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Shadow Economy Index for the Baltic Countries 2009—2019

Authors of the study

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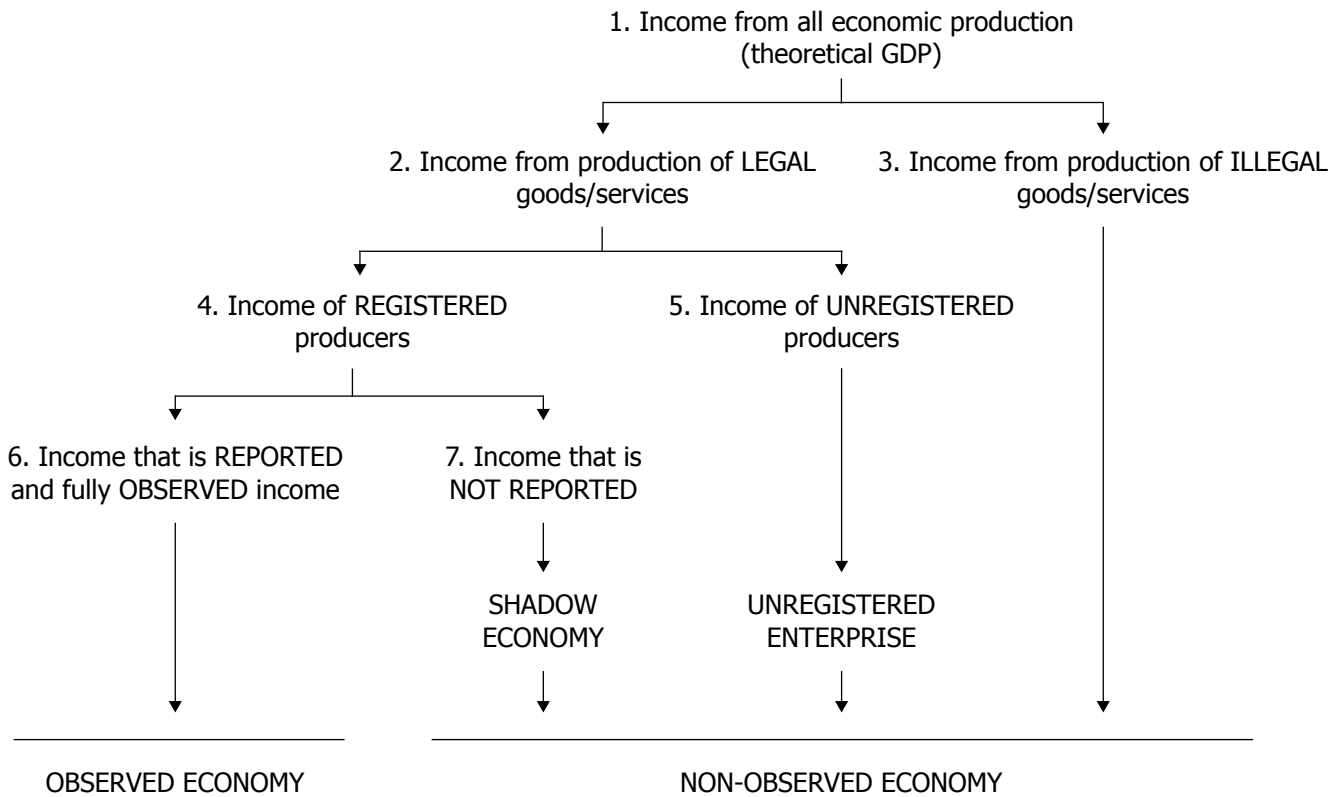
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Since 2009:

- 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 2009–2018
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 2020 about 2019 and 2018

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

- Random sampling, Orbis database

- Interviews performed by SKDS

- 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

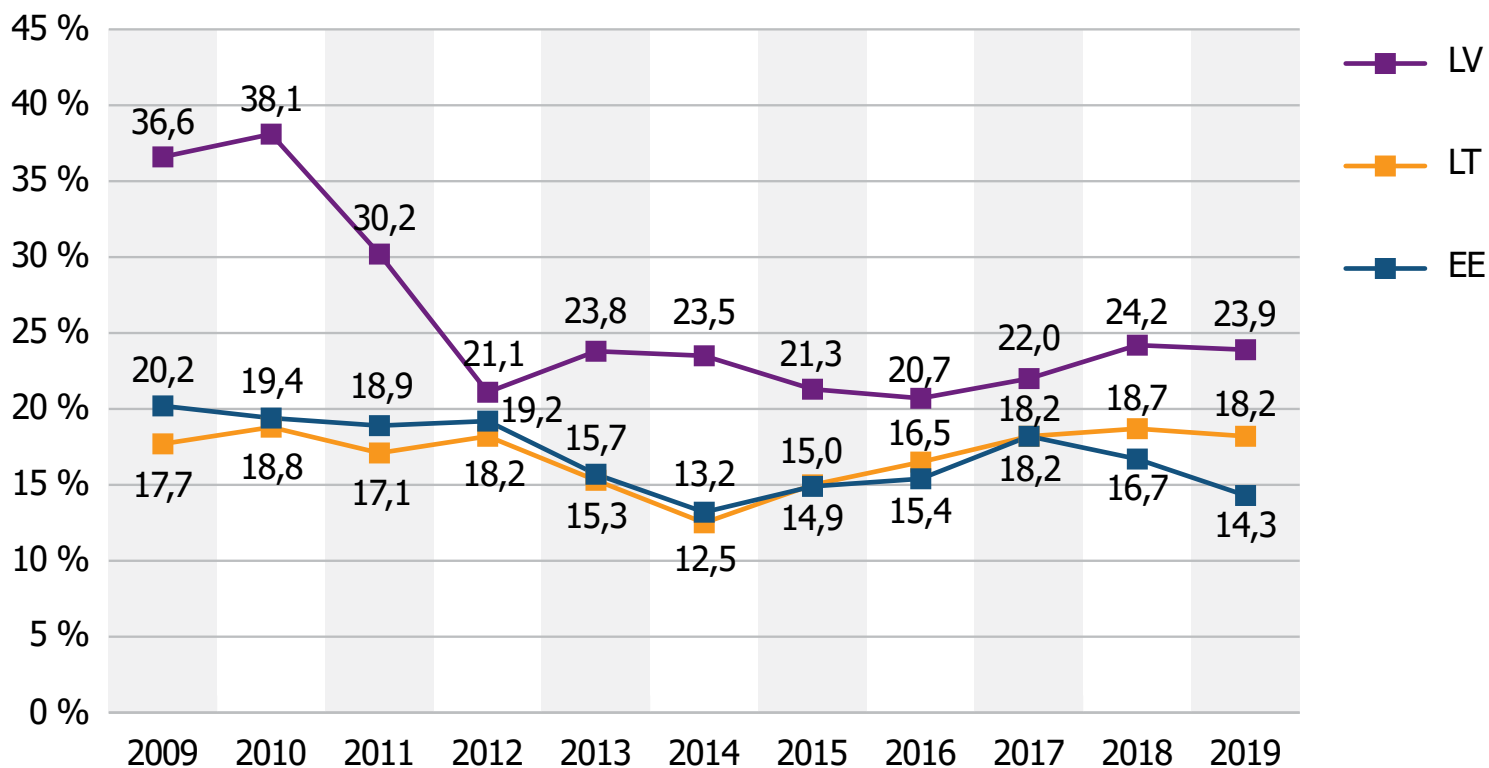- % of the contract value paid to secure a contract with the government: corruption

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2019
Results

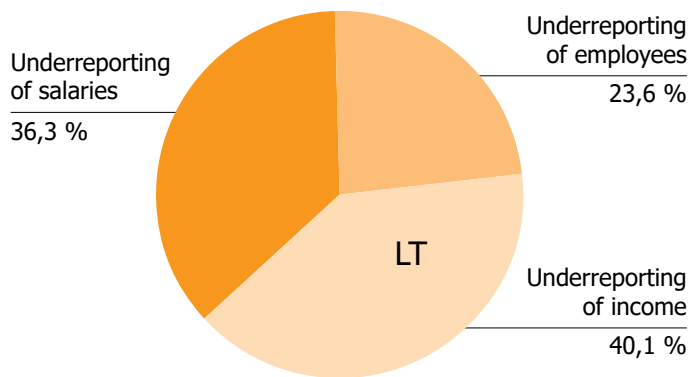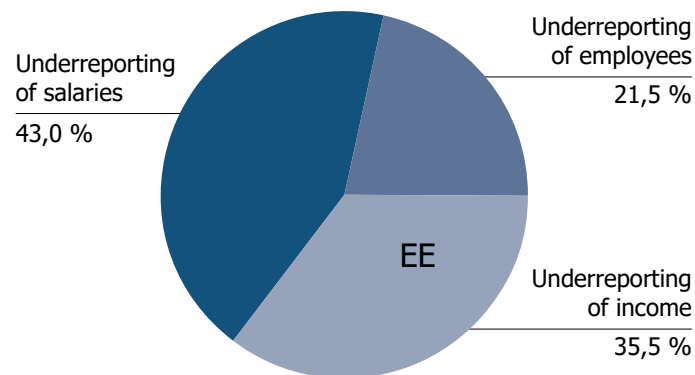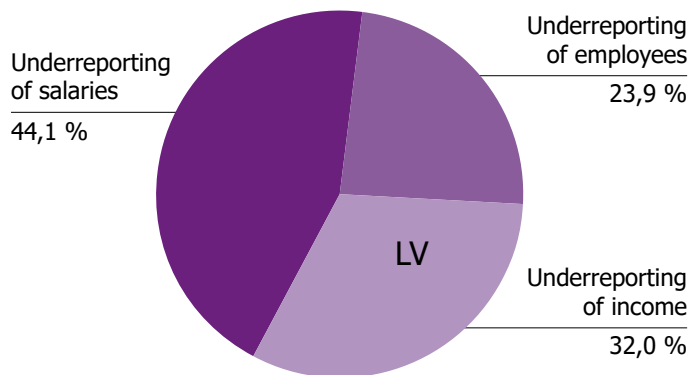# Shadow Economy Index for the Baltic countries (% of GDP), 2009–2019

	2019–2018	2019	2018	2017	2016	2015
Latvia	-0,3 (-2,5 1,8)	23,9 (21,4 26,3)	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	-0,5 (-1,9 0,9)	18,2 (16,5 19,9)	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	-2,4 (-4,1 -0,6)	14,3 (12,3 16,3)	16,7 (14,5 18,8)	18,2 (16,1 20,3)	15,4 (13,1 17,8)	14,9 (12,4 17,4)

	2014	2013	2012	2011	2010	2009
Latvia	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)
Lithuania	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)
Estonia	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)

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2019

Dynamics of the shadow economy in the Baltic countries, 2009—2019

Chart legend: LV, LT, EE

	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LV	36,6	38,1	30,2	21,1	23,8	23,5	21,3	20,7	22,0	24,2	23,9
LT	17,7	19,4	17,1	18,2	15,7	12,5	15,0	16,5	18,2	18,7	18,2
EE	20,2	18,8	18,9	19,2	15,3	13,2	14,9	15,4	18,2	16,7	14,3

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009—2019

Components of the shadow economy in 2019

Underreporting of salaries 44,1 % · Underreporting of employees 23,9 % · Underreporting of income 32,0 % — LV

Underreporting of salaries 43,0 % · Underreporting of employees 21,5 % · Underreporting of income 35,5 % — EE

Underreporting of salaries 36,3 % · Underreporting of employees 23,6 % · Underreporting of income 40,1 % — LT

Underreporting of business income 2009–2019 (average share of revenue in % that companies conceal from the government)

Chart data:

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

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2019
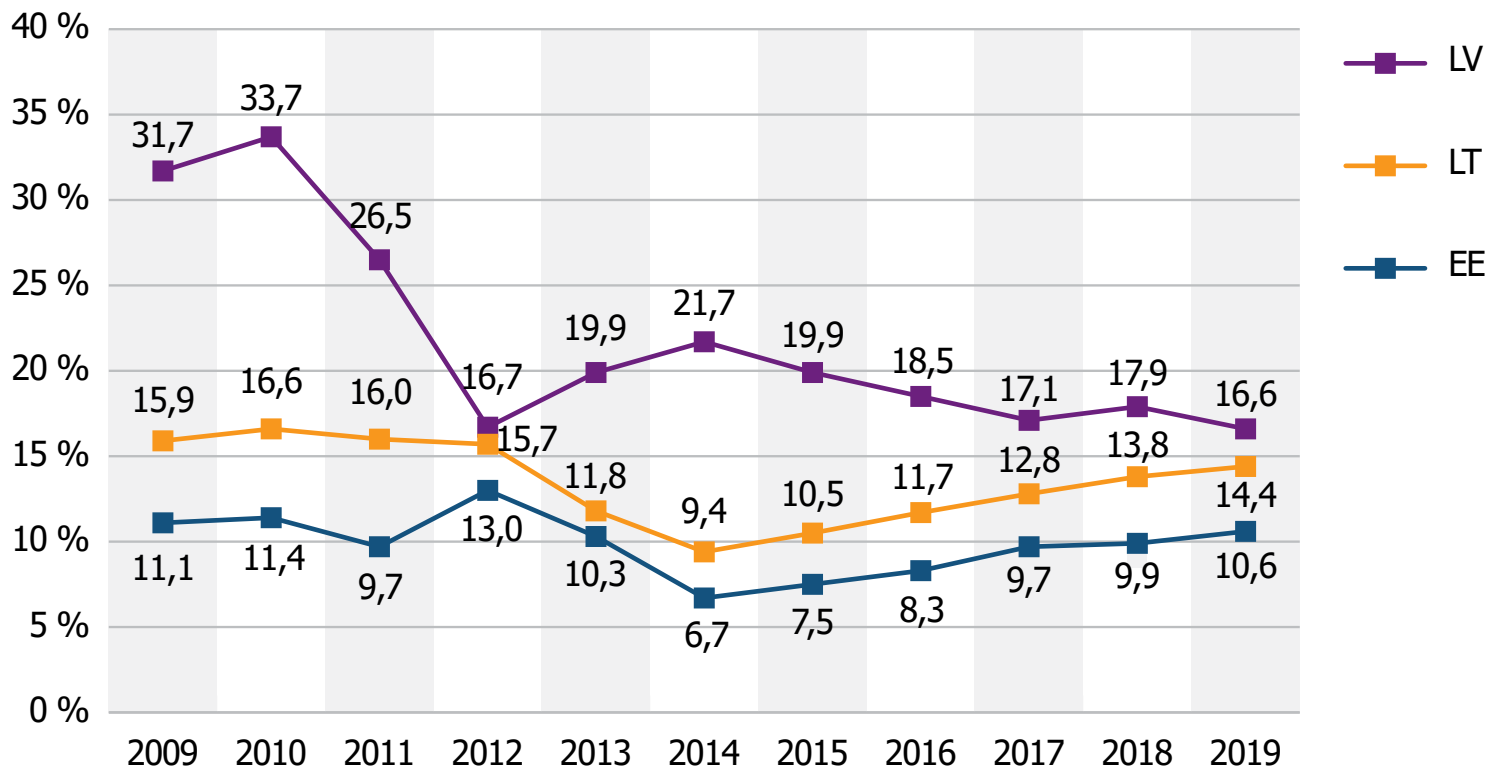
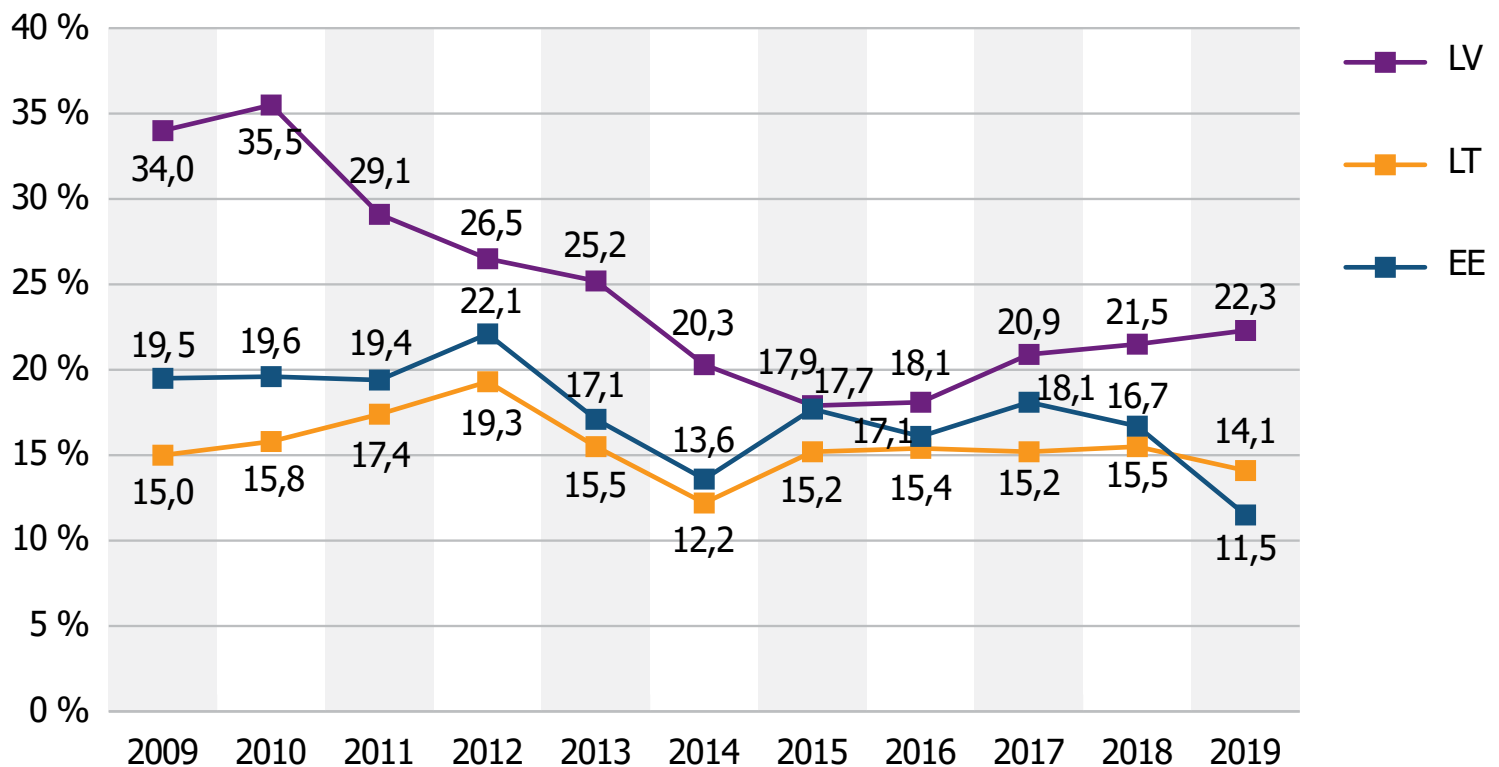# Underreporting of the number of employees, 2009–2019 (average share of the employees in % working without a contract)

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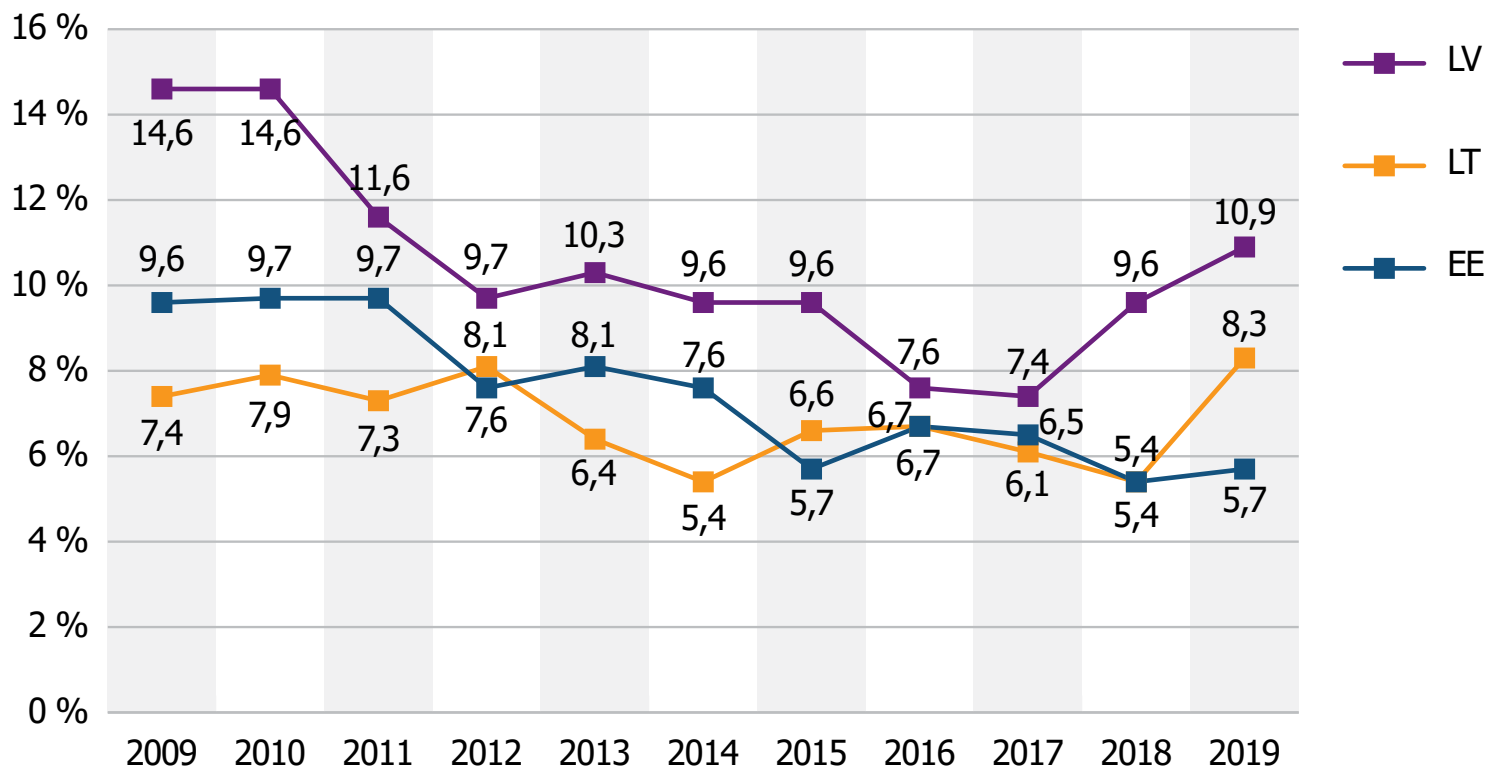
Envelope wages, 2009–2019
(average share of salaries in % which is paid by the employers, but concealed from the government)

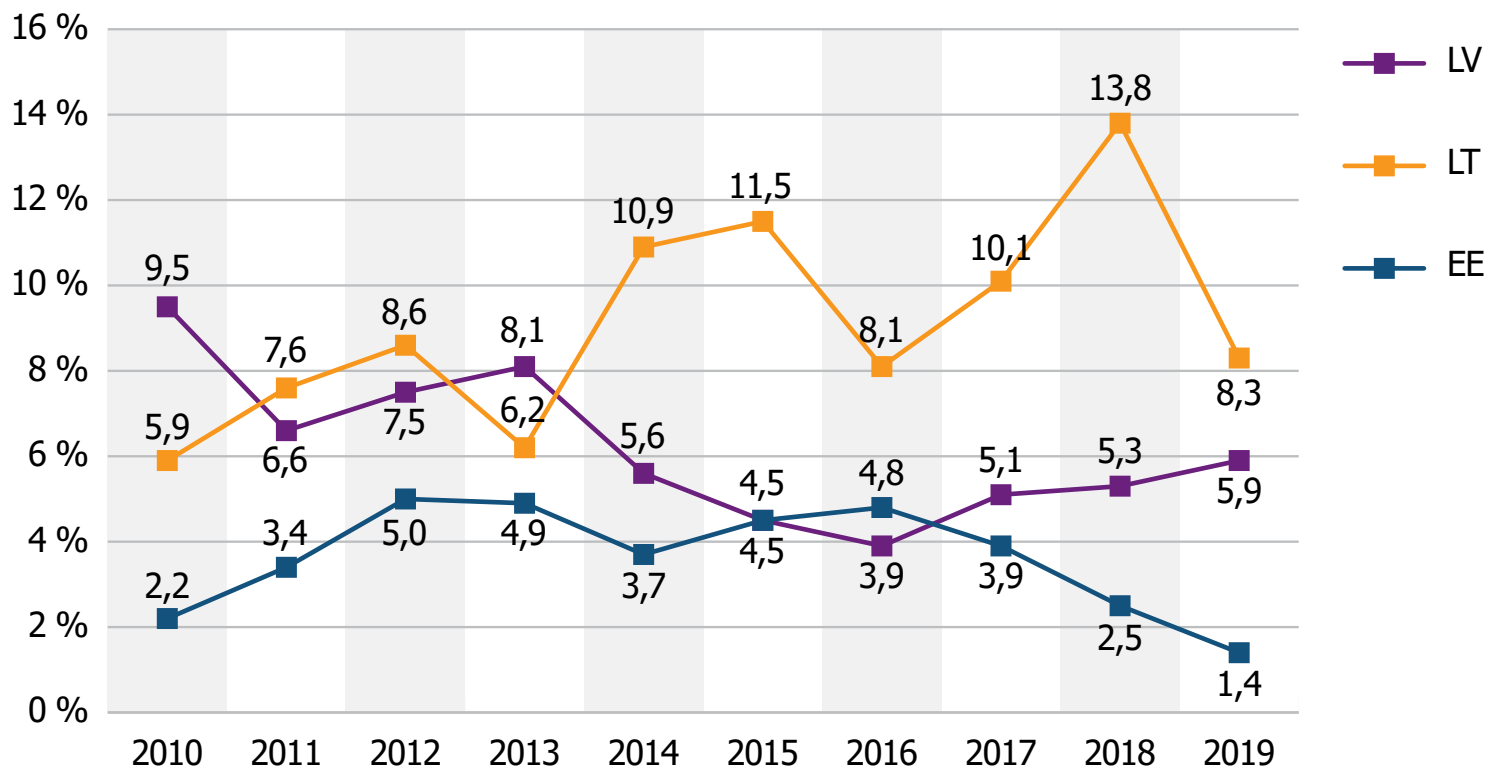|	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
LV	34,0	35,5	29,1	26,5	25,2	20,3	17,9	18,1	20,9	21,5	22,3
LT	15,0	15,8	17,4	19,3	15,5	12,2	15,2	15,4	15,2	15,5	14,1
EE	19,5	19,6	19,4	22,1	17,1	13,6	17,7	17,1	18,1	16,7	11,5

% of payments 'to get things done', 2009–2019 (average percentage of revenue paid as 'bribes')
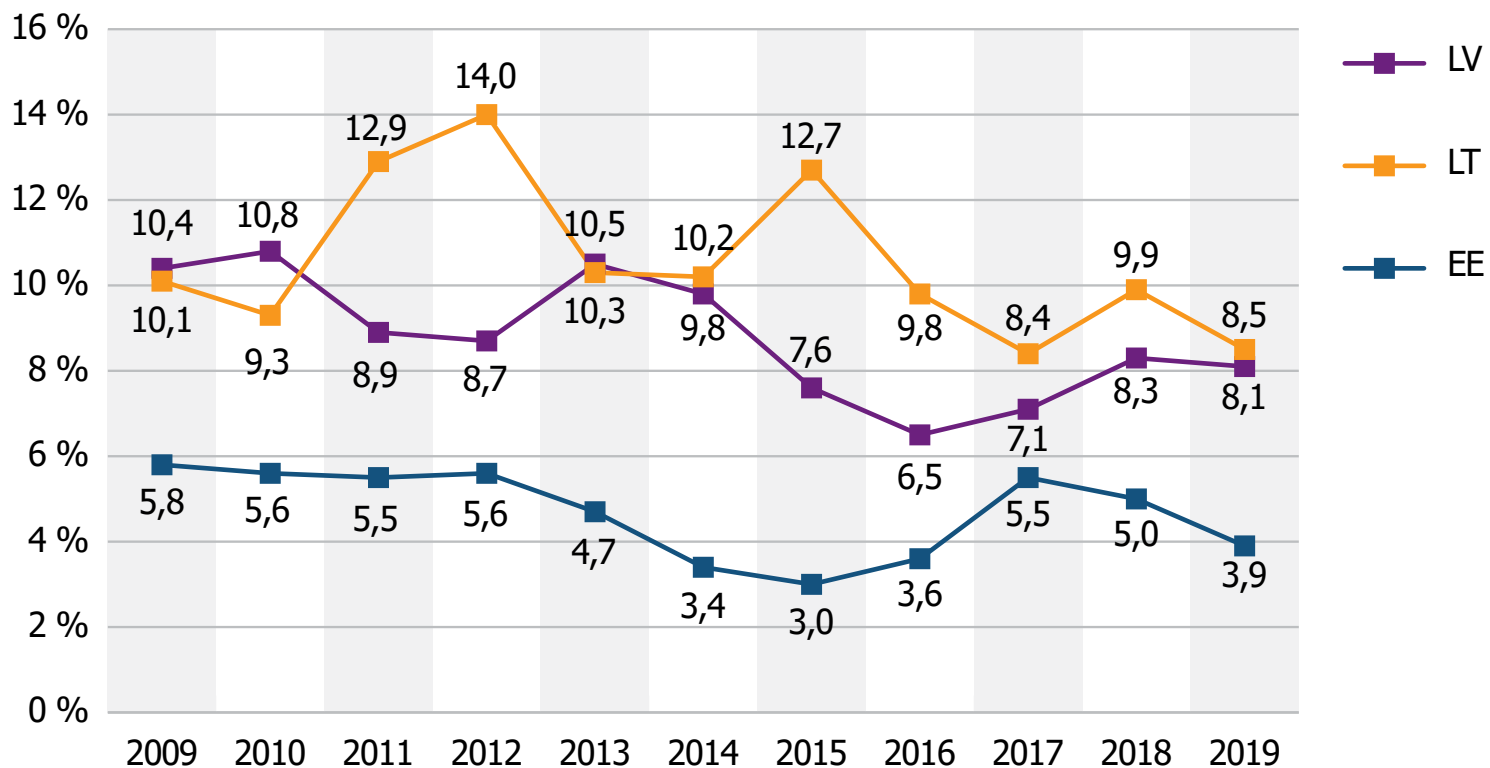
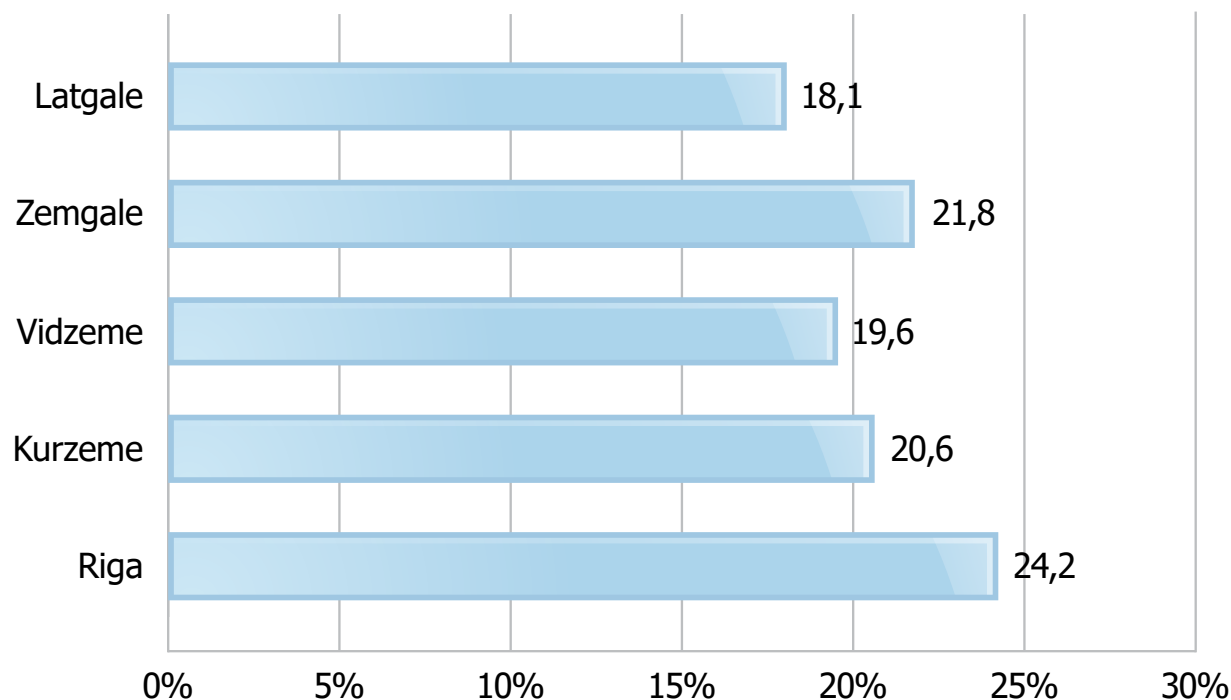# % of the contract value paid to secure contracts with the government, 2010–2019

Chart showing percentage of contract value paid to secure contracts with the government from 2010 to 2019 for LV, LT, and EE.

LV: 9,5 (2010), 6,6 (2011), 7,5 (2012), 8,1 (2013), 5,6 (2014), 4,5 (2015), 3,9 (2016), 5,1 (2017), 5,3 (2018), 5,9 (2019)

LT: 5,9 (2010), 7,6 (2011), 8,6 (2012), 6,2 (2013), 10,9 (2014), 11,5 (2015), 8,1 (2016), 10,1 (2017), 13,8 (2018), 8,3 (2019)

EE: 2,2 (2010), 3,4 (2011), 5,0 (2012), 4,9 (2013), 3,7 (2014), 4,5 (2015), 4,8 (2016), 3,9 (2017), 2,5 (2018), 1,4 (2019)

Size of the shadow economy in Latvia, Lithuania, and Estonia 2009–2019

Proportion of unregistered enterprises in the Baltic countries (% of GDP), 2013–2019

	Latvia	Lithuania	Estonia
2019. gads	8,0 (6,7 9,2)	9,2 (7,8 10,6)	4,0 (3,0 5,1)
2018. gads	8,6 (7,3 10,1)	10,0 (8,8 11,3)	6,4 (5,0 7,9)
2017. gads	6,5 (5,3 7,8)	8,6 (7,5 9,8)	7,0 (5,7 8,5)
2016. gads	5,3 (4,1 6,5)	8,4 (7,5 9,4)	6,1 (5,1 7,1)
2015. gads	5,2 (4,1 6,3)	7,3 (6,5 8,1)	5,8 (4,5 7,1)
2014. gads	5,6 (4,5 6,7)	5,2 (4,5 6,0)	6,3 (4,5 8,2)
2013. gads	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, 2016–2019)

Region	% of GDP
Latgale	18,1
Zemgale	21,8
Vidzeme	19,6
Kurzeme	20,6
Riga	24,2

Size of the shadow economy (% of GDP) by sector in Latvia (average, 2016–2019)

Sector	% of GDP
Construction	33,3
Services	20,7
Retail	27,7
Wholesale	26,6
Manufacturing	17,0
Other	21,7

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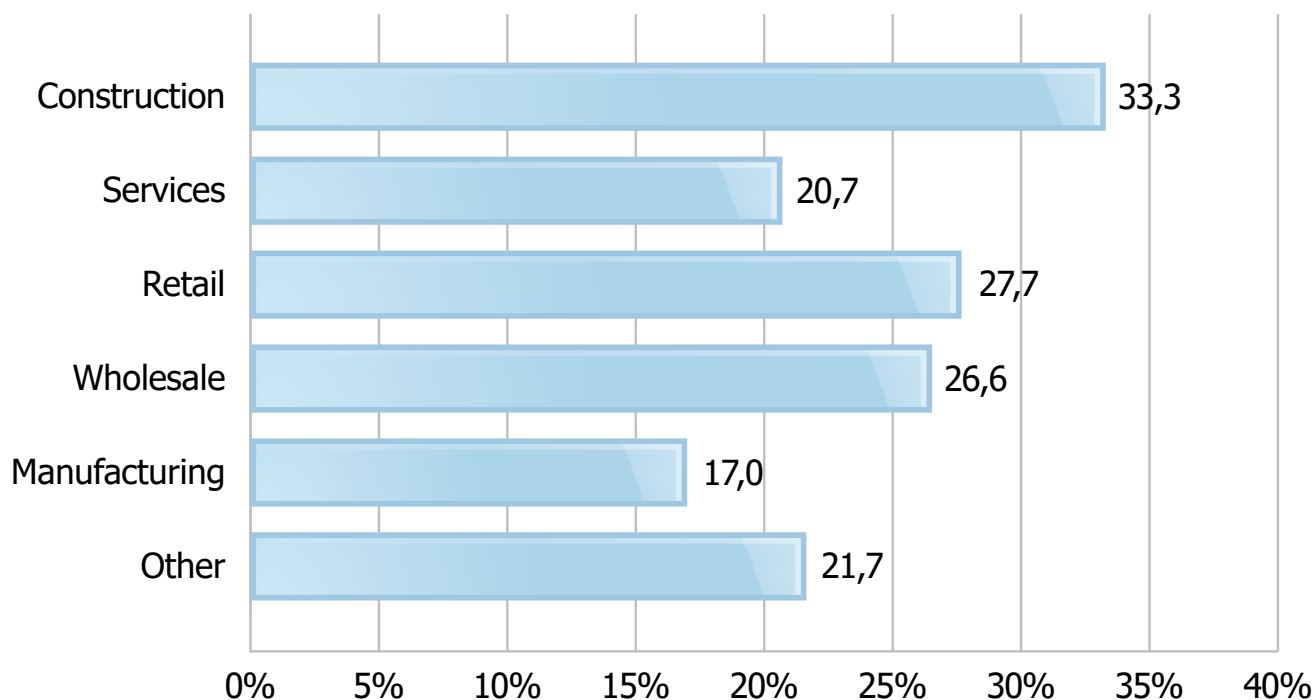
Involvement in the shadow economy

- 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, 2019

Chart legend: LV, LT, EE

Probability of being caught	LV	LT	EE
0 %	6,8	7,6	13,0
1-10 %	8,8	11,5	11,5
11-30 %	9,8	9,6	11,5
31-50 %	25,0	21,1	20,5
51-75 %	6,5	8,3	7,7
76-100 %	43,3	42,0	35,7

Probability of being caught

Main determinants of the shadow economy
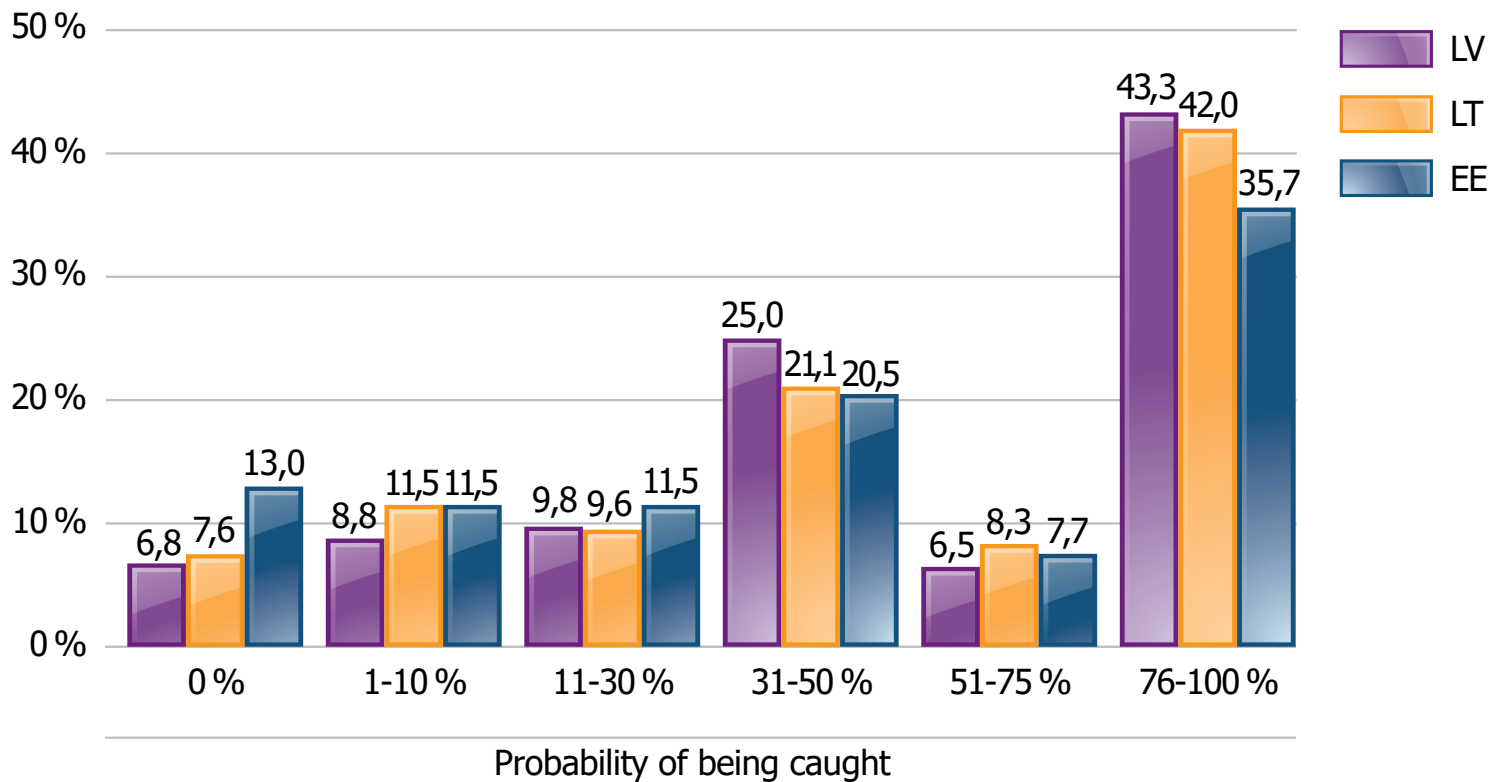
Consequences if caught for deliberate misreporting, 2019

Legend: LV, LT, EE

	Nothing serious	A small fine	Serious fine, affects competitiveness	Serious fine, risk insolvency	Company will cease operations
LV	7,5	17,4	34,7	19,6	20,1
LT	4,0	23,8	47,2	15,9	9,1
EE	10,6	34,2	26,6	10,4	18,2
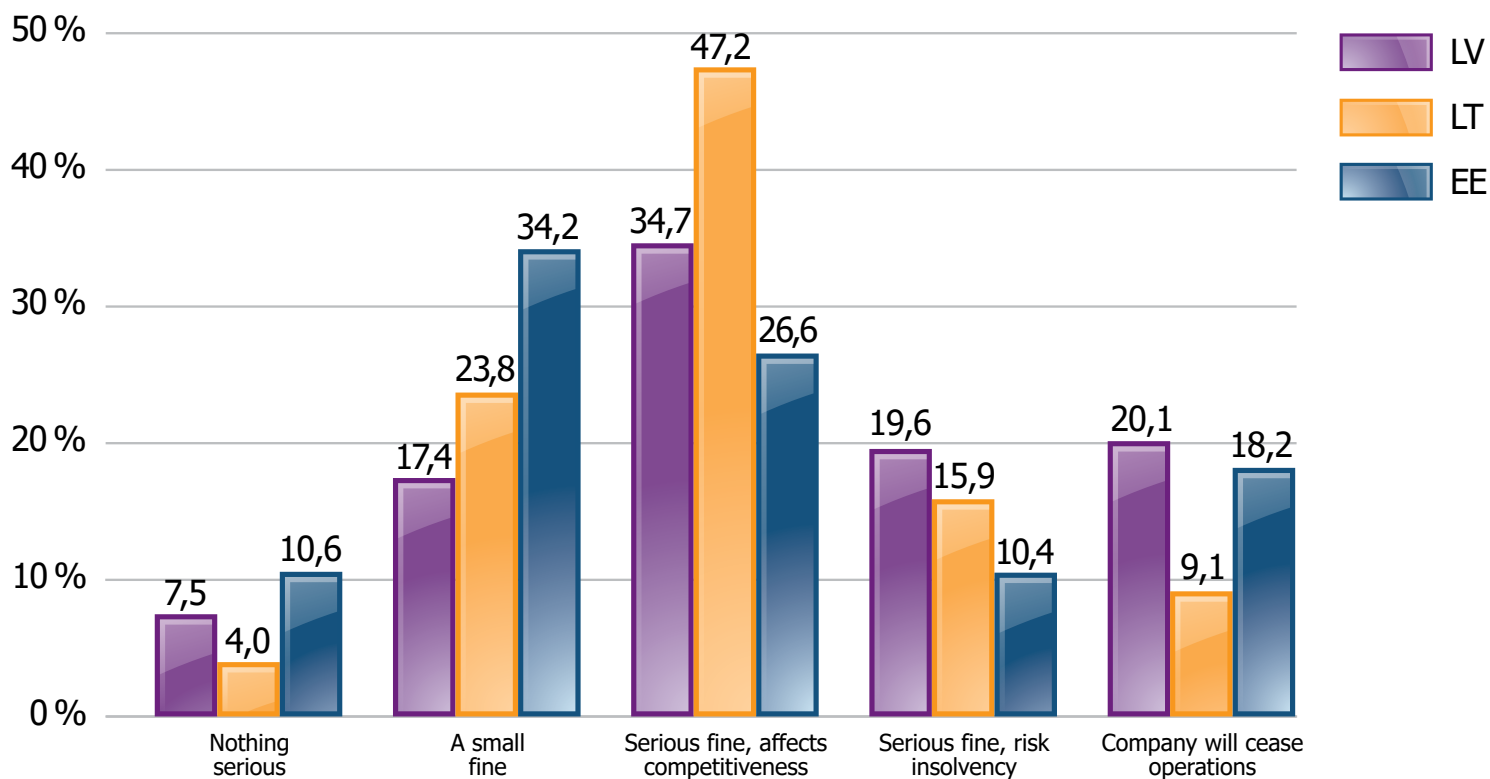
Statistically significant determining factors (using regression analysis)

■ 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, 2010–2019

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

Legend: LV, LT, EE
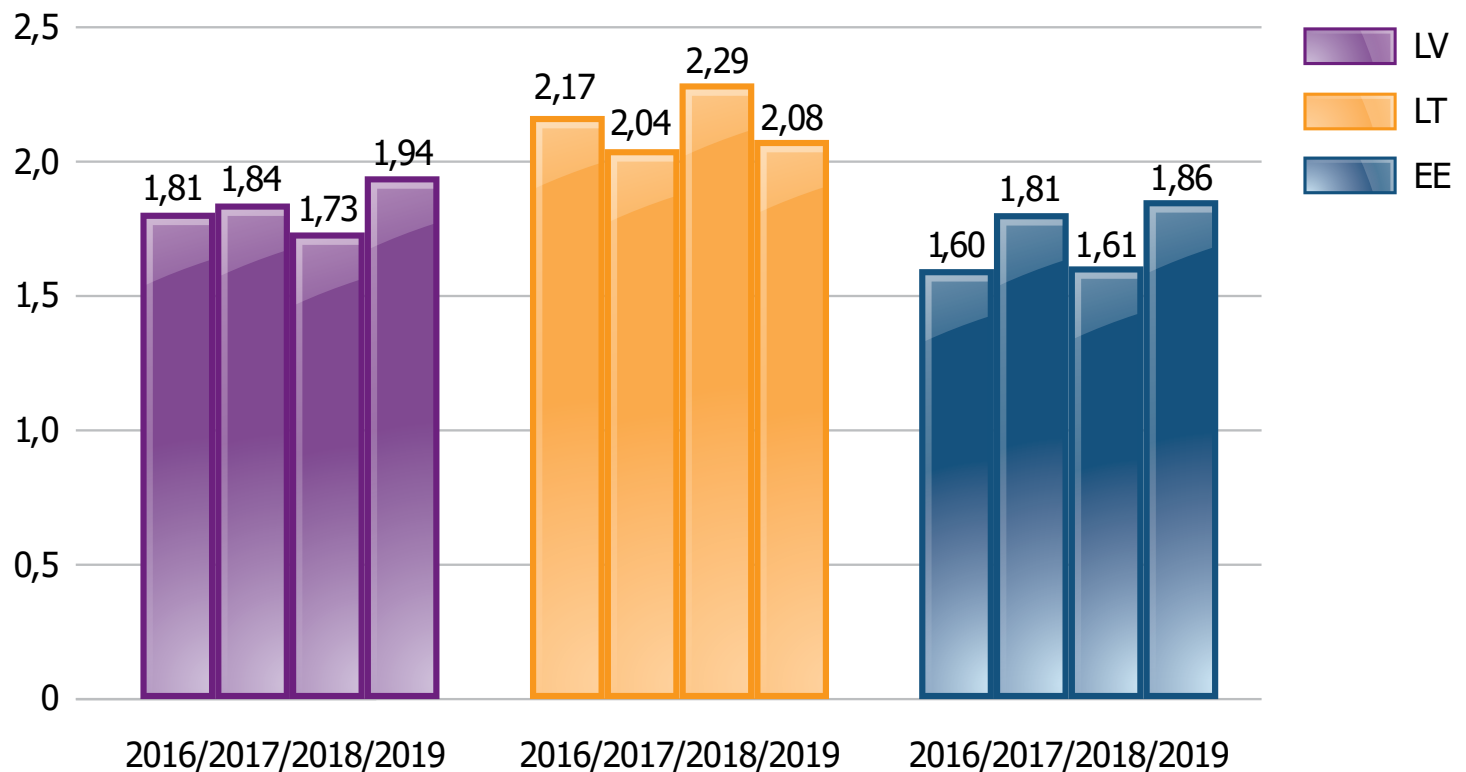
Year	LV	LT	EE
2010	3,21	3,39	3,67
2011	3,20	3,60	3,71
2012	3,39	3,66	3,60
2013	3,42	3,28	3,51
2014	3,46	3,31	3,37
2015	3,46	3,60	3,57
2016	3,20	3,33	3,52
2017	3,36	3,57	3,47
2018	3,39	3,53	3,57
2019	3,50	3,70	3,80
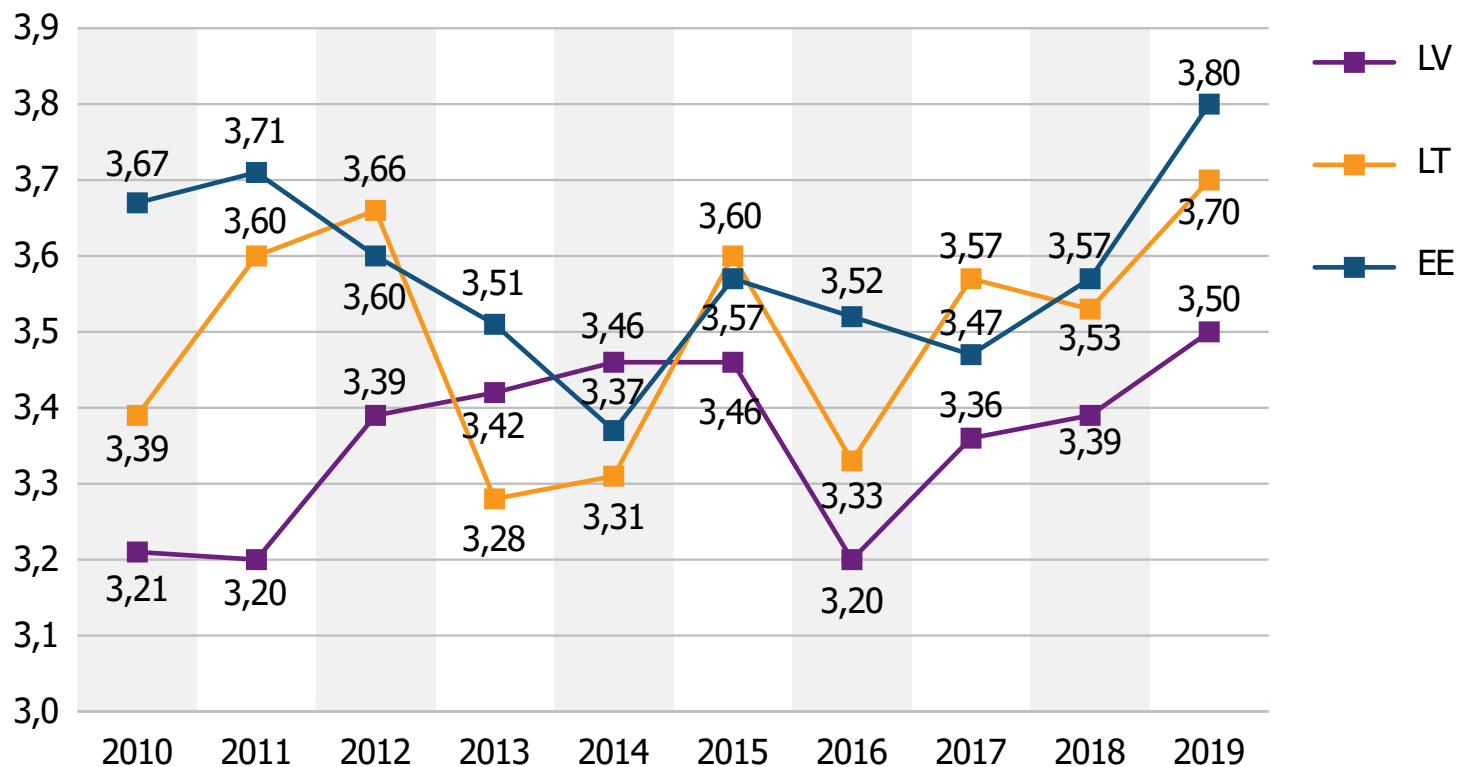
Satisfaction with the tax policy, 2010–2019

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

Legend: LV, LT, EE

Year	LV	LT	EE
2010	1,86	2,53	3,36
2011	2,25	2,48	3,07
2012	2,49	2,69	3,09
2013	2,44	2,64	2,91
2014	2,65	2,80	2,74
2015	2,43	2,78	2,67
2016	2,08	2,81	2,57
2017	2,50	2,87	2,20
2018	2,41	2,85	2,36
2019	2,60	3,10	3,10

Main determinants of the shadow economy
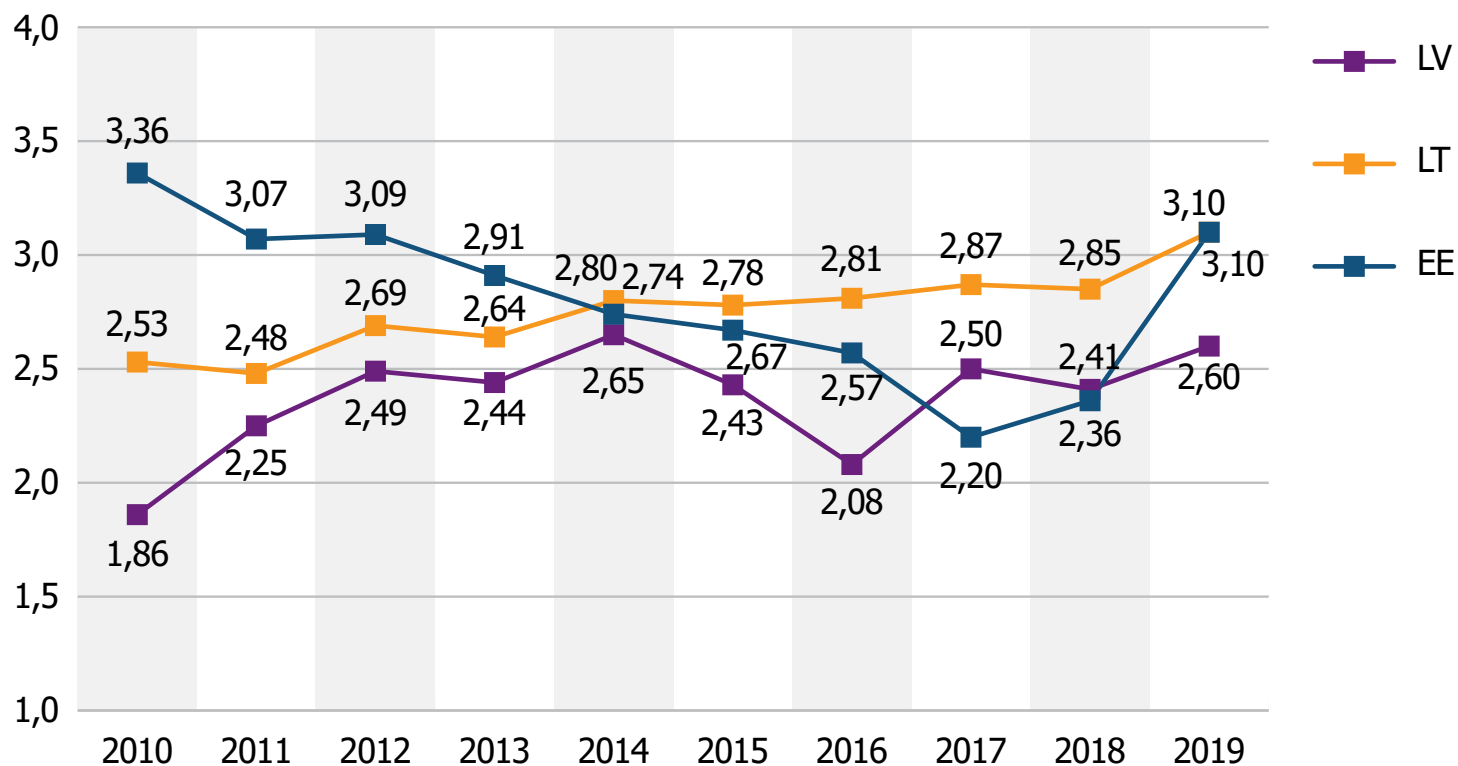
Satisfaction with the quality of business legislation, 2010–2019

(Average, in scale from 1-5, where '1': very low satisfaction, but '5'- very high satisfaction)
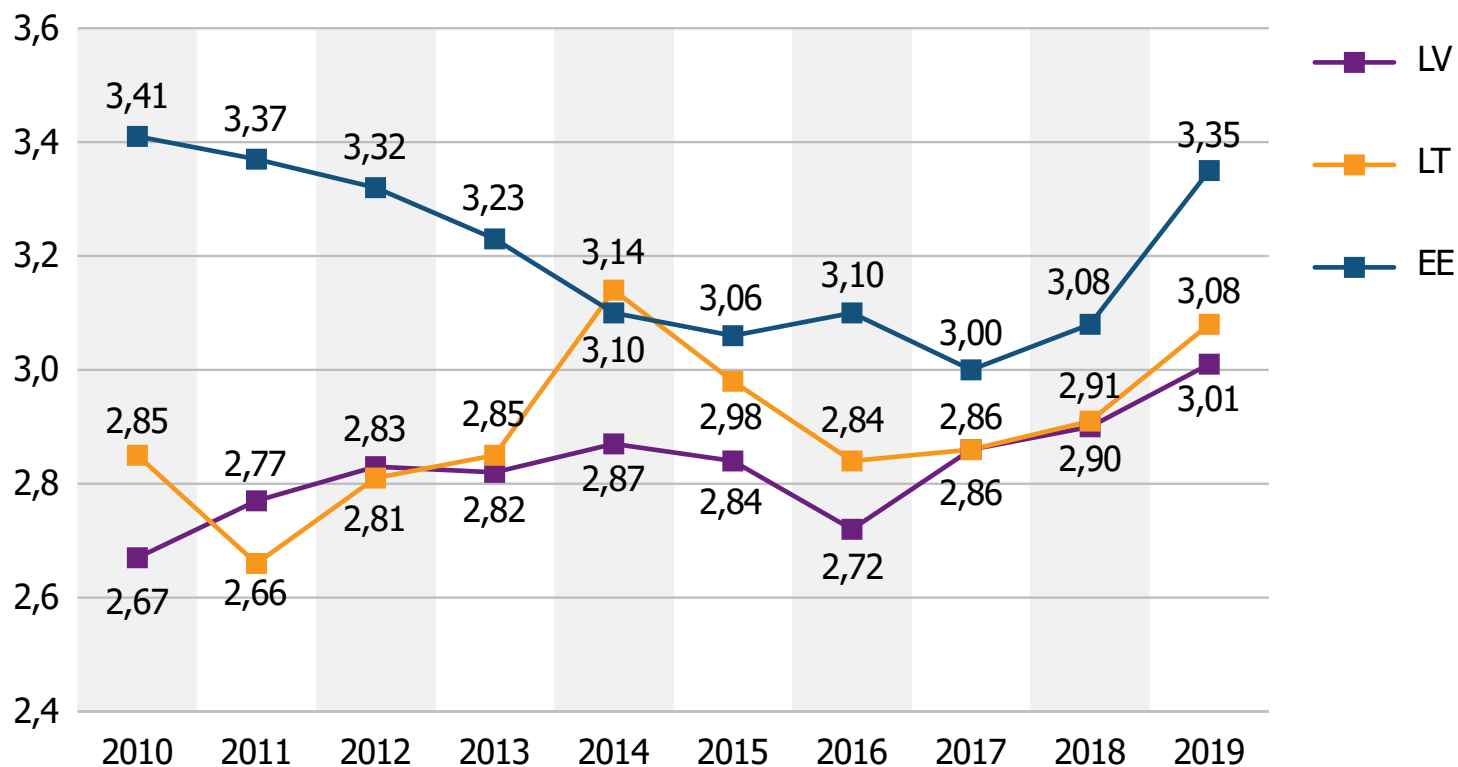
Satisfaction with the government's support to entrepreneurs, 2010–2019

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

Main determinants of the shadow economy
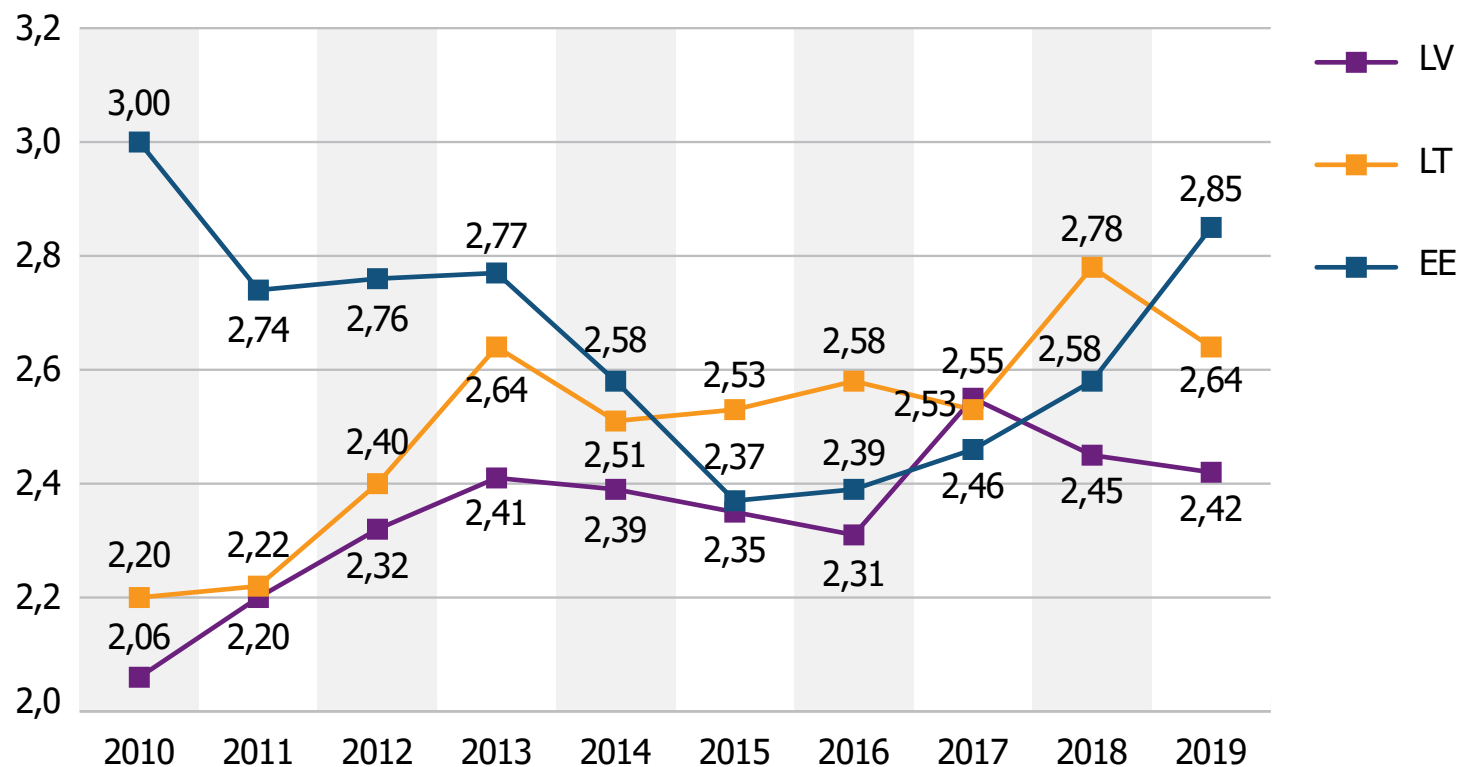
Statistically significant determining factors (using regression analysis)

- 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

LV: 2016: 1,81 / 2017: 1,84 / 2018: 1,73 / 2019: 1,94
LT: 2016: 2,17 / 2017: 2,04 / 2018: 2,29 / 2019: 2,08
EE: 2016: 1,60 / 2017: 1,81 / 2018: 1,61 / 2019: 1,86

2016/2017/2018/2019   2016/2017/2018/2019   2016/2017/2018/2019

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 2019 and trends covering the period 2009–2019. It also provides evidence about the main factors that

Summary and conclusions

influence entrepreneurial involvement in the shadow economy as well as some policy recommendations.

According to our estimates, the size of the shadow economy in Latvia has been on an upward trend since 2016: 20.7% of GDP in 2016, 22.0% in 2017 and 24.2% of GDP in 2018. The data from the recent study, however, show that in 2019 the size of the shadow economy in Latvia had decreased, though only slightly: by 0.3%, standing at 23.9% of GDP. Thus, we can conclude that despite relatively rapid economic growth over the past 3-4 years, as well as various policy initiatives implemented to reduce the size of the shadow economy, Latvia has not succeeded in this respect.

It is believed that as the economic situation improves, the shadow economy should also decrease, in particular because entrepreneurs are better off and should in general be better motivated to pay taxes. However, this may not be the case, for example, if businesses do not trust that tax money is being used properly; or if corruption or other cases undermine public confidence in the government; or if no appropriate support measures have been implemented to improve the business environment or control measures to limit the shadow economy. As a result of the Covid-19 pandemic, an economic downturn is expected in 2020 and for the next few years. In such a situation, it is quite likely that the size of the shadow economy in Latvia will increase in the coming years.

Summary and conclusions

A slight decrease in the shadow economy in 2019 is also observed in Lithuania, with a decrease of 0.5% (from 18.7% in 2018 to 18.2% in 2019). In Estonia, however, the shadow economy continues to decline faster, reaching 14.3% of GDP in 2019, or 2.4% less than in 2018 and the lowest level of the shadow economy in the country since 2015.

Our estimates suggest that envelope wages were the most significant component of the shadow economy both in Latvia and Estonia in 2019. Namely, in Latvia envelope wages make up 44.1% of the total shadow economy, and in Estonia: 43.0%. Unreported income in Latvia makes up 32.0% of the total shadow economy, but the component of undeclared employees: 23.9%. The most significant component of the shadow economy in Lithuania in 2019 was unreported income (40.1%), followed by envelope wages (36.3%) and unreported employees (23.6%).

In 2019 the average share (%) of wages that entrepreneurs do not report to the state was relatively similar in Lithuania and Estonia (11.5% and 14.1%, respectively), but significantly higher in Latvia (22.3%). In addition, if envelope wages in Lithuania and Estonia decreased in 2019, as compared to 2018 (by 5.2% in Estonia and by 1.4% in Lithuania), then our data shows an increase in the level of envelope wages in Latvia (by 0.8%). Consequently, according to the results of our research, the gap between the level of envelope wages in Latvia and the other Baltic countries is widening.

Summary and conclusions

A positive trend is observed in Latvia with regard to underreporting income (profit). Namely, in Latvia, the average share of income (%) that entrepreneurs hide from the state in 2019 decreased by 1.3%, reaching 16.6%. In Lithuania and Estonia, the amount of underreporting of income reached 10.6% in 2019 (an increase of 0.7%) and in Lithuania: 14.4% (an increase of 0.6%). In turn, the amount of underreporting the number of employees (average % of the total number of employees employed without a contract) in 2019 increased in all three Baltic countries, reaching 10.9% in Latvia (an increase of 1.0%), 8.3% in Lithuania (an increase of 2.9%) and 5.7% in Estonia (an increase of 0.3%).

We also assessed the proportion of unregistered companies. According to our data, unregistered companies in Latvia accounted for 8.0% of all companies, and in Lithuania and Estonia, respectively, 9.2% and 4.0% of all companies in 2019.

Lithuania still stands out with the highest level of bribery in the Baltic countries, especially regarding government procurement. According to the results of the study, in 2019, Lithuanian companies paid an average of 8.3% of the contract amount to secure a contract for public procurement. This is, however, a significant improvement compared to 2018, when these payments averaged 13.8%. The level of bribery for obtaining governmental orders in Latvia in 2019 reached 5.9% of the contract amount (an increase from 5.3% in 2018), while in Estonia, it was only 1.4% (a decrease from 2.5% in 2018).

Summary and conclusions

The general level of bribery (percentage of income paid by companies in unofficial payments to "get things done") in all three countries decreased in 2019 as compared to 2018. Namely, in Latvia the general level of bribery in 2019 reached 8.1% (a decrease of 0.2% compared to 2018), in Lithuania: 8.5% (a decrease of 1.4%), but in Estonia: 3.9% (a decrease of 1.1%)

The highest level of the shadow economy in Latvia in 2019 was in Riga, Zemgale and Kurzeme regions. By sector, the highest share of the shadow economy remains in construction.

Regarding attitude, companies in Baltic countries are still relatively satisfied with the work of the State Revenue Service (SRS). Our results also show that satisfaction with the SRS slightly increased in 2019 in all three countries. Namely, on a scale of 1-5, where 5 means very high satisfaction, in Latvia the satisfaction of entrepreneurs with the SRS was assessed at 3.5 (3.39 in 2018), while in Lithuania at 3.7 (3.53 in 2018), and in Estonia at 3.8 (3.57 in 2018).

In all three countries, but especially in Lithuania and Estonia, satisfaction with the tax policy has also increased: whereas in 2018 in Estonia, Lithuania and Latvia entrepreneurs assessed satisfaction with tax policy, respectively, at 2.36 (ET); 2.85 (LT) and 2.41 (LV), in contrast the ratings for 2019 (on the same 1-5 scale where 5 means very high satisfaction) were 3.10 (ET); 3.10 (LT) and 2.60 (LV). Satisfaction with the quality of business legislation has also slightly increased in all three countries, ranging from 3.01 to 3.35 in 2019. In turn, satisfaction with

Summary and conclusions

government support to entrepreneurs in the Baltic countries in 2019 was approximately at the same level as in 2018: in the range from 2.42 to 2.85.

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 nine survey rounds, which gives a panel that spans the years 2010-2019 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. Furthermore, 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.

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 such as retail.

Our results indicate the need to continue reforms and other policy initiatives to reduce the shadow economy both in Latvia and in the other two Baltic countries. It is especially important to implement such reforms, including reviewing the approach to decreasing the size of the shadow economy, especially in the light of the economic downturn expected in the coming years.

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 March - April 2020 collects information about shadow activity during 2019 and 2018. The overlap of one year in consecutive survey rounds (e.g., collecting information about 2018 shadow activity in both the 2019 and 2020 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.

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.

Acknowledgments