STOCKHOLM SCHOOL OF ECONOMICS

SSE RIGA

Shadow Economy Index for the Baltic Countries 2009—2020

Authors of the study

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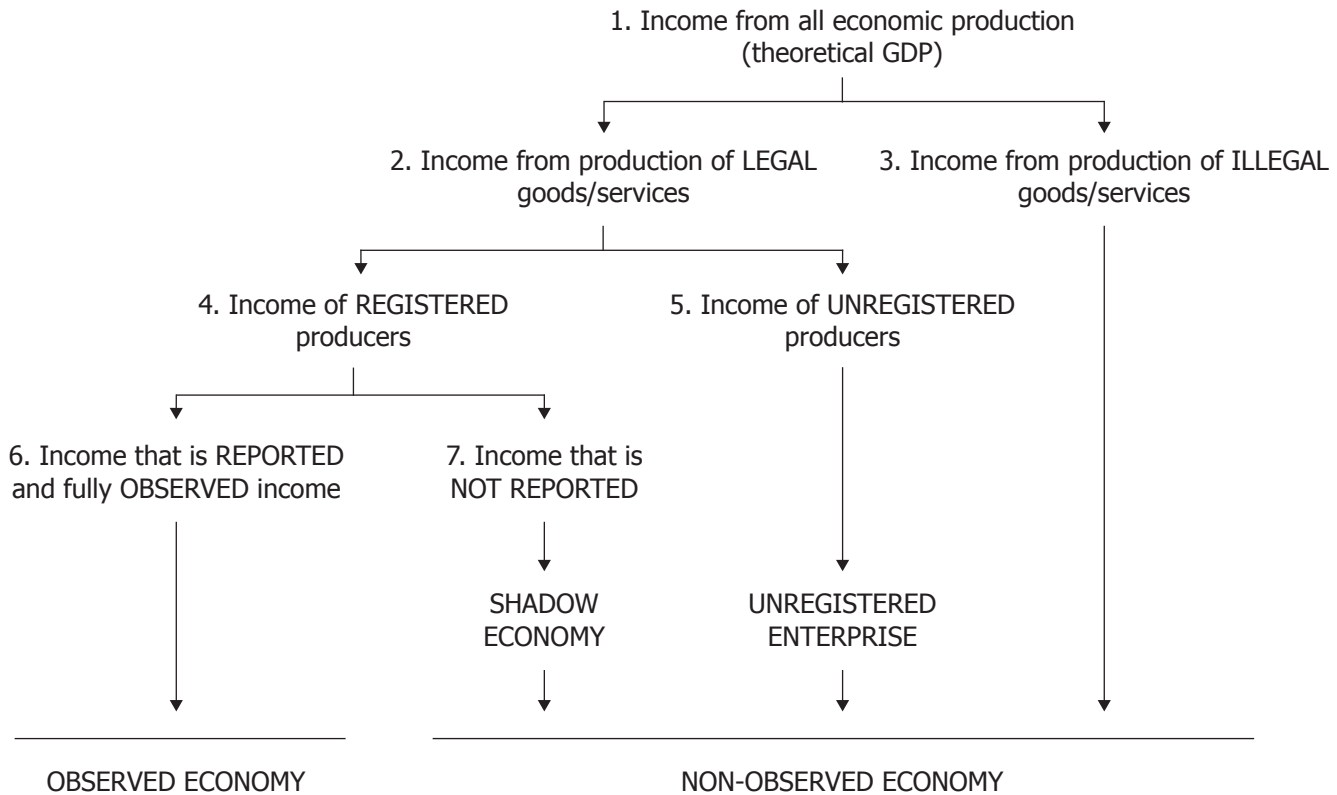
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Since 2009:

- 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

1. Income from all economic production (theoretical GDP)

2. Income from production of LEGAL goods/services

3. Income from production of ILLEGAL goods/services

4. Income of REGISTERED producers

5. Income of UNREGISTERED producers

6. Income that is REPORTED and fully OBSERVED income

7. Income that is NOT REPORTED

SHADOW ECONOMY

UNREGISTERED ENTERPRISE

OBSERVED ECONOMY

NON-OBSERVED ECONOMY

Measuring the shadow economy using company managers

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Size of the shadow economy in different countries 2009–2020 Results

Shadow economy index (% of GDP)

	2018	2017	2016	2015
Russia	44,7 (42,4 46,9)	45,8 (43,4 48,1)	-	-
Ukraine	38,2 (35,3 41,2)	38,5 (35,5...1,5)	-	-
Kyrgyzstan	44,5 (40,9 48,1)	46,1 (42,4 49,6)	-	-
Latvia	24,2 (21,5 26,8)	22,0 (19,6 24,5)	20,7 (18,0 22,6)	21,3 (19,0 23,7)
Lithuania	18,7 (17,0 20,4)	18,2 (16,1 20,4)	16,5 (14,8 18,3)	15,0 (13,8 16,3)
Estonia	16,7 (14,5 18,8)	18,2 (16,1 20,3)	15,4 (13,1 17,8)	14,9 (12,4 17,4)
Moldova	27,5 (24,0 31,0)	29,4 (25,7 33,1)	29,7 (26,9 32,5)	29,8 (27,0 32,6)
Kosovo	39,5 (n/a, n/a)	-	-	-
Romania	-	-	33,3 (30,4 36,3)	35,6 (32,2 39,0)
Poland	-	-	25,0 (22,5 27,4)	24,4 (22,0 26,9)

Study

- "Direct survey method": interviews with company owners/managers in the Baltic countries

- Entrepreneurs as experts

- In 2021 about 2020 and 2019

- Approximately 500 telephone interviews in Latvia, 500 in Lithuania, 500 in Estonia every year

- 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

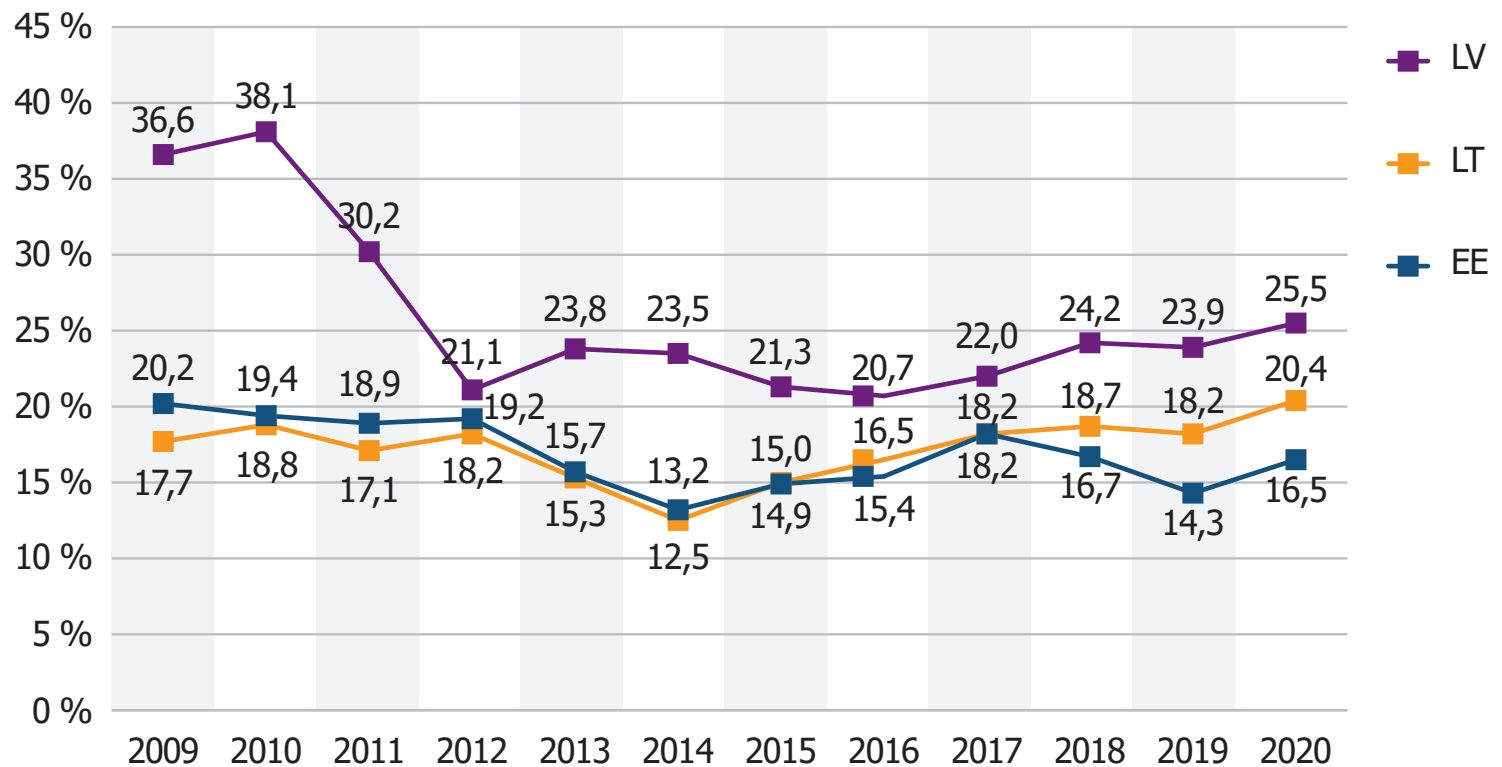- % of the contract value paid to secure a contract with the government: corruption

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2020
Results

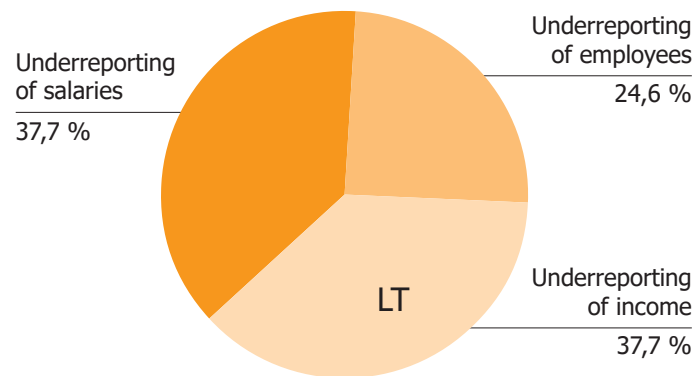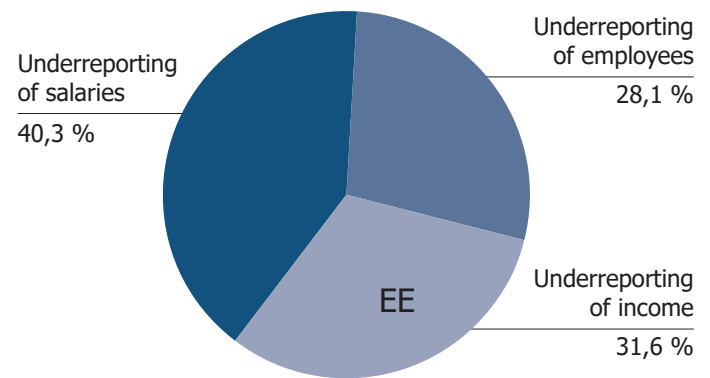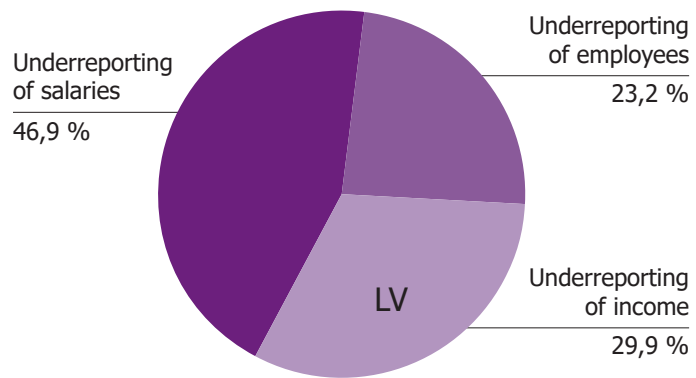# Shadow Economy Index for the Baltic countries (% of GDP), 2009–2020

	2020–2019	2020	2019	2018	2017	2016
LV	+1,6 (-0,1 3,4)	25,5 (23,6 27,4)	23,9 (21,4 26,3)	24,2 (21,5 26,8)	22,0 (19,6 24,5)	20,7 (18,0 22,6)
LT	+2,2 (0,7 3,7)	20,4 (18,4 22,3)	18,2 (16,5 19,9)	18,7 (17,0 20,4)	18,2 (16,1 20,4)	16,5 (14,8 18,3)
EE	+2,2 (0,4 4,1)	16,5 (14,3 18,8)	14,3 (12,3 16,3)	16,7 (14,5 18,8)	18,2 (16,1 20,3)	15,4 (13,1 17,8)

	2015	2014	2013	2012	2011	2010	2009
LV	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	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	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), 2009–2020

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2020

Components of the shadow economy in 2020

LV

Underreporting of salaries
46,9 %

Underreporting of employees
23,2 %

Underreporting of income
29,9 %

EE

Underreporting of salaries
40,3 %

Underreporting of employees
28,1 %

Underreporting of income
31,6 %

LT

Underreporting of salaries
37,7 %

Underreporting of employees
24,6 %

Underreporting of income
37,7 %

Underreporting of business income 2009–2020 (average share of revenue in % that companies conceal from the government)

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LV	31,7	33,7	26,5	16,7	19,9	21,7	19,9	18,5	17,1	17,9	16,6	18,0
LT	15,9	16,6	16,0	15,7	11,8	9,4	10,5	11,7	12,8	13,8	14,4	15,8
EE	11,1	11,4	9,7	13,0	10,3	6,7	7,5	8,3	9,7	9,9	10,6	11,6

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2020
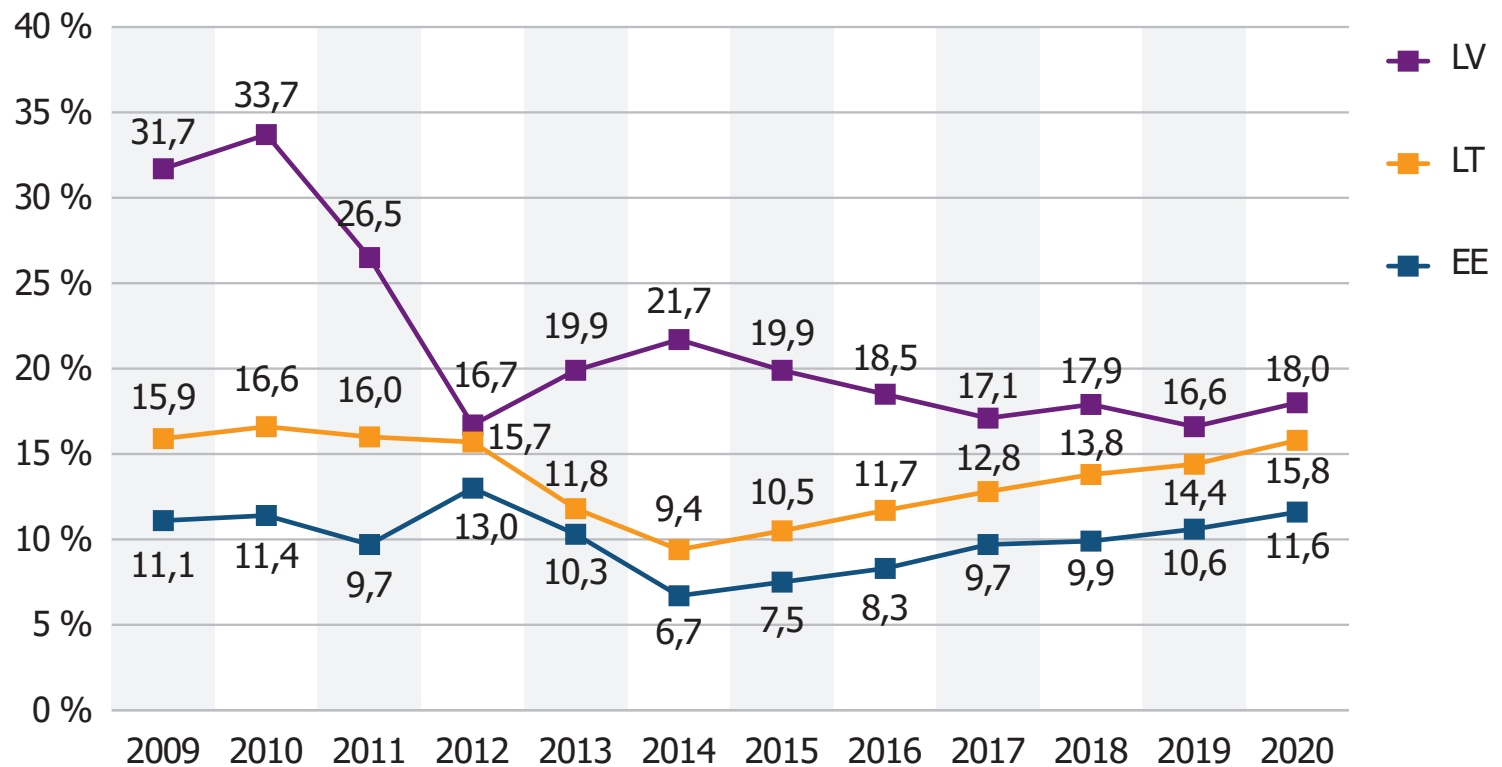
Underreporting of the number of employees, 2009–2020 (average share of the employees in % working without a contract)

Legend: LV, LT, EE

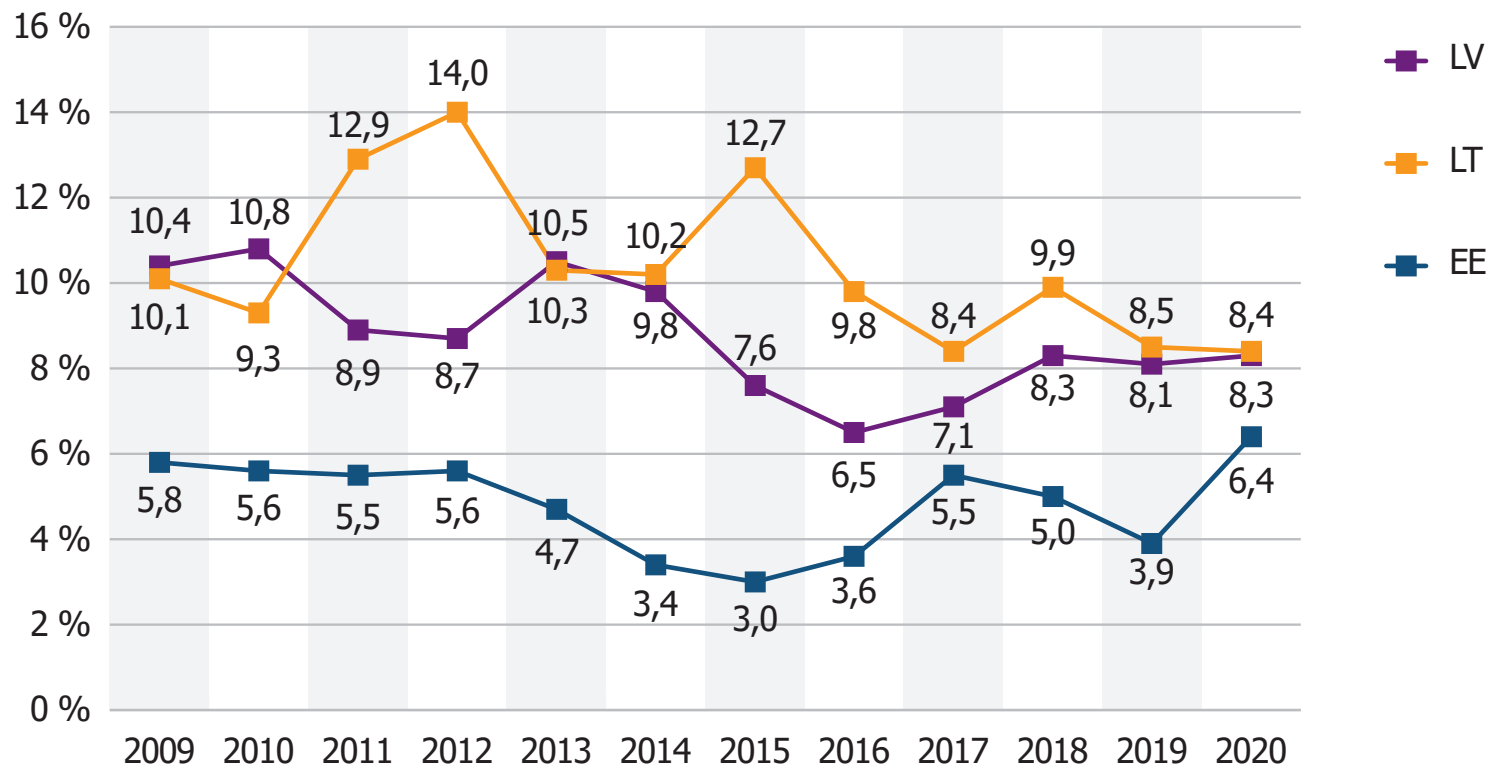|	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LV	14,6	14,6	11,6	9,7	10,3	9,6	9,6	7,6	7,4	9,6	10,9	10,9
LT	7,4	7,9	7,3	8,1	6,4	5,4	6,6	6,7	6,1	5,4	8,3	9,3
EE	9,6	9,7	9,7	7,6	8,1	7,6	5,7	6,7	6,5	5,4	5,7	9,0
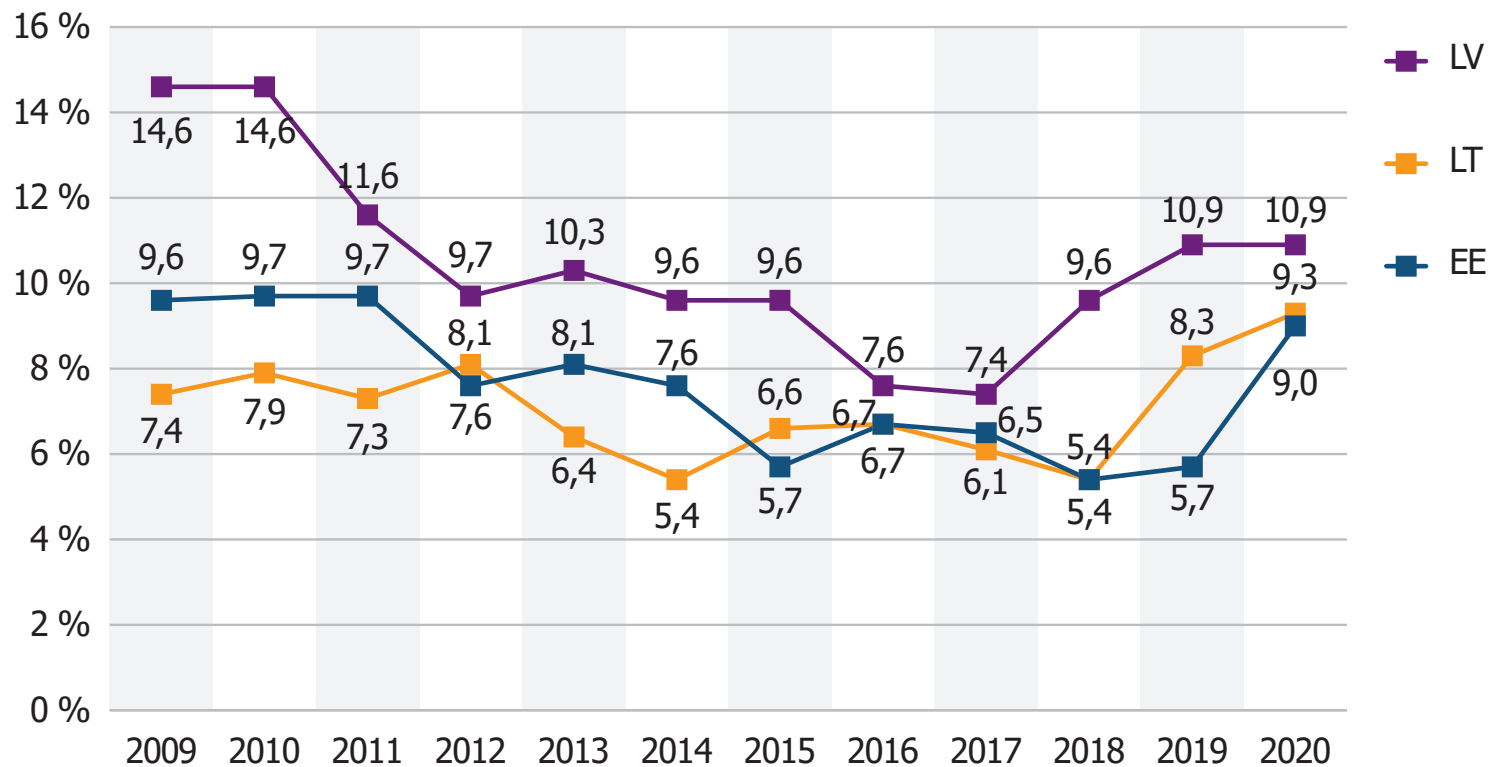
Envelope wages, 2009–2020
(average share of salaries in % which is paid by the employers, but concealed from the government)

Legend:
- LV
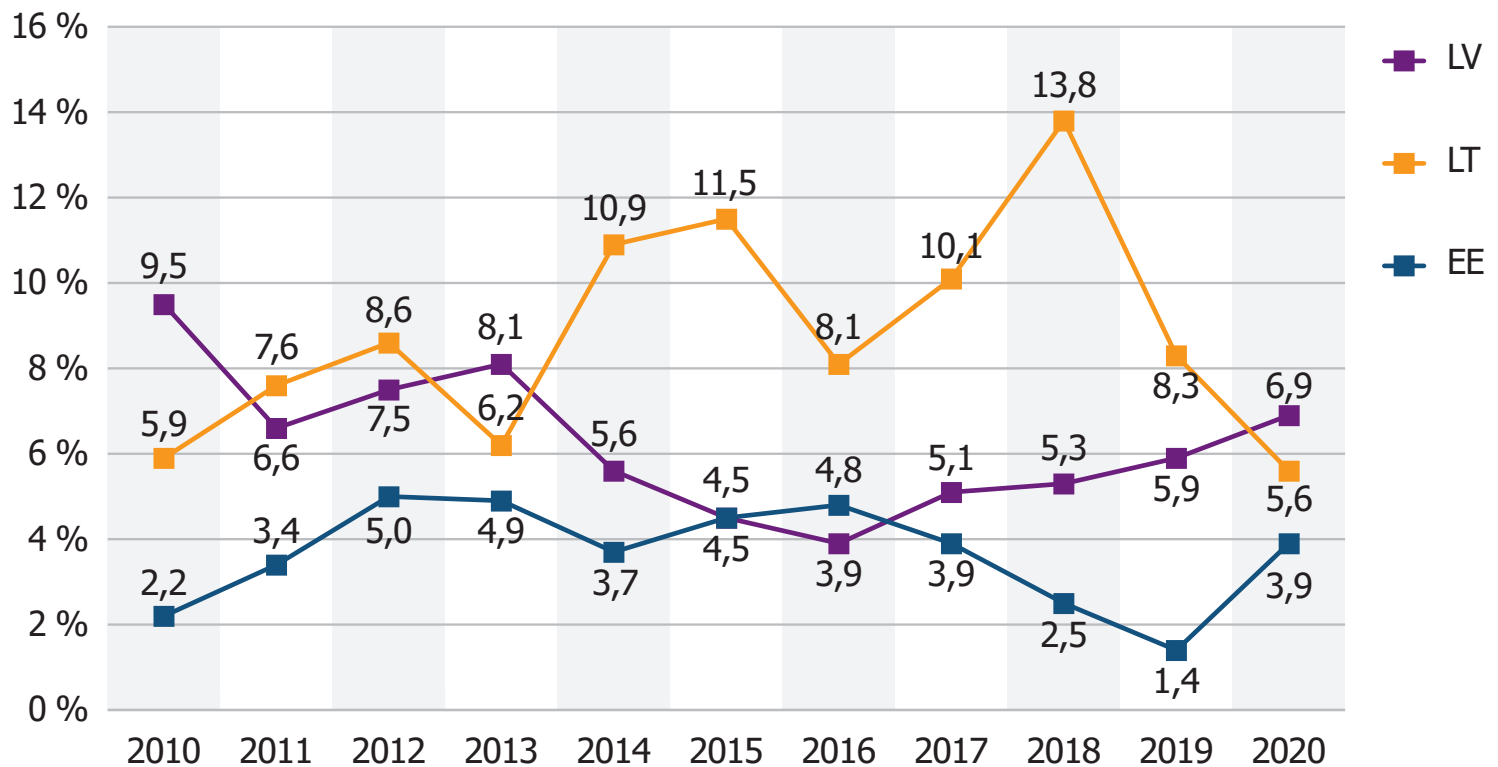- LT
- EE

Year	LV	LT	EE
2009	34,0	15,0	19,5
2010	35,5	15,8	19,6
2011	29,1	17,4	19,4
2012	26,5	19,3	22,1
2013	25,2	15,5	17,1
2014	20,3	12,2	13,6
2015	17,9	15,2	17,7
2016	18,1	15,4	17,1
2017	20,9	15,2	18,1
2018	21,5	15,5	16,7
2019	22,3	14,1	11,5
2020	23,5	15,3	13,2

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2020
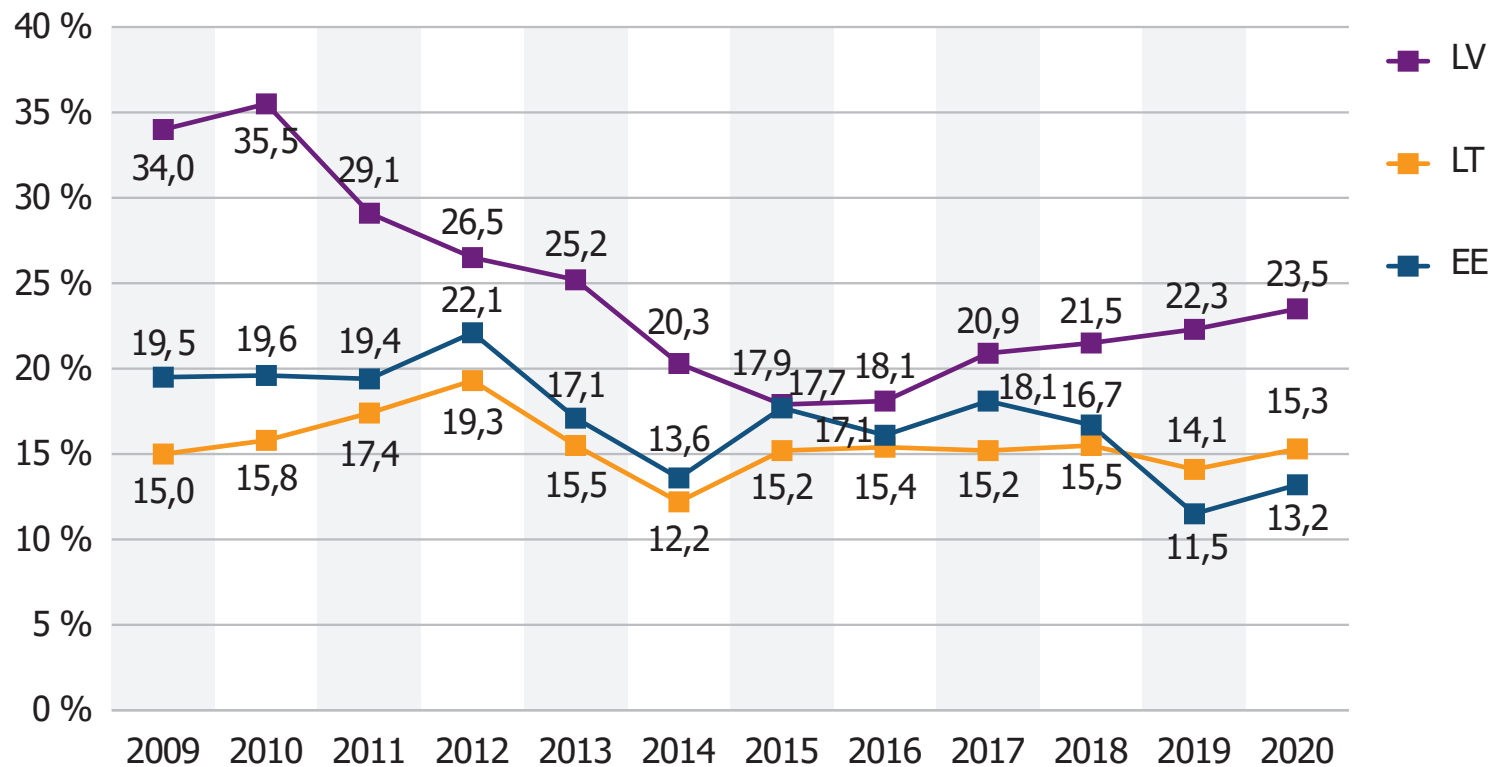
% of payments 'to get things done', 2009–2020 (average percentage of revenue paid as 'bribes')

LV
LT
EE

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
LV	10,4	10,8	8,9	8,7	10,5	9,8	7,6	6,5	7,1	8,3	8,1	8,3
LT	10,1	9,3	12,9	14,0	10,3	10,2	12,7	9,8	8,4	9,9	8,5	8,4
EE	5,8	5,6	5,5	5,6	4,7	3,4	3,0	3,6	5,5	5,0	3,9	6,4

% of the contract value paid to secure contracts with the government, 2010–2020

Legend: LV, LT, EE

Year	LV	LT	EE
2010	9,5	5,9	2,2
2011	6,6	7,6	3,4
2012	7,5	8,6	5,0
2013	8,1	6,2	4,9
2014	5,6	10,9	3,7
2015	4,5	11,5	4,5
2016	3,9	8,1	4,8
2017	5,1	10,1	3,9
2018	5,3	13,8	2,5
2019	5,9	8,3	1,4
2020	6,9	5,6	3,9

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2020

Proportion of unregistered enterprises in the Baltic countries (% of GDP), 2013–2020

	Latvia	Lithuania	Estonia
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 (average, 2016–2020)

Region	Value
Latgale	19,2
Zemgale	21,0
Vidzeme	24,7
Kurzeme	27,1
Riga	26,3
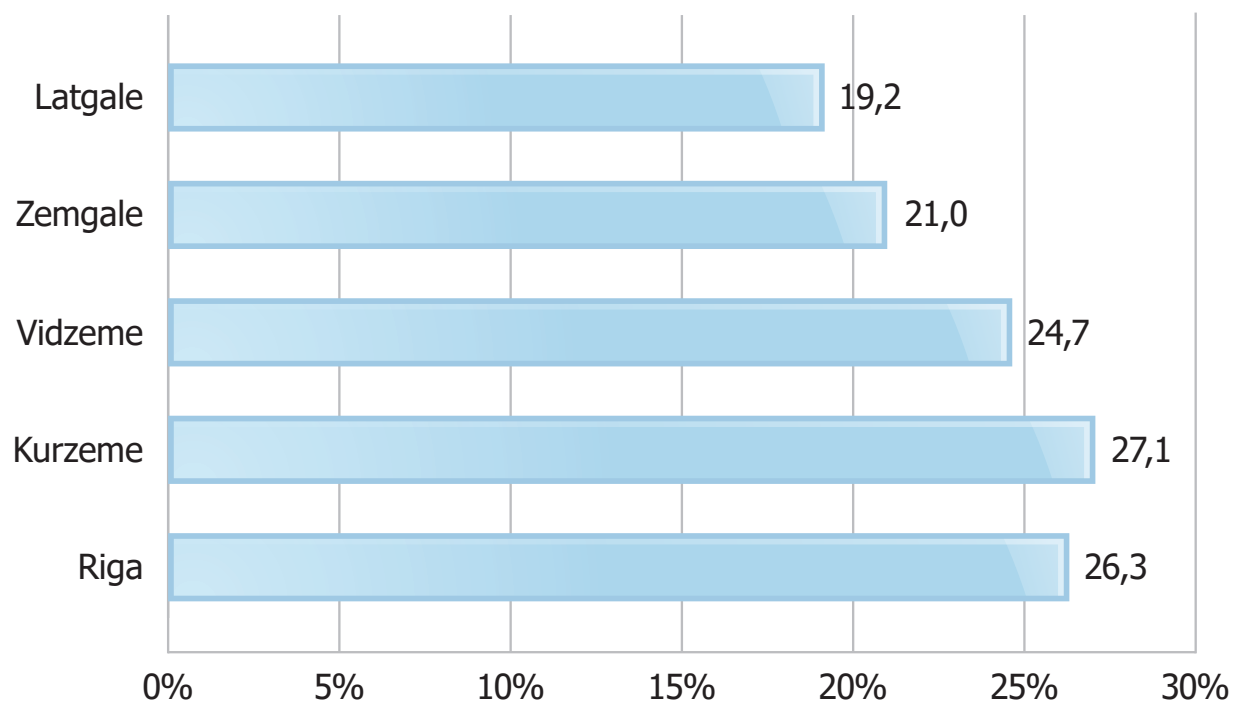
Size of the shadow economy (% of GDP) by sector in Latvia (average, 2016–2020)

Sector	Value
Construction	28,7
Services	24,9
Retail	23,9
Wholesale	25,3
Manufacturing	23,0

0% 5% 10% 15% 20% 25% 30% 35% 40%
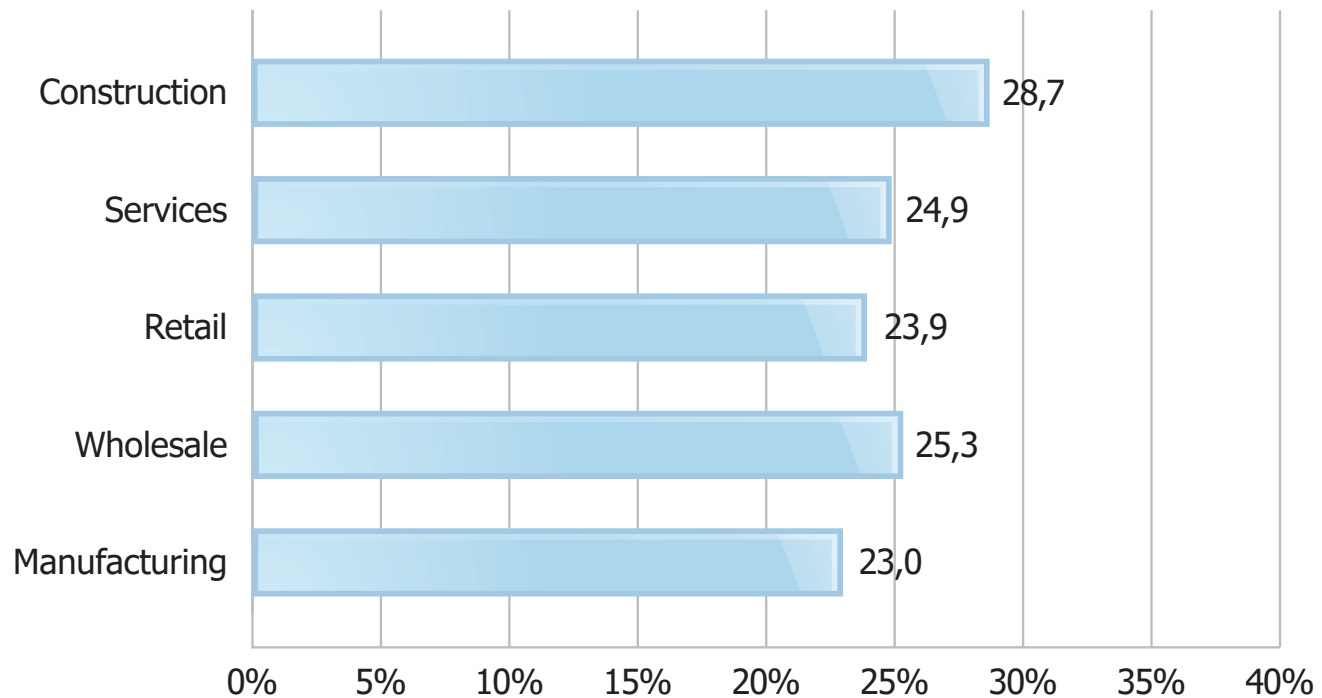
Involvement in the shadow economy

- 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

Probability of being caught
for underreporting business profits, 2020

Probability of being caught

Legend: LV, LT, EE

Probability of being caught	LV	LT	EE
0 %	3,9	3,9	11,9
1-10 %	11,5	13,8	10,7
11-30 %	11,0	13,6	11,9
31-50 %	24,5	19,2	22,6
51-75 %	7,6	5,2	6,8
76-100 %	41,5	44,3	36,0

Main determinants of the shadow economy
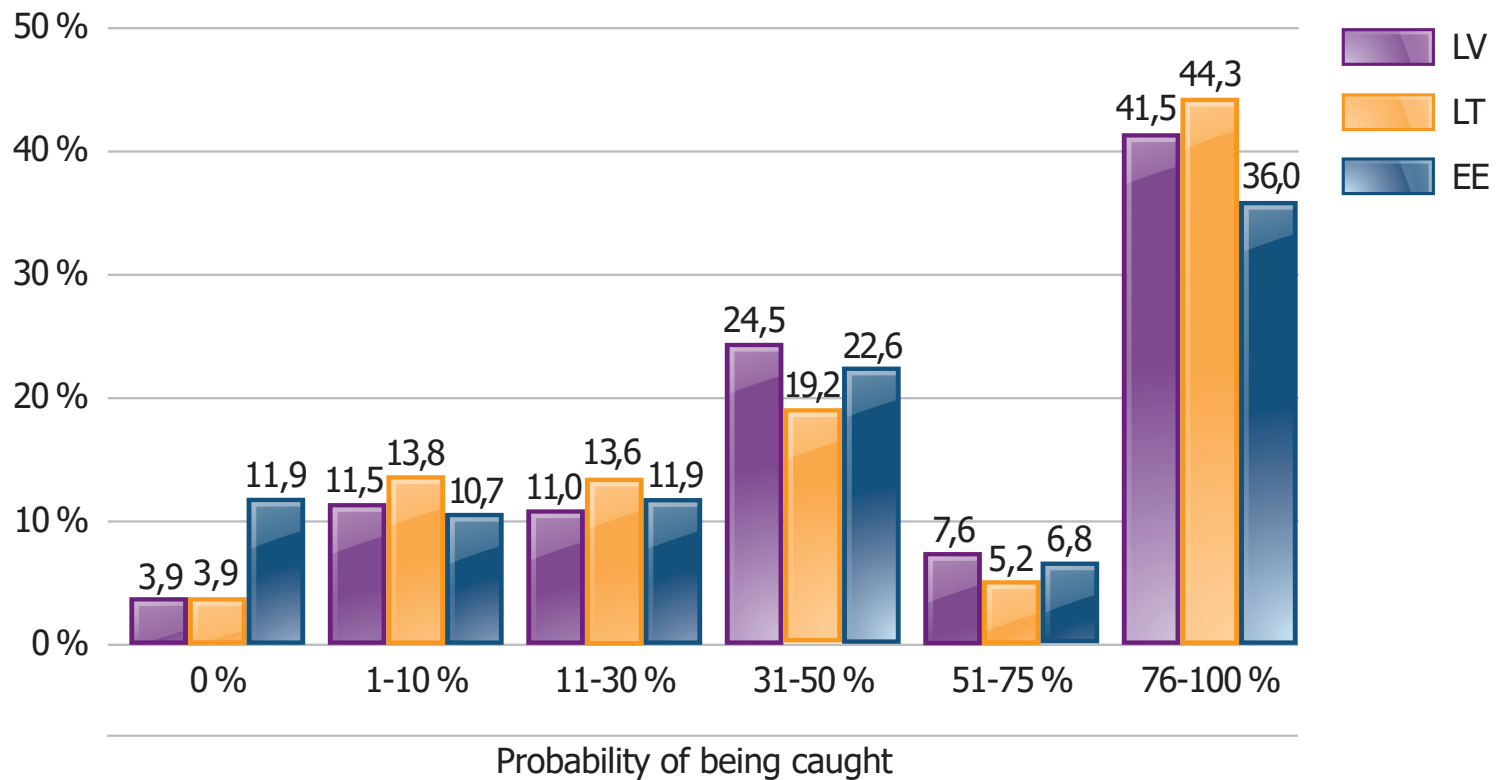
Consequences if caught for deliberate misreporting, 2020

Legend:
- LV
- LT
- EE

Category	LV	LT	EE
Nothing serious	4,0	5,9	14,1
A small fine	13,6	27,9	26,7
Serious fine, affects competitiveness	36,9	42,5	29,5
Serious fine, risk insolvency	25,3	14,6	13,3
Company will cease operations	20,2	9,1	16,3
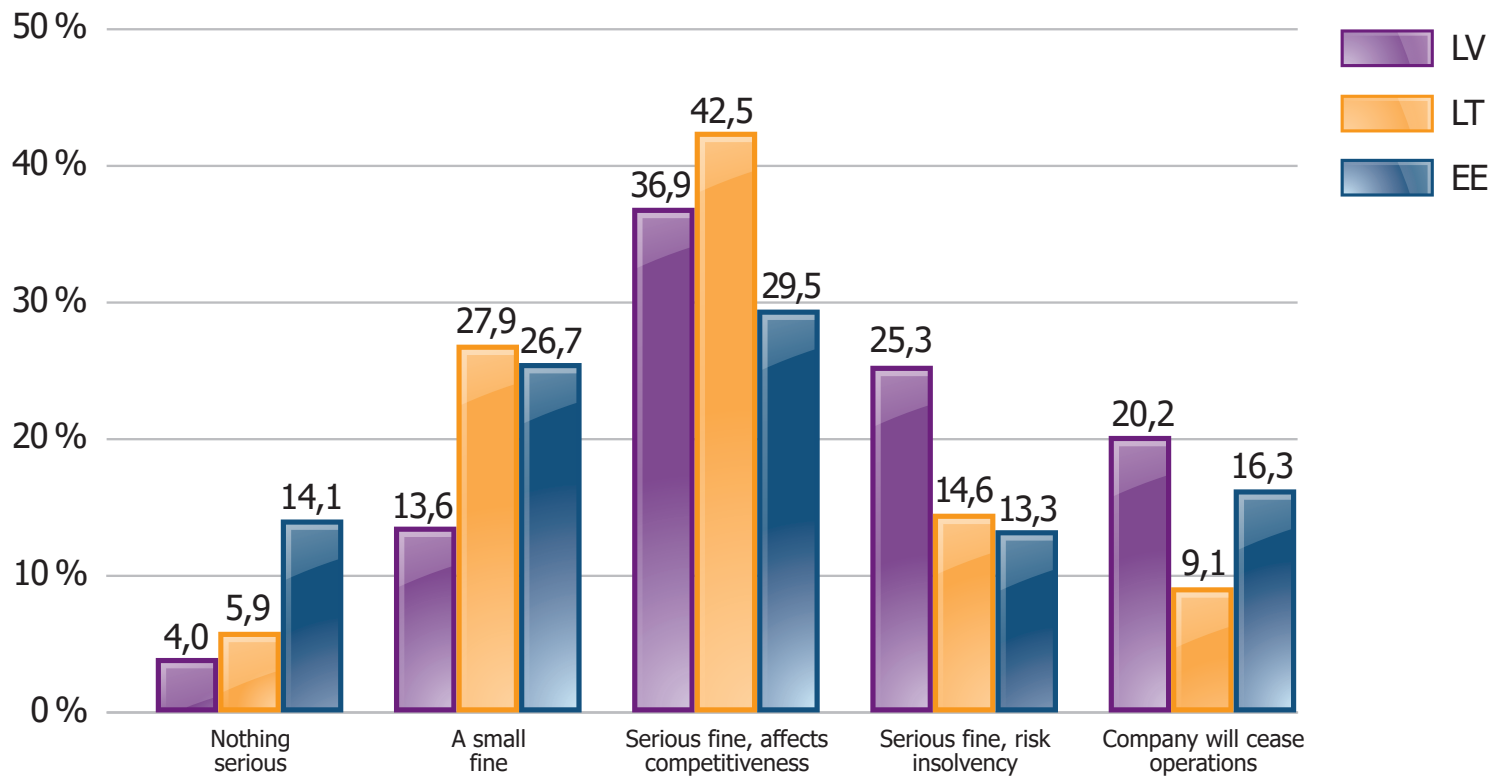
Statistically significant determining factors (using regression analysis)

- 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, 2010–2020

(Average, in scale from 1-5, where '1': very low satisfaction, but '5'- very high satisfaction)
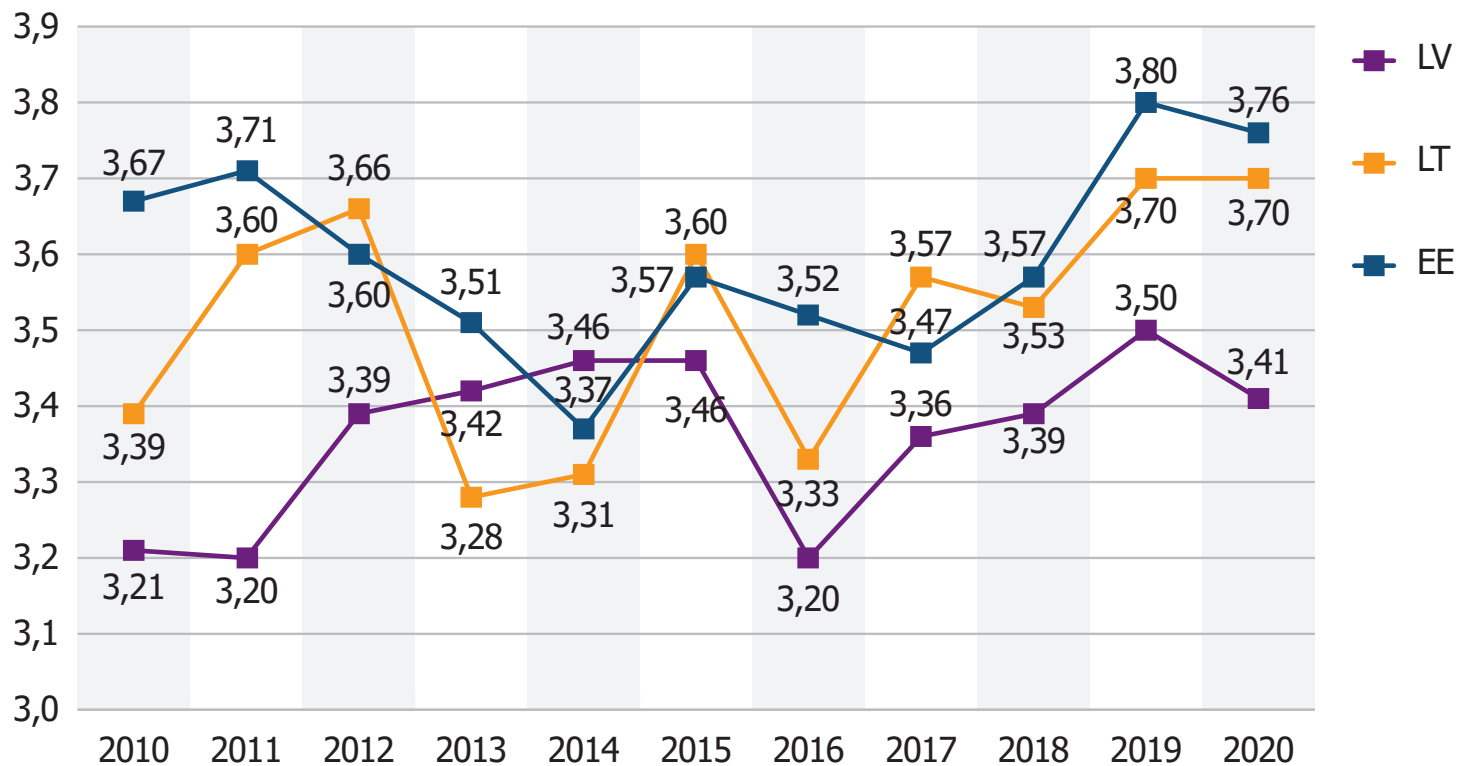
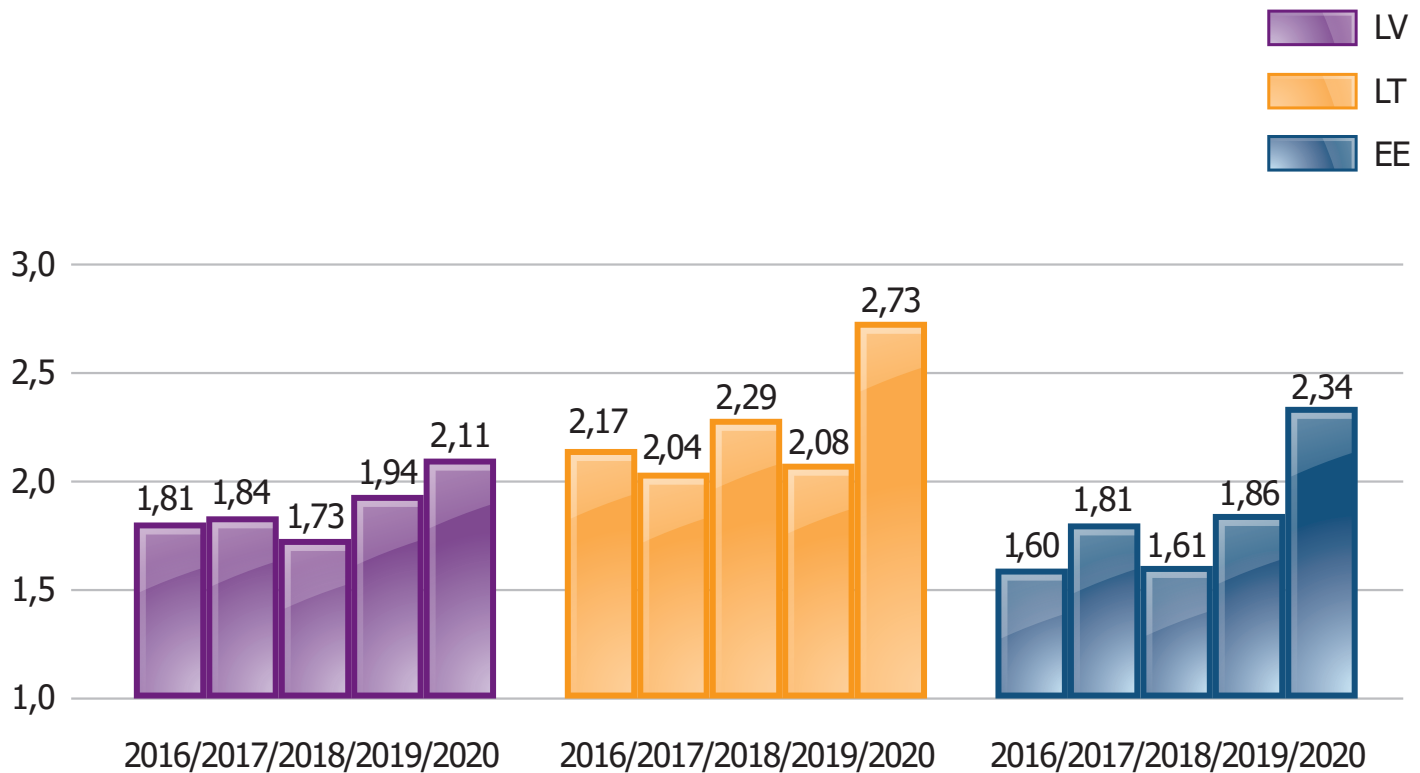# Satisfaction with the tax policy, 2010–2020

(Average, in scale from 1-5, where '1': very low satisfaction, but '5'- very high satisfaction)

Main determinants of the shadow economy
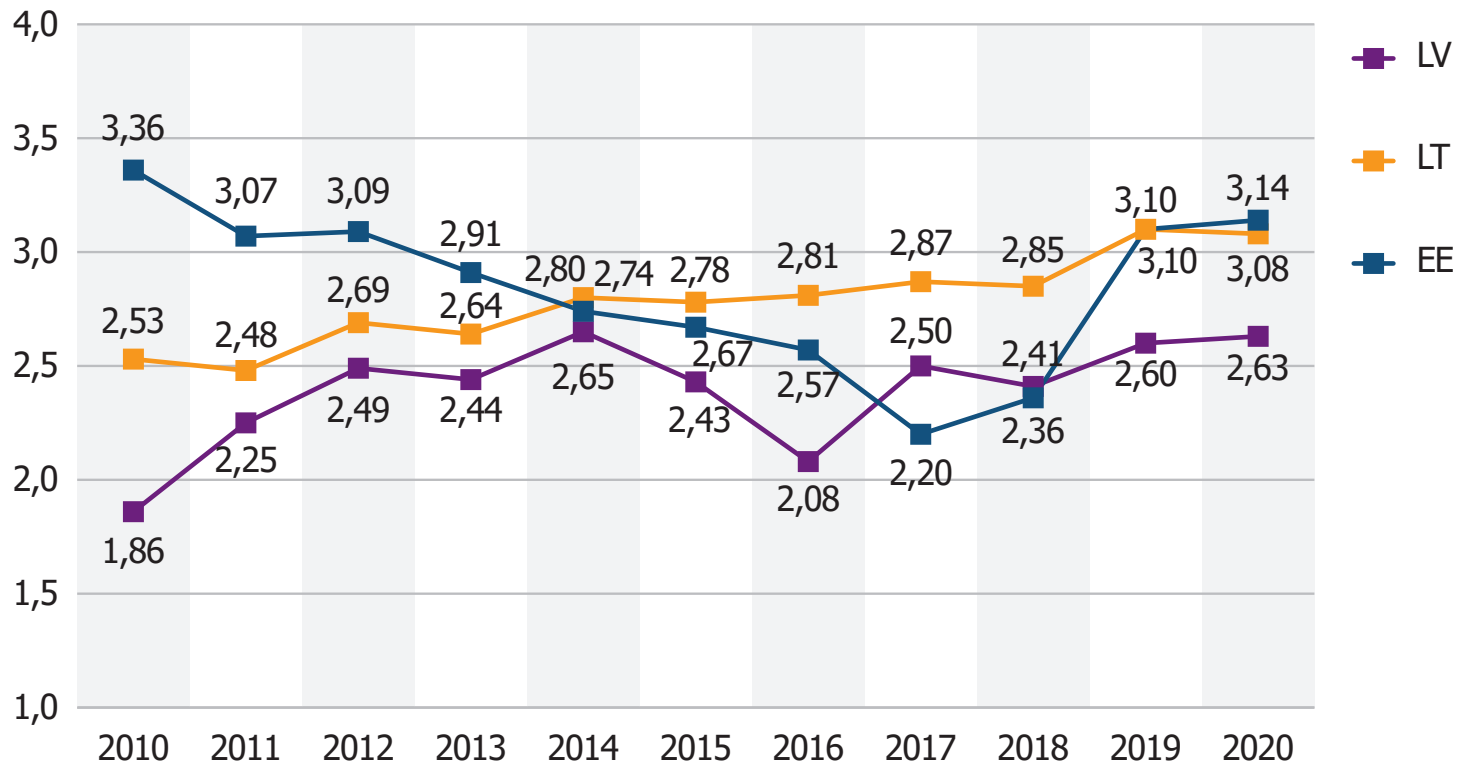
Satisfaction with the quality of business legislation, 2010–2020

(Average, in scale from 1-5, where '1': very low satisfaction, but '5'- very high satisfaction)
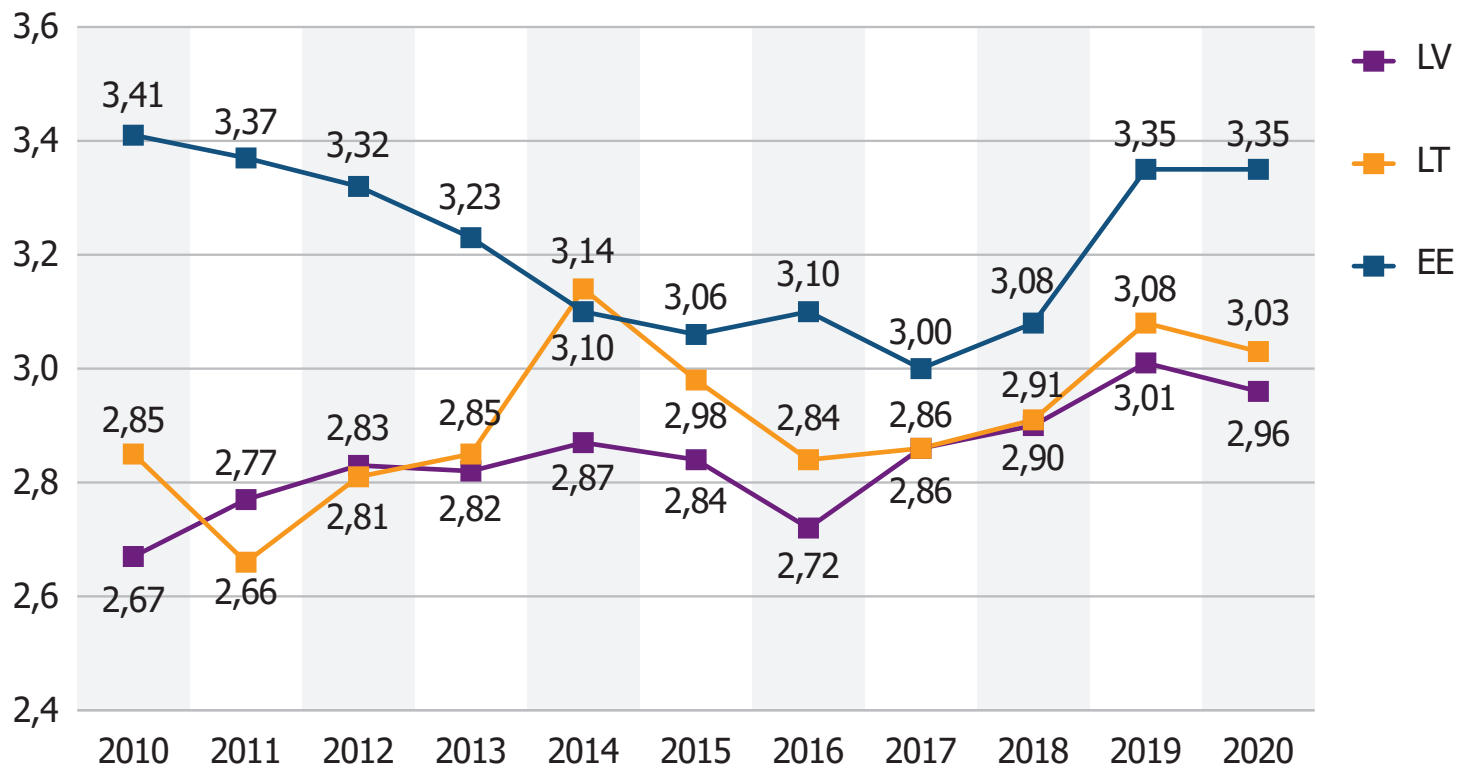
Satisfaction with the government's support to entrepreneurs, 2010–2020

(Average, in scale from 1-5, where '1': very low satisfaction, but '5'- very high satisfaction)
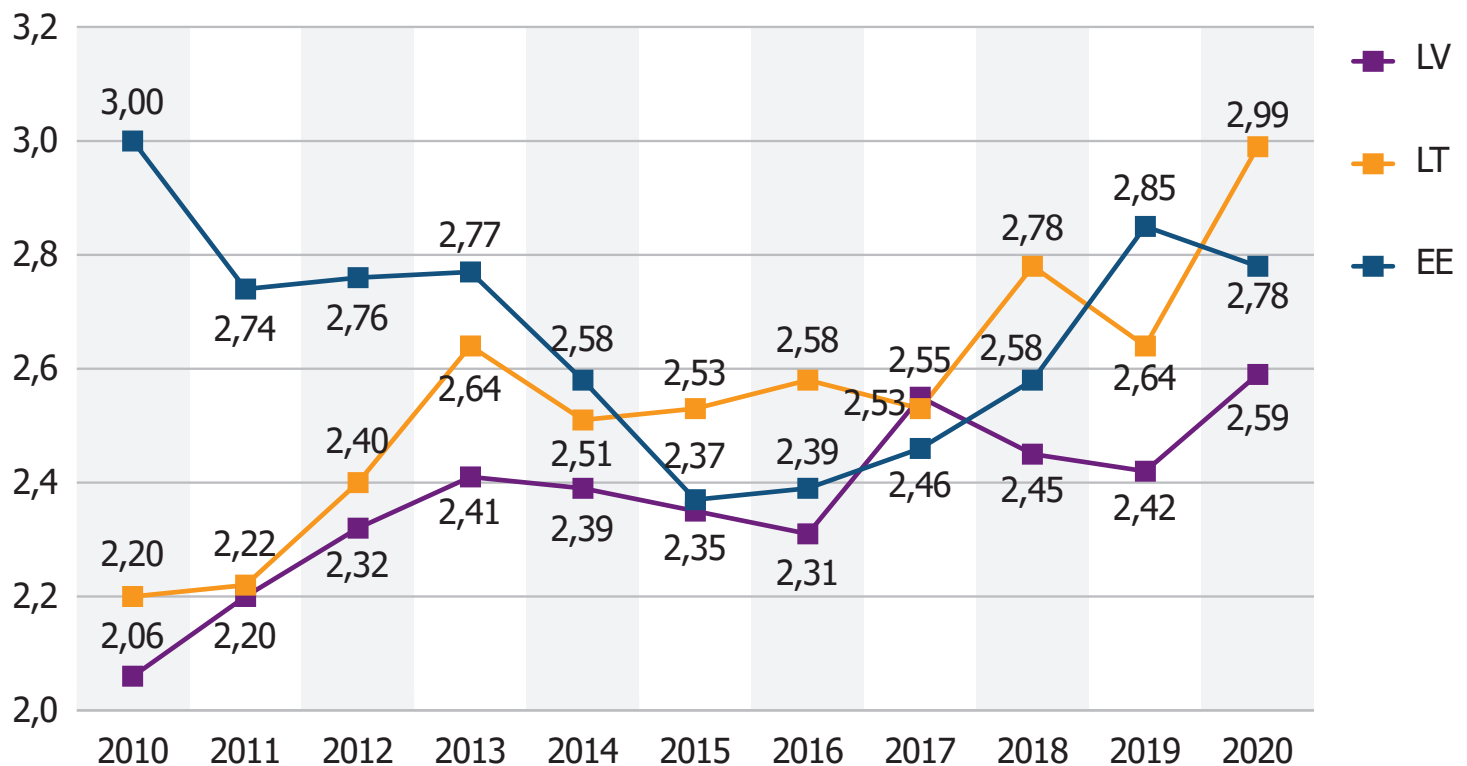
Statistically significant determining factors (using regression analysis)

■ Greater tolerance towards involvement in shadow economy ➜ greater involvement in shadow economy

Tax morale: cheating on tax, if there is a chance, can always be justified

(Average, in scale from 1-5, where '1': very low satisfaction, but '5'- very high satisfaction)

Legend:
- LV
- LT
- EE

Year	LV	LT	EE
2016	1,81	2,17	1,60
2017	1,84	2,04	1,81
2018	1,73	2,29	1,61
2019	1,94	2,08	1,86
2020	2,11	2,73	2,34

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 determined annually based on a methodology developed by Putniņš and Sauka (published in the *Journal of Comparative Economics* in 2015) and using business surveys in the Baltic countries: Latvia, Lithuania and Estonia. Several survey and data collection techniques are used in surveys, which have been shown to be effective in eliciting relatively 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 Russia, Ukraine, Moldova, Romania, Poland, Kyrgyzstan and Kosovo.

In this study, the main focus is on estimates of the shadow economy in 2020 and trends covering the period 2009–2020. It also provides evidence about the main factors that influence entrepreneurial involvement in the shadow economy as well as some policy recommendations.

Summary and conclusions

According to our calculations, the size of the shadow economy in Latvia from 2016 to 2018 has had an increasing trend: 20.7% of GDP in 2016, 22.0% in 2017 and 24.2% of GDP in 2018. In 2019, there was a slight decrease in the shadow economy in Latvia (23.9% of GDP), while the latest survey data show that in 2020, the size of the shadow economy in Latvia has continued to grow, reaching 25.5% of GDP. This is the highest indicator of the size of the shadow economy in the country since 2011, when the shadow economy in Latvia reached 30.2% of GDP.

It is still relatively difficult to conclude to what extent the indicators of the 2020 shadow economy have been affected by the Covid-19 pandemic. However, similarly to last year's study, it is safe to conclude that, despite the efforts of policy makers, since 2012 reducing or significantly reducing the size of the shadow economy in Latvia has failed. Namely, as we emphasised in conclusions of the previous year's study, unfortunately, the volume of the shadow economy in Latvia also did not decrease significantly during economic growth - in a situation, when the shadow economy should decrease, because entrepreneurs are doing better and they are thus more motivated to pay taxes. Then and now we point to problems that contribute to the shadow economy, such as distrust of entrepreneurs in government regarding the ability to spend tax money adequately, corruption scandals and cases where, for example, for the payment of "envelope" wages, inadequately low penalties are given. Also, regarding the unpredictability of the tax system and the overall uncertainty in the business environment. As well as communication of policy makers with entrepreneurs and the general public, for example, regarding various services provided by the state, incl. education, medicine, state support for entrepreneurs and the socially most

Summary and conclusions

vulnerable groups. All of these factors together could have had a negative impact on the size of the shadow economy, especially in the context of the Covid-19 pandemic. In general, taking the dynamics of the shadow economy in the previous 8 years and the current situation in the economy into account, it is highly probable that the size of the shadow economy in Latvia will continue to grow in the next 2-3 years.

According to the results of the latest research, growth of the shadow economy in 2020 is also observed in Lithuania and Estonia. In both countries, compared to 2019, the shadow economy has increased by 2.2%, reaching 16.5% of GDP in Estonia and 20.4% of GDP in Lithuania. Our estimates show that in Lithuania this is the highest indicator of the size of the shadow economy since 2009, that is, since we started measuring the shadow economy in the Baltic states. While in Estonia in 2020 the shadow economy returned to approximately the level of the shadow economy of 2018, when it reached 16.7% of GDP.

Our calculations also show that the most important component of the shadow economy in Latvia and Estonia in 2020 was "envelope" wages, which in Latvia comprise 46.9% of the total shadow economy (in 2019: 44.1%), but in Estonia: 40.3% (in 2019 43.0%). Unreported revenues in Latvia comprise 29.9% (in 2019: 32.0%) of the total shadow economy, but the component of unreported employees: 23.2% (in 2019: 23.9%). The most significant components of the shadow economy in Lithuania in 2020 were unreported revenues and "envelope" wages (both: 37.7%), followed by unreported employees (24.6%).

Summary and conclusions

Although in 2020, compared to 2019, the share of the average salary (%) that entrepreneurs hide from the state, or "envelope" salaries increased in all three Baltic states, they are still significantly higher in Latvia. Namely, in Latvia the amount of envelope salaries in 2020 reached 23.5% (an increase of 1.2% compared to 2019), while in Lithuania: 15.3% (an increase of 1.2%), but in Estonia: 13.2% (an increase of 1.7%). An increase in all Baltic countries is also observed in the area of unreported income (profit): In Latvia, the average share of income (%) that entrepreneurs hide from the state in 2020 increased by 1.4%, reaching 18.0%; In Lithuania: by 1.4% (15.8%); In Estonia by 1.0% (11.6%). In turn, the amount of unreported employees (average% of the total number of employees employed without a contract) in Latvia in 2020 has remained at the level of 2019: 10.9%, but increased in Lithuania (by 1.0%, reaching 9.3%) and relatively significantly increased in Estonia (by 3.3%, reaching 9.0%).

We also assessed the proportion of unregistered companies. According to our data, unregistered companies in Latvia accounted for 8.4% of all companies, and in Lithuania and Estonia, respectively, 6.2% and 4.0% of all companies in 2019.

According to our results, the general level of bribery (the percentage of income paid by companies in informal payments to "settle things") in 2020, compared to 2019, slightly increased in Latvia (by 0.2%, reaching 8.3%) and slightly decreased in Lithuania (by -0.1%, reaching 8.4%). Although the overall level of bribery in Estonia is still lower than in the other two Baltic states, the latest survey shows a negative trend. Namely, in 2020, compared to 2019,

Summary and conclusions

the level of bribery in Estonia increased by 2.5%, reaching 6.4%, which is the highest level since 2009. The results of our study also show that the average % of the contract amount needed to secure a public procurement is the highest in Latvia (6.9% in 2020, compared to 5.9% in 2019), followed by Lithuania (5.6% in 2020, compared to 8.3% in 2019) and Estonia (3.9% compared to 1.4% respectively).

The highest level of the shadow economy in Latvia is observed in Kurzeme, the Riga region and Vidzeme. In terms of sectors, the highest share of the shadow economy in Latvia is still in the construction sector (in 2020: 28.7%), followed by wholesale (25.3%), services (24.9%), retail (23.9%) and manufacturing (23.0%).

In terms of attitudes, companies in the Baltic states are still relatively satisfied with the performance of the State Revenue Service (SRS). In Lithuania in 2020, satisfaction with the SRS has remained at the level of 2019 (3.70 on a scale of 1-5, where 5 means very high satisfaction), while in Estonia it has slightly decreased: from 3.80 in 2019 to 3.76 in 2020. Satisfaction with the operation of the SRS in 2020, compared to 2019, has also decreased in Latvia, from 3.50 to 3.41. It should be noted that, according to the results of our research, the satisfaction of Latvian entrepreneurs with the SRS had an increasing positive trend from 2016 to 2019.

The results of the study show that in Latvia and Estonia, satisfaction with the state tax policy has slightly increased: from 2.60 to 2.63 and 3.10 to 3.14 per year, respectively (2019, compared to

Summary and conclusions

2020). While in Lithuania satisfaction with the state tax policy decreased slightly in 2020: from 3.10 to 3.08 (on a scale of 1-5, where 5 means very high satisfaction). In turn, satisfaction with the quality of business legislation in Estonia remained at the level of 2019 (3.35), but decreased both in Lithuania (from 3.08 in 2020 to 3.03 in 2020) and in Latvia (from 3.01 to 2.96).

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 ten survey rounds, which gives a panel that spans the years 2010-2020 and has a cross-section of approximately 1,500 firms per year.

The country dummy variables suggest that during the sample period, the size of the shadow economy is smaller in Estonia and Lithuania relative to Latvia after controlling for a range of explanatory factors, and the differences are statistically significant. 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 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

Summary and conclusions

activity. This evidence suggests a possible policy tool for reducing the size of the shadow economies, namely increasing the probability of detection of misreporting.

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. 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 such as retail.

Results indicate the need to continue reforms and other policy initiatives to reduce the shadow economy in all Baltic countries. Such reforms are particularly important in the light of current and projected economic developments taking the influence of the pandemic into account.

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 - February 2021 collects information about shadow activity during 2020 and 2019. The overlap of one year in consecutive survey rounds (e.g., collecting information about 2019 shadow activity in both the 2020 and 2021 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 2021. survey we interviewed 509 respondents in Lithuania and 502 respondents in Estonia. In Latvia, however, 802 respondents were interviewed: at least 100 company managers in construction, wholesale, retail, manufacturing and service industries. This was done in order to get more representative data for each of the aforementioned industries. 2021. 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; and

(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.

References

Putnins, T. and A. Sauka (2015), Measuring the Shadow Economy Using Company Managers. *Journal of Comparative Economics,* 43 (2), 471–490.

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