reaches 22.9% of GDP according to the method of Putniņš and Sauka (2015), according to MIMIC method (Schneider et al.): 20.6% of GDP, according to the recalibrated MIMIC method (Putniņš and Sauka, 2022): 25.7% of GDP, but according to the combined method: 24.3% of GDP.

Accordingly, in Lithuania: In 2023, the shadow economy reaches 26.4% of GDP according to the method of Putniņš and Sauka (2015) and according to the MIMIC method (Schneider et al.): 23.1% of GDP, according to the recalibrated MIMIC method (Putniņš and Sauka, 2022): 28.8% of GDP, but according to the combined method: 27.6% of GDP.

In Estonia: In 2023, the shadow economy reaches 17.9% of GDP according to the method of Putniņš and Sauka (2015) and according to the MIMIC method (Schneider et al.): 24.3% of GDP, according to the recalibrated MIMIC method (Putniņš and Sauka, 2022): 30.2% of GDP, but according to the combined method: 24.1% of GDP.

Combined method for estimating the shadow economy in the Baltic states

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