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Igor Fedotenkov[1,2], Friedrich Schneider[3]

Military Expenditures and Shadow Economy in the Central and Eastern Europe: is There a Link?

1 Department of Economics, Bank of Lithuania, Vilnius, Lithuania.
Corresponding author: igor.fedotenkov@gmail.com
2 Russian Presidential Academy of National Economy and Public Administration, Moscow, Russia.
3 Department of Economics, Johannes Kepler University of Linz

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Abstract: The main goal of our paper is to determine the existence of a link between government (military) expenditures and the shadow economy in the Central and Eastern European countries, which are the members of the European Union. The empirical investigation is conducted for the years 2003–2015. We show that there is a high statistically significant positive dependence between the size of the shadow economy and military expenditures in the Baltic States. Our conclusion is that higher military expenditures indeed lead to a larger shadow economy and this result is robust to different model specifications. In order to demonstrate the importance of our results, we undertook a simulation, where we calculated how much the size of the shadow economy would increase if the size of military expenditure as a percentage of GDP were to double. For example, in the Czech Republic, such an expansion would have led to an increase in the size of the shadow economy from 11.50% to 12.96%, and in Estonia, from 18.34% to 22.72% in 2012.

Keywords: Shadow economy, military expenditures, Eastern Europe

JEL Codes: E26, E62, H26, H50, H56, O17

1 Introduction and Literature Review

The shadow economy and its determinants are of great interest to academic researchers and policy-makers – the amount of economic knowledge in this field is constantly increasing. It is known that economic entities operating in the shadow economy often pay bribes (Dreher and Schneider, 2010; Goel and Saunoris, 2014a). Bribes, unlike taxes, involve unpredictable distortions in the uncertain and discretional use of government power (Cieślik and Goczek, 2018). This provides costs to business, and alongside, with resources allocated to unproductive activities, (such as military spending) impose extra burden on the economies. Therefore, the interconnection between military spending and shadow economy is of great interest.

Our paper contributes to the topic by providing an empirical estimation of a link between government (military) expenditure and the shadow economy in the Central and Eastern European countries, which are members of the European Union.[1] We find that there is dependence between government military expenditure and the shadow economy. This effect is very robust and it remains significant in many alternative specifications of the model after a number of socioeconomic factors are controlled for, such as level of corruption, rule of law and GDP per capita. There are several possible explanations for these results. First, military-controlled property, such as land and real estate, can be misused for illegal economic activities (Gupta *et al.*, 2001). Furthermore, military expenditures are the most opaque expenditures made by governments. This increases the potential for corruption, and illegal incomes can increase demand for goods and services produced in the shadow sector. It is also known that the size of shadow economy depends on the effectiveness of the government to provide public goods and services (Johnson, Kaufmann, and Zoido-Lobaton, 1999). In general, people tend to work legally if they understand that their contributions will return to them in the form of public goods (Alm *et al.*, 1992; Alm *et al.*, 1995; Kanniainen *et al.*, 2004). However, not all people understand the usefulness of military expenditures, or at least, the obtained feeling of safety does not outweigh the tax burden used for financing these expenditures. Consequently, a number of people prefer to operate in shadow economy if military expenditure grows.

The most straightforward way for shadow economy reduction is deterrence (Andreoni, Erard, and Feinstein, 1998); however, other papers do not support its effectiveness (Fenge and Schneider, 2010; Fugazza and Jacques, 2004). A much more important role is played by taxes and social contributions, quality of institutions, public sector services and tax morale (Schneider and Enste, 2000; Schneider, 2005; Schneider, 2010; Tanzi, 1999). Our paper contributes to the topic by expanding the knowledge of the role of public sector services, namely, the role of composition of government expenditures, which are used to finance public services.

The most relevant paper to our work is that of Goel and Saunoris (2014b). In a sample of 162 countries, they found that military expenditures reduce the size of shadow economy. They explained this result by greater centralization of military spending and the absence of numerous middlemen associated with such spending (compared to non-military spending). However, our results for the Central and Eastern European countries suggest the opposite relation. At least a part of the difference between our results and those found by Goel and Saunoris can be attributed to different methods employed for the analysis. Goel and Saunoris used a pooled regression. We employ fixed-effects panel data techniques, and solve many endogeneity problems arising from different culture, history, mentality, geography, existence of 'unfriendly' neighbouring countries, and so on. In fact, if we do not control for these factors, our results become similar to those found by Goel and Saunoris.[2]

The link between the provision of public services and the shadow economy has not been studied extensively. It is known that production reallocation to the unofficial economy undermines tax collection, and reduces the ability of the government to provide public goods and services in the official sector (Johnson *et al.*, 1997; Johnson *et al.*, 1998, 1999). This makes being in the official sector even less attractive, and leads to further growth in the size of the shadow economy. Two equilibria are possible: One equilibrium is 'good' with low taxes, high tax revenues and a low level of shadow economy, as found in most western countries. The other equilibrium is 'bad' with high taxes, low tax revenues, and a high level of shadow economy. It corresponds to

1 Namely: Bulgaria, Croatia, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia and Slovenia.

2 These results are available upon request.

the situation observed in many post-Soviet countries and Latin America.

Prado (2011) also indirectly studied the link between government expenditures and the shadow economy. In his model, government expenditures are financed by taxes collected in the formal sector and enforcement, which the government extracts from the informal sector. Higher taxes increase the size of the shadow economy; higher enforcement reduces it. Government expenditure is fixed in the model, but its expansion would affect the size of the shadow economy depending on whether the government decides to finance it by increasing taxes or enforcements.

Contributions paid by agents often return to them in one form or another. So, higher state transfers received by agents reduce the size of the shadow economy, higher pensions increase it (Kanniainen *et al.*, 2004). The authors hypothesize that people understand that contributions to the system return to them (at least partly) in the form of public goods and transfers. Consequently, higher government transfers increase tax morale.[3] However, demographic developments make people uncertain about their future pensions, which leads to the opposite results. The authors conclude that governments should inform agents about the link between their contributions to the public system and benefits received from it.

Academic literature also suggests that there is a strong link between military expenditure and corruption (d'Agostino *et al.*, 2012; Delavallade, 2006; Gupta *et al.*, 2001; Hessami, 2014). This link arises due to various channels: foreign suppliers of weapons and equipment bribe officials; military spending is opaque, and not monitored by tax and customs administration. Moreover, military-controlled land, hardware, testing grounds, transport vehicles, housing and training centres are large and provide further opportunities for corruption (Gupta *et al.*, 2001). In our model, even if we control for corruption, the coefficient of military expenditures remains significant. This means that there is also a direct link between military expenditures and shadow economy.

The rest of the paper is structured as follows: In the next section, we discuss the data used in the model and methodology. Section 3 presents the results of the paper, section 4 performs robustness checks and section 5 concludes.

3 Stankevičius and Vasiliauskaitė (2014) also confirmed the negative link between public transfers and shadow economy for the Southern and Eastern EU countries.

2 Data and Methodology

We collected data on the Central and Eastern European countries from several sources. Our dependent variable was the size of the shadow economy as a percentage of official GDP. This variable is unobserved, but it can be estimated with various methods. We took the values estimated by Medina and Schneider (2018), and took the range 2003–2015. The size of the shadow economy was estimated using a MIMIC method. The shadow economy is defined as 'activities that are hidden from official authorities for monetary, regulatory, and institutional reasons', and it does not include activities of a criminal nature. In our paper, it is defined in the same way.

The size of the shadow economy is limited by zero from below; therefore, it is logical to transform it in such a way that the fitted values in our regressions are above zero. Theoretically, the size of the shadow economy as a percentage of official GDP is not limited from above. However, it is possible to notice that in all the countries, the estimates of the size of the shadow economy, obtained by Medina and Schneider (2018), are far below 100% of the official GDP level. This observation is also in line with the estimates of the size of the shadow economy received by Buehn and Schneider (2012). Therefore, we used a slightly modified logit transformation for our dependent variable, such that its domain is (0; 100). In a robustness check, we also performed estimations with other functional forms, leading to similar results.

Government expenditures were collected from two sources: World Bank development indicators and Eurostat. Military expenditures and expenditures on education as a percentage of GDP were obtained from the World Bank development indicators. Moreover, the World Bank development indicators provide data on total health expenditures in the country as a percentage of GDP and the percentage of public expenditures in total health expenditures. We used this data to calculate public health expenditures as a percentage of GDP. Eurostat also provides data on total government expenditures as a percentage of GDP. We used this data to calculate the government expenditures other than military, health and education. We used the observations for the period 2003–2015. However, the data on education expenditures was available for the period 2004–2012, and a number of observations for this period were missing. This also limited the number of observations for 'other government expenditures'.

Tab. 1. Descriptive statistics. For representational reasons, we divided GDP/cap by 1000

Variable	Description	Data range	Arithmetic mean	Standard deviation	Min	Max
		Dependent variable:				
Shadow	Shadow economy, % of GDP	2003–2015	20.76	4.94	10.5	33.0
		Government expenditures:				
Mil. exp.	Military expenditures, % of GDP	2003–2015	1.5006	0.3958	0.7646	2.7002
Educ. exp.	Education expenditures, % of GDP	2004–2012	4.6031	0.7402	2.3413	5.9542
Health exp.	Public health expenditures, % of GDP	2003–2015	5.0435	0.9597	3.2495	7.0650
Other exp.	Other expenditures, % of GDP	2004–2012	23.2611	3.8529	16.406	32.0431
		Other variables:				
GDP/cap.	GDP per capita in 2002 prices	2003–2015	21.9410	4.5565	10.931	31.1378
Unempl.	Unemployment rate	2003–2015	10.0311	3.7053	4.3	19.6
Regul. qual.	Regulatory quality	2003–2015	77.5833	7.6272	51.5	93.3
Corruption	Control of Corruption	2003–2015	65.1288	9.1549	47.1	87.5
Rule of law	Rule of law	2003–2015	68.4068	11.0075	45.0	86.5

If we regress the size of the shadow economy directly on government expenditures, it can give us biased results, because both shadow economy and government expenditures may be correlated with GDP per capita, unemployment, level of corruption and other socioeconomic variables (Dreher, Kotsogiannis, and McCorriston 2009; Dreher and Schneider 2010). Therefore, we used GDP per capita (2002–2015), expressed in 2011 prices, and unemployment, from the World Bank development indicators as control variables. For representational reasons, we divided GDP per capita by 1000.

Furthermore, we used the control of corruption, regulatory quality and the rule of law, which were obtained from the World Bank's worldwide governance indicators, as control variables. The higher values of these indexes according to their definitions indicated the lower level of corruption, the higher regulatory quality and the higher rule of law. The descriptive statistics of the data we used are presented in Tab. 1. The data and algorithms written in R can be found on the corresponding author's personal web page.

It is also known from the very early literature on the shadow economy that taxes play a crucial role in determining its size (Allingham and Sandmo, 1972; Cagan, 1958). However, we cannot include taxes in our models because they were used by Medina and Schneider (2018) as inputs to the MIMIC model for the estimation of the size of the shadow economy.

The collected data constituted an unbalanced panel, which was much better than cross-country data in our case for the following reason. The MIMIC model, which was used to estimate the shadow economy, only determined the changes in the size of the shadow economy. The absolute size of the shadow economy remains unknown (Frey and Weck-Hanneman 1984). Therefore, there is a need for an evaluation of the absolute size of the shadow economy with a different method for at least one period. This is often performed using the currency demand approach (Schneider, 1986). However, in such a case, mistakes in the estimation of the absolute level of the shadow economy are persistent for countries. That is, mistakes of the absolute level of shadow economy shift its profile upwards or downwards and these mistakes do not vanish with time. The use of country-specific fixed effects solves this problem.

Our core hypothesis reads: Higher military expenditures increase shadow economy, ceteris paribus due to the reasons explained in the introduction. The sign of coefficients corresponding to the health, education and other expenditures is more ambiguous, because apart from the corresponding tax burden levied on the economy in order to finance these expenditures and possible misuse of funds, these expenditures may provide agents with some tangible benefits. We also expect that higher GDP per capita and lower unemployment will reduce the shadow economy because it is known that the size of shadow economy declines during periods of economic growth (Arandarenko, 2015; Fedajev and Arsic, 2017), while GDP per capita and unemployment rate are indicators of economic activity. We also expect that higher

regulatory quality, rule of law and control of corruption will reduce the shadow economy, ceteris paribus, because higher values of these variables correspond to more efficient public institutions.

3 Results

We estimate regression in the following form:

$$log\left(\frac{Shadow_{c,t}}{100 - Shadow_{c,t}}\right) = f_c(+f_t) + \beta_1 X_{1,ct} + \cdots + \beta_k X_{k,ct} + \varepsilon_{ct}, \quad (1)$$

where $X_{i,ct}$, $i = 1\ldots k$ denote explanatory variables, c is a country-specific index, t stands for time, f_c denotes country-specific effects, and f_t represents time-specific effects.

Tab. 2 presents the estimated coefficients of equation (1) in a model with country-specific fixed effects. Based on the results of the Breusch–Godfrey test, we provide Arellano-type standard errors (Arellano 1987), which solve the problem of auto-correlated residuals. The use of robust standard errors also allows for possible heteroscedasticity in the data. In the first column, we present the case in which our dependent variable is regressed on government expenditures only. Military expenditures have a positive coefficient, which is significant at the 0.01 significance level.

In model 2, we extend model 1 by including GDP per capita and the unemployment rate. In models 3 to 5, we also add one of the socioeconomic variables: regulatory quality, corruption and the rule of law. In fact, we cannot insert all the variables into one equation, because they are highly correlated (see Tab. 6 in the appendix), and the number of observations is relatively small. Therefore, we show three different equations. In all four cases, we obtained very similar results: the coefficient corresponding to military expenditures is positive and very significant. Health expenditures became positive and significant at the 0.01 significance too, but the size of the coefficient is twice lower than that of the military expenditures. Education expenditures remained insignificant. GDP per capita has a negative sign, and is highly significant in all the cases. Rule of law and corruption are significant at the 10% significant level and have the expected sign: stronger rule of law and better control for corruption reduce the shadow economy.

We include control variables gradually into the model. The coefficients corresponding to military expenditures change insignificantly, implying that our results are robust to possible endogeneity of control variables included in the model.

The positive sign of military expenditures can be explained in several ways. First, agents prefer not to pay taxes if they do not see tangible benefits from public policies financed with these taxes. Taxpayers may find that the benefits of military expenditures (in contrast to education expenditures, for instance) are less tangible.[4] In other words, even if agents approve of being a member of NATO, and even if they are confident in their army, an increase in military expenditures may not provide an adequate increase in the feeling of safety. However, increasing military expenditures reduce other expenditures or increase taxes. This may reduce agents' willingness to pay taxes.

Second, military expenditures are usually the least transparent expenditures in governments' budgets. This may increase the possibilities of improper use of budget funds, while illegal benefits received by officials have large chances to be spent in the shadow sector. However, it is unlikely that there is a reverse causality: that increasing shadow economy leads to an increase in military expenditures, because struggling with the shadow economy in the Central and Eastern European countries is a task of police, not soldiers, expenditures for police being a part of 'other expenditures'.

Third, Gupta *et al.* (2001) explained that military-controlled property, such as land, buildings, training centres and vehicles, can be used for illegal economic activities. Our macro-data analysis does not allow us to answer the question about which factors play major roles in determining our results. It is possible that all of them play roles to a certain extent. We also admit that there are other factors that may play a role.

It is often considered that in the absence of time-fixed effects, the model represents global dependence between variables. Therefore, we can conclude that global dependence between military expenditures and the size of the shadow economy is positive in the Central and Eastern Europe. Higher health and 'other' expenditures have a positive impact on the shadow economy too. Global dependence between GDP per capita and the size of the shadow economy is negative.

4 In most cases, higher health expenditures increase shadow economy too, but to a lower extent in comparison to the military expenditures.

Tab. 2. Dependent variable: logit-transformed shadow economy, country fixed effects

Variable	1	2	3	4	5
Mil. exp.	0.3625***	0.0939***	0.0883**	0.1011***	0.0821***
	(0.0495)	(0.0300)	(0.0362)	(0.0276)	(0.0309)
Educ. exp.	0.0842	0.0093	0.0085	0.0055	0.0142
	(0.0558)	(0.0170)	(0.0170)	(0.0167)	(0.0157)
Health exp.	-0.0568	0.0491***	0.0500***	0.0532***	0.0603***
	(0.0440)	(0.0177)	(0.0279)	(0.0175)	(0.0200)
Other exp.	0.0176***	0.0078***	0.0089***	0.0083***	0.0099***
	(0.0031)	(0.0021)	(0.0031)	(0.0026)	(0.0021)
GDP/cap.		-0.0541***	-0.0541***	-0.0545***	-0.0510***
		(0.0039)	(0.0038)	(0.0038)	(0.0047)
Unempl.		0.0031	0.0023	0.0029	0.0023
		(0.0023)	(0.0030)	(0.0027)	(0.0020)
Regul. qual.			-0.0018		
			(0.0028)		
Corruption				-0.0035*	
				(0.0020)	
Rule of law					-0.0055**
					(0.0024)
R^2	0.4597	0.9233	0.9243	0.9280	0.9304
N	99	99	99	99	99

* $p < 0.1$

** $p < 0.05$

*** $p < 0.01$

We also performed a Hausman endogeneity test for military expenditures in models 3 to 5 (Wooldridge 2010), using lagged values for military expenditures as potential instrumental variables. The hypothesis that military expenditures are strictly exogenous is not rejected, the corresponding p-value being in the range 0.4480–0.9489.

In Tab. 3, we include time-fixed effects in the models. Again, we provide Arellano-type standard errors. In the presence of time-fixed effects, the impacts of global trends in variables are removed. Moreover, time-fixed effects remove the impact of common structural breaks, such as the effects of the economic crisis in 2008–2009. Only short-run deviations from global trends matter.

The coefficients corresponding to military expenditures remained positive and highly significant and their size in models 2–5 has even increased. This result alludes us that misuse of funds and military-controlled property play a higher role in determining the size of shadow economy than agents' changed behavior, because it is unlikely that agents keep track of all temporal changes in government expenditures, while global trends are more likely to affect their behavior.

Health expenditures remained positive too but their absolute size is lower in comparison to the case with no time-fixed effects. Therefore, it is likely that in healthcare, the level of misuse of funds is lower in comparison to military expenditures, but agents are dissatisfied by the quality. That is, the quality of healthcare services from the agents' opinion does not correspond to the amount of taxes paid. GDP per capita remained negative and highly significant.

In model 3, an Augmented Dickey-Fuller Test rejects the hypothesis of a unit root existence in the residuals at the 0.01 significance level, the corresponding p-value being equal to 0.009. A Phillips-Perron Test gives a p-value of 0.01. However, normality tests reject the hypothesis that the residuals are normal (Kolmogorov test gives a p-value of $1.9*10^{-15}$). Therefore, we may expect that the significance of the coefficients presented in Tab. 2 would be lower than the reported results. Nevertheless, the t-test is a robust test, and deviation from the reported significance levels should not be large. The other models are similar.

The endogeneity test was performed for models 3 to 5. The hypothesis that military expenditures are

Tab. 3. Dependent variable: logit-transformed shadow economy, country and time-fixed effects

Variable	1	2	3	4	5
Mil. exp.	0.1509***	0.1085***	0.0967***	0.1041***	0.1007***
	(0.0508)	(0.0265)	(0.0337)	(0.0297)	(0.0267)
Educ. exp.	0.0327	-0.0045	0.0032	-0.0001	-0.0131
	(0.0309)	(0.0195)	(0.0193)	(0.0190)	(0.0186)
Health exp.	0.0046	0.0345*	0.0365*	0.0464**	0.0459**
	(0.0476)	(0.0204)	(0.0212)	(0.0212)	(0.0216)
Other exp.	0.0128***	0.0056	0.0075**	-0.0072**	0.0082***
	(0.0039)	(0.0025)	(0.0035)	(0.0029)	(0.0026)
GDP/cap.		-0.0495***	-0.0489***	-0.0457***	-0.0431***
		(0.0111)	(0.0099)	(0.0094)	(0.0093)
Unempl.		0.0031	0.0017	0.0029	0.0019
		(0.0034)	(0.0041)	(0.0038)	(0.0034)
Regul. qual.			-0.0030		
			(0.0025)		
Corruption				-0.0049**	
				(0.0021)	
Rule of law					-0.0057**
					(0.0023)
R^2	0.1357	0.4393	0.7376	0.7553	0.7552
N	99	99	99	99	99

* $p < 0.1$
** $p < 0.05$
*** $p < 0.01$

Tab. 4. Change in shadow economy (% of GDP) if military expenditures double

BGR	HRV	CZE	EST	HUN	LVA
3.74%	3.94%	1.46%	4.38%	1.84%	1.96%
LTU	POL	ROU	SVK	SVN	
1.76%	3.57%	2.65%	2.17%	1.52%	

strictly exogenous was not rejected, with corresponding p-values being in the range 0.2299–0.7049.

We used the logit transformation for our dependent variable modification. This makes marginal effects more complicated. In order to calculate the effects of an increase in military expenditures, we used model 4 (in Tab. 3). To facilitate the intuition of the estimates, we calculated how much the size of the shadow economy would have increased in 2012, if the size of military expenditures as a percentage of GDP were to double. The results are presented in Tab. 4. The maximal increase in the size of shadow economy was predicted for Estonia (4.38%, from 18.34% to 22.72%), and the lowest change was predicted for the Czech Republic (1.46%, from 11.50% to 12.96%). These changes were calculated keeping in mind the nonlinear nature of the logistic transformation. We performed calculations for the year of 2012, because 2012 is the latest period when the data on education expenditures is available.

4 Robustness

In this section, we have provided the robustness tests of the results. First, we took model 4 in Tab. 3 as a benchmark, and tried different functional forms. The results are presented in Tab. 5. In model 1, we took a logarithm of the shadow economy as a percentage of GDP and explanatory variables enter the model linearly. In

Tab. 5. Dependent variable: Shadow economy or its transformation

Variable	1 log-linear	2 log-log	3 linear	4 differences	5 lags	6 Balt	7 Other Shad. Ec.
Mil. exp.	0.0763***	0.0829*	1.9473**	0.0172*	0.0230**	0.0917***	0.0324*
	(0.0214)	(0.0430)	(0.7631)	(0.0086)	(0.0103)	(0.0120)	(0.0190)
Educ. exp.	0.0031	0.0525	-0.1618		-0.0069		-0.0111*
	(0.0136)	(0.0447)	0.4258		(0.0474)		(0.0063)
Health exp.	0.0343**	0.1425**	0.8812*	0.0037	0.0012	-0.0032	0.0057
	(0.0148)	(0.0587)	(0.4814)	(0.0032)	(0.0050)	(0.0074)	(0.0036)
Other exp.	0.0069**	0.1652***	0.0514		0.0009		-0.0004
	(0.0024)	(0.0536)	(0.0569)		(0.0009)		(0.0013)
GDP/cap.	-0.0392***	-0.7009***	-0.5742***	-0.0123***	-0.0039**	0.0018	-0.0047**
	(0.0067)	(0.1028)	(0.2048)	(0.0026)	(0.0018)	(0.0039)	(0.0022)
Unempl.	0.0010	-0.0293	0.1165	0.0011	-0.0000	-0.0037	0.0006
	(0.0027)	(0.0241)	(0.0784)	(0.0010)	(0.0007)	(0.0024)	(0.0011)
Corruption	-0.0032*	-0.0025*	-0.1229***	-0.0010***	-0.0003	0.0003	0.0002
	(0.0016)	(0.0014)	(0.0424)	(0.0035)	(0.0006)	(0.0009)	(0.0006)
R^2	0.7774	0.7245	0.6216	0.4858	0.2216	0.6594	0.3150
N	99	99	99	121	99	36	99

* $p < 0.1$ Other Shad. Ec. – Alternative estimate of shadow economy (Schneider *et al.* 2015).

** $p < 0.05$

*** $p < 0.01$

model 2, we took a logarithm of both dependent and explanatory variables. In model 3, the functional form was linear. In all the three models, military expenditures had a positive and significant impact. GDP per capita, health expenditures and control of corruption were significant too at some reasonable significance levels.

In column 4, we differentiated equation (1) having eliminated country-specific effects, and estimated the model for first-order differences. As the data on education and other expenditures contains many missing observations, we excluded these variables from the analysis. The coefficients for military expenditures, corruption and GDP per capita remained significant at the 10% significance level, with unchanged signs.

Model 5 presented in Tab. 5 is similar to model 4 in Tab. 3, with the difference that explanatory variables are taken with a one-year lag. The advantage of this approach is that causality is clear (Granger causality: explanatory variables at t–1 affect the endogenous variable at t and not vice versa.) The size of the coefficient corresponding to military expenditures declined but remained significant at the 5% significance level.

In column 6, we included a model estimated on the data for the Baltic States only: Estonia, Latvia and Lithuania. The estimated impact of the military expenditures on the level of shadow economy is similar to that in the complete sample.

Finally, as a robustness check, in column 7, we used alternative estimates of the shadow economy size. This time, we used estimates by Schneider *et al.* (2015) for the same period. Feige (2016) and Dybka *et al.* (2018) criticized these estimates. These estimates are higher than those obtained by Medina and Schneider (2018), and the correlation between them is 0.8165. The resulting coefficient for military expenditures remains positive and highly significant. Furthermore, the coefficient corresponding to education expenditures is negative and significant at the 0.1 significance level.

Therefore, we can draw a conclusion that there is a strong partial correlation between military expenditures and the estimates of the size of the shadow economy in the Central and Eastern Europe, and this result is robust to different model specifications.

5 Discussion and conclusions

We showed that there is a positive dependence between the size of the shadow economy and military expenditures in the Central and Eastern Europe. We attribute this dependence to the fact that military expenditures are the least transparent expenditures in government budgets; consequently, there may be more opportunities for misuse of budget resources, which increase demand for goods and services produced in the shadow. The misuse of military-controlled property can also take place. Our result contradicts those found by Goel and Saunoris (2014b), and the difference is at least partly determined by different methodological approaches. Instead of pooled regression, used by Goel and Saunoris, we performed fixed-effects panel data analysis, which solves a number of endogeneity problems.

There is also evidence that increasing health expenditures raised shadow economy but to a much lower extent in comparison to military expenditures. Other expenditures did not have a statistically significant impact on the size of the shadow economy in most of the model specifications. The link between real GDP per capita and the size of the shadow economy was negative, implying that economic growth reduced the size of the shadow economy. These results are very robust to model specifications.

As policy advice, we could suggest that governments make more effort to explain the need for military expenditure and make it as transparent as possible. In addition, there could be better control over the use of budget funds to prevent their misuse, as well as better control of military-owned property.

Suggestions for future research would be to check whether similar results hold for Western Europe or OECD countries, other post-Soviet countries and Latin America. In addition, it would be useful to verify the results on longer time series, when more data become available. Development of more elaborate methods for estimation of the shadow economy size will enable more precise estimates.

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Appendix

Tab. 6. Correlation matrix

Variable	1	2	3	4	5	6	7	8	9	10
1 Shadow	1									
2 Mil. exp.	0.1455	1								
3 Educ. exp.	0.0514	0.1772	1							
4 Health exp.	-0.0164	0.2553	0.4221	1						
5 Other exp.	-0.6206	0.4579	-0.8703	-0.1552	1					
6 GDP/cap.	-0.1627	0.2993	-0.0029	0.6090	0.0655	1				
7 Unempl.	-0.1837	-0.4156	0.4423	0.1086	0.7671	-0.2956	1			
8 Regul. qual.	0.1511	0.1765	-0.3180	0.2733	0.2799	0.6061	-0.2396	1		
9 Corruption	0.1721	0.2022	-0.3747	0.2024	0.3441	0.4459	-0.1448	0.9172	1	
10 Rule of law	-0.1333	0.2399	-0.3796	0.3824	0.4517	0.6875	-0.1013	0.8949	0.8810	1