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Discussion Papers

1122

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Berlin, May 2011

IMPRESSUM

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http://www.diw.de

ISSN print edition 1433-0210
ISSN electronic edition 1619-4535

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The shadow economy in OECD countries: Panel-data evidence

Konstantin Kholodilin[1] and Ulrich Thießen

Abstract

In this paper, the extent of the shadow economy in OECD countries is investigated. The estimates of the size of the shadow economy are obtained using the panel-data techniques applied to the data on 38 OECD member states over the period 1991-2007. Our estimates tend to be somewhat lower than the alternative estimates. However, our and alternative estimates of shadow economy are quite well correlated — the corresponding correlation coefficients lie between 0.63 and 0.65. The only exception is our estimates for 2002 and those of Schneider et al. (2010) for 2002, for which a low correlation is observed. We find that the estimates of the size of the shadow economy are very sensitive to the assumption on the velocity of money circulation. It is shown that the micro- and macro-evidence are consistent at a relatively low velocity of money circulation.

Keywords: shadow economy; OECD countries; panel-data estimation.
JEL classification: C51; E26.

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1. Introduction

The number of empirical estimates of the shadow economy (SE) grew tremendously during recent years. This paper produces yet another estimate of the size of the shadow economy. To obtain it we performed a panel analysis considering both the cross-section and time dimension and using the currency approach. Why an additional estimate might be needed? Below are the six reasons, why we endeavored into such an adventure as producing a new estimate of the shadow economy.

First, there is a multitude of analyses of the SE based on the so-called Mimic approach (Multiple Indicators Multiple Causes, see, for instance, Loayza, 1997, Dell Anno and Schneider 2003, Bajada and Schneider 2005, Brambila 2008, Bühn and Schneider 2008, Schneider et al. 2010), perhaps because this method may appear to be both technically more advanced and representing the "state of the art" compared to other methods like the currency demand approach. However, the Mimic model always yields an index, whose conversion into cardinal values requires an estimate of the SE (or ratio of the SE to official GDP) coming from another source, usually from another currency demand estimation. Moreover, SE estimates from currency demand functions require an assumption of a particular velocity of currency used in the SE, to which the estimates are very sensitive. Unfortunately, details of the underlying currency demand estimation, the velocity assumption, and sensitivity of the results are usually not provided in Mimic model papers. Hence, Mimic estimates of the SE size may appear to be independent estimates directly derived from the Mimic model but, in fact, they are to a large extent determined by former currency method estimates and velocity assumptions. In addition, the Mimic method is not new but was introduced to the analysis of the SE at the early 1980s (Frey

and Weck-Hannemann, 1984) at about the same time when the currency demand method was reaching a peak of recognition owing to Tanzi (1983). It has particular weaknesses, which were recently discussed by Breusch (2005a, 2005b, and 2006).

Secondly, there appears to be a growing recognition that the relatively high estimates of the SE in industrial countries exceeding 5% or even 10% of official GDP are way too high: For example, Breusch (2006) mentions the case of SE estimates for Australia of 15% of official GDP published in several articles by Bajada (e.g., Bajada, 2003), which were reconsidered by the author (Bajada, 2006) owing to Breusch's critique arguing, in particular, that the assumed income velocity of currency used in the SE was implausibly large. The very high estimates of the SE for Australia were subsequently revised downwards to around 5% of GDP, or two thirds less than previously. The new estimates show the SE on a long-term decline as a percentage of official GDP. However, Breusch (2006) argued that these new estimates were still flawed and too high, after which the revised estimates of 2006 were withdrawn from submission.

Thirdly, Mimic results are usually published without reference to their sensitivity despite their dependence on other estimates and, for instance, velocity assumptions, and although this is a longstanding demand (Angrist and Pischke, 2010).

Fourthly, since some macro model estimates of the SE have been so large for many countries — and presented without sensitivity scenarios or confidence bands — many finance ministries reacted by increasing the intensity of both controls of economic activity and punishment levels. It is noteworthy that these tendencies occur at a time when economic research extends more and more into the area of morality, social norms, social capital, and happiness, and finds

evidence in experiments for the quantitatively important influence of social interactions such as pro-social behavior, reciprocity, intrinsic motives to pay taxes, and fairness effects (e.g., Fortin et al., 2007, Carpenter and Matthews, 2005, Dohmen et al., 2009 and the overview by Riedl, 2010). Hence, researchers should address these tendencies, since they are directed against freedom and may do more harm than good. For instance, it could be that these tendencies impair the intrinsic motivation to pay taxes.

Fifthly, there are several observations suggesting that the influence of the standard causes of the SE (tax and social security burden, administrative burden, labor market regulations) depends on many other factors. We noted already the potential importance of social interactions. There is also the finding of a statistically significant negative association between the tax burden and the SE (Friedman et al., 2000) and there are some countries with a relatively high tax burden (Scandinavian countries) but a simultaneously relatively low SE, at least according to the micro-evidence. Hence, testing conditional effects and more elaborate specifications may allow simulations where the government would be able to compensate the SE increasing effect of a relatively high tax burden through relatively high satisfaction of economic agents with, for instance, the quantity and quality of public goods and services offered.

Sixthly and finally, claims about recent increases or decreases of the SE can be verified only through the use of the time-series dimension within a panel-data analysis. This a further contribution of the paper.

The remainder of the paper is structured as follows. Section 2 describes our data and preliminary tests. Section 3 explains the estimated panel models and simulations. Section 4 presents the empirical results with regard to the analyzed influences, estimated sizes of the SE and their sensitivity. Section 5 emphasizes

the indicative nature of this simulation approach, which applies also to mimic models, and concludes.

2 Data and preliminary tests

The data used in this study cover 38 OECD member states for the period 1991-2007. Thus, the maximum number of observations per variable is 646. However, due to the numerous gaps in the data, particularly before 2002, the effective number of observations used in each regression is substantially lower.

In our analysis, we use 12 variables listed and described in Table 1.[2] Our dependent variable and indicator of the shadow economy, is the share of currency in the money aggregate M2, *c_m2*. The relative magnitude of cash transactions is thought to reflect the role of shadow economy under the assumption that shadow transactions are conducted mostly in cash.[3] As Table 1 shows, this ratio varies between 1% and 40.2%.

As control variables in our regressions we use *gdprpppc*, *defgdp*, and *deuro1*. Real per-capita GDP, *gdprpppc*, should positively affect the currency-to-M2 ratio, since growing real income implies growing demand for cash to carry out current transactions. Likewise, a higher inflation rate should have a positive impact on the dependent variable (up to a certain point) due to increased demand for currency owing to the real depreciation of money.[4] *deuro1* is a dummy variable reflecting the introduction of the euro in the European Monetary Union (EMU) countries. In many of the EMU members, this event was accompanied by a decrease in the currency-to-M2 ratio. Thus, this dummy would separate the

[2] The used indices are merely representative of particular influences. Other indicators yield relatively similar results but tend to be less statistically significant.
[3] In our estimations, this variable was multiplied by 1000 to reduce zeros in the coefficients.
[4] Of course, this is true only up to a certain point because under hyperinflation currency will eventually tend to be replaced by other means of payment.

consequences of introduction of the euro from the effects related exclusively to the shadow economy factors.

Regarding the potential causes of the shadow economy, we distinguish traditional ones from those that reflect more recent theories. Traditional ones are the administrative burden, the tax burden, labor market regulations, and unemployment.

The administrative burden is measured by the business freedom index, *hbf*, defined by the Heritage Foundation as "a quantitative measure of the ability to start, operate, and close a business that represents the overall burden of regulation as well as the efficiency of government in the regulatory process". It varies between 0 and 100, where 100 is the best possible business environment. Hence, higher values of this index are expected to be associated with lower values of the currency-to-M2 ratio. In our data set, *hbf* varies between 55 and 100, the mean value being 75.

The variable taxes on goods and services, *tgsgdp*, measures the percentage share of taxes in GDP. The tax burden is assumed, *ceteris paribus*, to promote shadow economic activity. Hence, a positive association between this variable and the currency-to-M2 ratio is expected. As can be seen from Table 1, the values of this variable vary between 4.0% and 17.6%, with mean and median being around 11%.

The indicator of labor market regulations, *f5j*, measures the degree of economic freedom of employers and employees, according to the Fraser Foundation. The higher the index, the larger is economic freedom. Given that more labor market freedom for employers and employees tends to reduce incentives to participate in the SE, the expected sign of this variable in our regressions is negative.

As a measure for unemployment we use the non-employment rate in the economy variable, *ner*. It is expressed as a percentage of those who do not officially work in the working-age population. We prefer this measure of unemployment to the official unemployment rate because the latter may be subject to various manipulations designed to keep the official unemployment rate low. Thus, this indicator is thought to reflect unemployment more objectively. It is expected that when the non-employment rate rises, more people tend to be involved in the shadow economy and, thus, this variable should affect the dependent variable positively.

As stated above we aim at augmenting this model of traditional causes of the SE by variables allowing to test whether the traditional causes may be dependent upon other policies and, thus, whether a government may be able to compensate the SE increasing effect of, say a relatively high tax burden, through specific policies such as supplying public services that are satisfying to economic agents and/or securing an "efficient" government perceived by economic agents as not bribable through elites and private interests (see Kaufmann et al., 2009). Regarding this latter influence we use the "control of corruption indicator", *wbgc*, which measures "perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as "capture" of the state by elites and private interests". The values of the indicator are normalized so that the mean is zero and the standard deviation is one. Higher positive values correspond to better governance and 99% of the values fall between 2.5 and -2.5. Thus, the higher the control of corruption indicator the smaller should be the share of SE. In our sample, this variable varies between -0.8 and 2.6.

Regarding the quality of public services we use the variable "integrity of the legal system", *f2d*, which is a measure of the extent to which the rule of law is applied impartially and consistently. It varies between 1 and 10. Higher values of this index are expected to be associated with a smaller SE, because impartial and consistent application of law is both an essential requirement for the functioning of a market economy and an indicator of the quality of public goods and services. Here, the mean value of the index is 8.7, whereas the median value is even higher 9.7.

Finally, we use a proxy for the crime-related SE in order to separate the criminal economy, which will never be legalized, from the rest of the SE. Owing to a lack of better alternatives we use the motor vehicle theft rate, *ca*, which is thus also included in the set of control variables.

One additional variable shown in Table 1 is the M2-to-GDP ratio, *m2_gdp*, the inverse of velocity, which is simply needed to calculate the estimated amount of currency used in the SE, given the definition of our dependent variable, *c_m2*:

$$\text{Currency in shadow economy} = (\text{Currency/M2}) \times (\text{M2/GDP})$$

Since we employ the panel-data techniques we need to determine — prior to the estimations — whether the variables are integrated or not. Out of 11 variables used in our regressions, 9 by construction are constrained and, thus, should be unit-root stationary. Only two variables, GDP per capita, *gdprpppc*, and the GDP deflator, *defgdp* — are not restricted and hence tested for unit-root non-stationarity. Using the Im, Pesaran, and Shin panel unit-root test we find that the null hypothesis for them to be non-stationary for all countries cannot be rejected. Regarding their first differences the null is, however, safely rejected at the 1% significance level. Hence, these series were differenced once and their first

differences are denoted as *dlgdprpppc* and *dldefgdp,* where *dl* stands for difference of logs.

3 Estimation and simulation

All estimations were carried out using panel-data regressions with fixed country and time effects. The estimation results are reported in Table 2.

First, a benchmark model (see column 1, Table 2) was estimated. This model includes only our control variables together with the non-employment rate and the indicator for the crime-related SE because these variables are thought to affect the size of the shadow economy but could be difficult to be affected themselves. All variables are significant and have expected signs.

Second, we estimate augmented models including each time one of our four institutional variables — business freedom (*hbf*), labor market regulations (*f5j*), control of corruption (*wbgc*), and public goods quality (*f2d*) — and also the tax burden (*tgsgdp*), which, according to our theoretical assumptions, influence the shadow economy. It can be seen that the signs are robust to different model specifications. However, the institutional variables are not always statistically significant, which is true in particular, for our corruption (*wbgc*) variable, although it has the expected negative sign. Since in other empirical studies of the SE corruption proved to be an important variable both with regard to its statistical significance and quantitative impact, it was exceptionally retained for simulation purposes.

Finally, the last column of Table 2, model 4, represents the most comprehensive model including all regressors discussed above. This specification was used for

our simulation purposes to estimate the size and dynamics of the shadow economy in the OECD countries.

Regarding the estimated size of the SE, parameter estimates of model 4 were used in the following way: First, the "actual SE" currency-to-M2 ratios were computed as the fitted values of model 4. Second, the values of the four institutional variables and *tgsgdp* were set to the "minimum shadow economy" level. Thus, for the institutional variables the country-specific maxima were computed, since the largest values of these variables correspond to the lowest size of shadow economy. On the other hand, minimum levels of the taxes on goods and services variable were calculated for each country, because lower levels of tax burden are associated with lower shadow economy. Third, "minimum SE currency-to-M2 ratios" were computed using actual values of control variables and minimum shadow economy values of institutional variables and of the taxation variable. Fourth, the difference between the actual and minimum SE currency-to-M2 ratios was obtained. Fifth, this difference was multiplied by the respective actual M2-to-GDP ratio. Finally, in order to obtain the estimated value added of the SE, the estimated currency used in shadow economic transactions needs to be multiplied by an assumed income velocity (GDP divided by a monetary aggregate).

For several reasons this deserves special attention: estimates of the SE are directly proportional to the assumed velocity, which obviously increases the smaller the chosen definition of the monetary aggregate. But even for a given definition, velocities differ extremely from country to country and most of them have a clear time trend. Hence, to eliminate implausible differences of estimated SE's stemming only from large velocity differences, an average was chosen. Given structural differences between industrial countries, on the one hand, and developing countries, including transforming Eastern European countries, on the

other hand, separate averages were used for these two country groups and based on the last observation only, 2007, to account for the falling time trend. Regarding the choice of a monetary aggregate we follow the arguments of Breusch (2005a) in using a relatively broad aggregate, M2, in our base simulation. Consistent with the ongoing substitution of plastic cards for currency Breusch (2005a) argued that the work currency does in income generation should not be exaggerated. In addition, the micro-evidence of the SE in industrial countries typically finds ratios to GDP of not more than a few percent of GDP. This is relatively low when compared with some macroeconomic estimates, such as those of Schneider et al. (2010), which are often even above 15% of GDP only due to an assumed relatively high velocity. In these very large estimates the exact velocity assumption is neither explained, nor it is said how the large country differences in velocities are smoothed so as to avoid huge differences in the estimates when using country-specific velocities. Overall, it is much harder to defend a relatively high velocity than a relatively low one such as that of M2 averaged over a range of similar countries. Hence, our velocity values in the baseline simulation of Table 3 are averages of 2007 for industrial countries (3.5) and for developing countries including Eastern Europe (5.3).

In order to demonstrate the sensitivity of the results to the velocity assumption we also used the income velocity of M1. For the two country groups and the year 2007 the average M1 velocities were 9.0 and 12.0, respectively.

4 Results

The estimates of the relative size of the shadow economy as a percentage share of GDP are reported in Table 3. It contains three point estimates: an average over the whole period and the estimates for 2002 and 2006. In addition, for the

latter two years the estimates are decomposed into the effects of the individual contributing factors.

The column under the heading "change" shows the direction and magnitude of the change of the size of shadow economy during 2002 through 2006 in the 26 countries. The last three columns give results from other studies to allow a comparison.

Owing to the data limitations we were able to produce estimates only for 26 countries out of 38. The results stemming from our estimations are described below. As discussed later, though, they need to be considered with great caution.

Firstly, the estimated size of the SE is consistent with the micro evidence, i.e., relatively moderate. The ranking of countries is consistent with that of other studies: among the industrial countries above average are, for instance, Greece, Italy, and Portugal. Below average are some Scandinavian countries and the USA. On the other hand, Eastern European countries have relatively high SEs between 4% and 6% of official GDP, where Bulgaria and Romania are, however, missing due to a lack of data. Turkey, which is the only other developing country, has an estimated SE of somewhat below 10% of GDP.

Secondly, another noteworthy result is that the SE tended to decrease in recent years prior to the financial crisis in the industrial countries (except Portugal and Spain), whereas it increased somewhat in the examined emerging economies (except Slovakia).

Let us consider, for example, the case of Germany. According to our estimates, in 2002, the ratio of the German shadow economy to the legal economy was 3.1% and thus Germany occupied the 9th rank among the OECD countries, if the

indicator is ranked in the ascending order. In 2006, it decreased to about 1.5% and remained at the same rank as before. Over the whole period its average value was 2.3% and thus almost 1.5 times smaller than the average shadow economy size for all 26 countries over the whole period. In both years, an insufficient integrity of the legal system made the largest contribution to the size of shadow economy. In addition, in 2002 the two other main contributors were: labor market regulations, business freedom, and tax burden measure as the ratio of axes on goods and services to GDP. By 2006, the integrity of legal system deteriorated causing an increase in the German shadow economy. However, this adverse effect was more than compensated by the lowering of taxes as well as by improvements in labor market regulations and business freedom.

Thirdly, for some countries, e.g., Austria, Canada, and Norway, a relative decrease in the size of the shadow economy is quite large, approaching 100%. However, this apparently huge decline can be explained by a low base effect, since in 2002 the size of the shadow economy for these countries was already very small. Therefore, for Austria a change from 1.8% to 0.1%, that is, 1.7 percentage points, represents a 93.6% decline.

It should be stressed that the estimates of the shadow economy are very sensitive to the assumed income velocity of currency used in shadow economic transactions. There are two aspects of this assumption: Velocity is defined as GDP divided by a monetary aggregate. Hence, the larger the used monetary aggregate, the larger will be both velocity and the estimated size of the shadow economy. But velocities between countries are very different without an apparent explanation, and also they are sensitive to the used monetary aggregate. For the simulations shown in Table 3 the monetary aggregate chosen was that of M1, a relatively narrow definition yielding a relatively high velocity. Considering that currency and demand deposits have less and less importance in

"financing" GDP one could also argue for a larger aggregate that would yield lower estimates of the size of the shadow economy. Hence, it needs to be stressed that these results are only indicative. Given the large differences of velocities between countries, two averages were used: 3.5 for the industrialized countries and 5.3 for the developing and transition countries. In other words, if one would not use averages, the estimated size of the shadow economy would largely swing from country to country only due to differences in currency velocities.

However, given that the lowest velocity of circulation for the industrialized countries is 1.48 and the highest is 10.85, the estimated size of the shadow economy varies significantly. For example, for Germany the estimate varies between 1.0% and 7.0%, whereas for the USA it varies between 0.6% and 4.1%. Thus, one has to choose the velocity of money circulation very careful in order to arrive at plausible absolute estimates of the shadow economy. The ranking of the countries would remain stable, provided that the value of the velocity of circulation taken to estimate the shadow economy does not vary across countries.

5 Concluding remarks

In this paper, using the panel-data techniques we estimated the size of shadow economy in 38 OECD member states. Our results were compared to the estimates obtained by Thießen (2010) using cross-section regressions as well as the estimates of Schneider et al. (2010), who uses the Mimic approach, for 2002 and 2006. The first observation is that our estimates are usually somewhat lower than the alternative estimates. However, our and alternative estimates of shadow economy are quite well correlated — the corresponding correlation coefficients

lie between 0.63 and 0.65. The only exception is our estimates for 2002 and those of Schneider et al. (2010) for 2002, for which a very low correlation is observed.

We find that the estimates of the size of the shadow economy are very sensitive to the assumption on the velocity of money circulation. It is shown that the micro- and macroeconomic evidence are consistent at a relatively low velocity of money circulation and that the latter can be much better defended than a high velocity.

References

Angrist, J. D., and J. S. Pischke (2010), The Credibility Revolution in Empirical Economics: How Better Research Design is Taking the Con out of Econometrics, Journal of Economic Perspectives 24 (2), 3-30.

Bajada, C., and F. Schneider (2005), The Shadow Economies of the Asia-Pacific, Pacific Economic Review 10/3, 379-401.

Bajada, C. (2006), Australia's Underground Economy Revisited, unpublished manuscript, University of Technology, Sydney.

Buehn, A., and F. Schneider (2008), MIMIC Models, Cointegration and Error Correction: An Application to the French Shadow Economy, Cesifo Working Paper No. 2200, Munich, January.

Brambila, M. (2008), Modeling the Informal Economy in Mexico. A Structural Equation Approach, Munich Personal RePEc Archive Paper N0. 8504, April.

Breusch, T. (2005a), Estimating the Underground Economy using MIMIC Models, Australian National University, Working Paper, Canberra, http://econ.unimelb.edu.au/SITE/workshops/ Breusch.pdf.

Breusch, T. (2005b), The Canadian Underground Economy: An Examination of Giles and Tedds, Canadian Tax Journal 53 (2), 367-391.

Breusch, T. (2006), Australia's Underground Economy — Redux ?, Munich Personal RePEc Archive, MRPE paper No. 9980, posted August 2008, http://mpra.ub.uni-muenchen.de/9980/.

Carpenter, J., and P. Matthews, (2005), "Norm Enforcement: Anger, Indignation or Reciprocity?," Middlebury College Economics Discussion Paper No. 05-03, Middlebury College, Vt., March.

Dell'Anno, R. and F. Schneider (2003), The Shadow Economy of Italy and other OECD countries: What do we know?, Journal of Public Finance and Public Choice 21 (2-3), 97-120.

Dohmen, T., A. Falk, D. Huffmann, and U. Sunde (2009), Homo Reciprocans: Survey Evidence on Behavioral Outcomes, Economic Journal 119, 592-612.

Fortin, B., Lacroix G., and M. C. Villeval (2007), Tax Evasion and Social Interactions, Journal of Public Economics 91 (11-12), 2089–2112.

Frey, B. S., and H. Weck-Hannemann (1984), The Hidden Economy as an 'Unobserved' Variable, European Economic Review 26 (1-2), 33-53.

Friedman, E., S. Johnson, D. Kaufmann, and P. Zoido-Lobaton (2000), Dodging the grabbing hand: the determinants of unofficial activity in 69 countries, Journal of Public Economics 76 (3), 459-493.

Kaufmann D., K. Aart, and M. Massimo (2009), Governance matters VIII: aggregate and individual governance indicators 1996-2008. Policy Research Working Paper Series 4978, The World Bank.

Loayza, N. A., (1997), The Economics of the Informal Sector. A simple model and empirical evidence from Latin America, World Bank Policy Research Working Paper 1727, Washington D.C.

Riedl, A. (2010), Behavioral and Experimental Economics Do Inform Public Policy, Finanzarchiv 66 (1), 65-95.

Schneider, F., and A. Buehn, and C. E. Montenegro (2010), New Estimates for the Shadow Economies all over the World, paper presented at the Workshop on the Shadow Economy of the University of Potsdam, April 2010, and International Economic Journal, forthcoming.

Tanzi, V. (1983), The Underground Economy in the United States: Annual Estimates, 1930-80", International Monetary Fund Staff Papers 30, 283-305.

Thießen, U. (2010), The shadow economy in international comparison: Options for economic policy derived from an OECD panel analysis. DIW Discussion paper 1031.

Appendix

Table 1. Descriptive statistics

Short name	Description	Source	Minimum	Mean	Median	Maximum	CV
c_m2	Currency / M2 ratio	IFS	10.00	96.76	77.00	402.00	0.72
gdprpppc	Real per-capita GDP at 2000 PPP, USD	OECD	-0.38	0.03	0.03	0.12	1.47
defgdp	GDP deflator, market prices	OECD	-0.02	0.09	0.03	2.35	2.66
ner	Non-employed people as a fraction of working age population (unemployed + inactive working age people)/working age people	Labor Force Survey	15.00	34.41	35.00	100.00	0.26
deuro1	Dummy for introduction of euro in EMU countries	Own	0.00	0.06	0.00	1.00	4.00
ca	Motor vehicle theft rate per 100,000 population	Eurostat	0.49	306.70	237.64	1035.31	0.77
tgsgdp	Taxes on goods and services	OECD	3.97	11.06	11.43	17.57	0.26
wbgc	Control of corruption, (higher value means less corruption)	World Bank Governance Indicators	-0.76	1.21	1.34	2.60	0.73
f2d	Integrity of the legal system (higher value means better quality)	Fraser Institute	3.33	8.71	9.65	10.00	0.18
f5j	Labor market regulations (higher value means more freedom)	Fraser Institute	2.49	5.19	5.04	8.33	0.25
hbf	Business freedom (higher value means more freedom)	Heritage Foundation	55.00	75.48	70.00	100.00	0.14
m2_gdp	M2 / GDP ratio	Own	0.17	0.76	0.63	3.78	0.69

Table 2. Estimation results of panel models

	Basic model	Model 1	Model 2	Model 3	Model 4
dlgdprpppc	178.629***	109.822	244.494***	238.946***	219.817***
(Annual difference of real per capita income)	44.788	68.352	56.014	62.853	74.708
dldefgdp	76.156***	-27.927	59.723**	101.380***	23.417
(Annual difference of GDP deflator)	17.753	-28.109	23.459	-23.745	30.045
deuro1	-6.779**	-5.712**	-10.037***	-9.848***	-5.163*
(Dummy Euro introd. in EMU countries)	-2.898	-2.667	-2.888	-2.771	-2.625
ner	2.082***	1.889**	1.628***	2.645***	2.236***
(Non-employment rate)	0.391	0.754	0.561	0.562	0.823
ca	0.023**			0.044***	0.040**
(Auto theft rate; proxy for crime; Crime)	0.011			-0.014	-0.016
hbf		-0.201	-0.258*	-0.261*	-0.152
(Administrative burden; Adm. bur.)		-0.136	-0.134	-0.142	-0.149
f5j		-1.889	-4.321**	-2.033	-2.274
(Labor market regulations, LMR)		-1.658	-1.803	-1.735	-1.688
tgsgdp		2.177	2.701*	2.605*	4.198*
(Taxes on goods and services; proxy for tax burden; Tax bur.)		1.619	1.516	1.533	2.137
wbgc		-4.621			0.37
(Control of corruption; proxy for quality of government: Gov. qual.)		-7.016			-7.44
f2d			-1.779		-2.617**
(Integrity of the legal system; proxy for quality of public services; PS qual.)			-1.171		-1.307
R^2	0.26	0.36	0.37	0.49	0.45
N	336	178	222	195	150

Note: entries in smaller font below the coefficient estimates are standard errors.
Source: authors' calculations.

Table 3. Estimated size of shadow economy with contribution of specific factors, percentage share of GDP

		2002						2006						Change 1	Thießen (2010)	Schneider et al. (2010), Tables 3.3.3 and 3.3.4	
	Average	Total	tgsgdp Tax burd.	wbgc Govt. qual.	f2d PS qual.	f5j LMR	hbf Adm. burd.	Total	tgsgdp Tax burd.	wbgc Govt. qual.	f2d PS qual.	f5j LMR	hbf Adm. burd.	%	scenario 1	2002	2006
Australia	1.9	2.5	1.82	0.00	0.00	0.47	0.23	1.6	1.01	0.00	0.62	0.00	0.00	-34.4		14.6	15.6
Austria	1.3	1.8	0.89	0.00	0.00	0.50	0.43	0.1	0.12	0.00	0.00	0.04	0.00	-93.6	1.6	9.7	10.5
Belgium	3.5	3.3	0.12	0.00	1.47	0.54	1.16	2.6	0.70	-0.04	1.74	0.04	0.12	-22.4	2.9	22.8	24.4
Bulgaria	---	---	---	---	---	---	---	---	---	---	---	---	---			37.1	39.4
Canada	2.6	4.3	2.44	-0.04	0.00	0.89	0.97	0.5	0.58	-0.04	0.00	0.00	0.00	-87.3	2.4	16.4	17.5
Cyprus	---	---	---	---	---	---	---	---	---	---	---	---	---				
Czech Republic	4.7	4.4	0.00	-0.04	1.60	1.11	1.69	4.6	0.58	-0.04	1.65	0.00	2.45	5.1		18.4	19.3
Denmark	2.2	2.4	0.81	0.00	0.00	1.24	0.39	1.5	1.32	0.00	0.00	0.00	0.19	-38.1	0.3	19.0	19.4
Estonia	---	---	---	---	---	---	---	---	---	---	---	---	---			38.8	39.6
Finland	1.5	0.9	0.39	0.00	0.00	0.27	0.27	0.5	0.47	0.00	0.00	0.08	0.00	-45.8	0.8	18.8	19.3
France	1.6	1.6	0.23	0.00	0.70	0.19	0.43	1.0	0.16	0.00	0.81	0.00	0.00	-39.0	1.3	15.6	16.7
Germany	2.3	3.1	0.58	0.00	1.01	0.81	0.70	1.5	0.39	-0.04	1.16	0.00	0.00	-51.3	2.3	16.1	16.8
Greece	5.6	5.1	1.40	0.00	3.14	0.43	0.12	2.4	0.54	-0.04	1.94	0.00	0.00	-51.9	3.3	29.8	30.8
Hungary	4.4	3.6	0.00	0.00	2.14	0.94	0.58	3.9	0.04	0.00	2.45	0.76	0.62	7.4		24.8	25.3
Iceland	---	---	---	---	---	---	---	---	---	---	---	---	---		1.2	16.4	17.0
Ireland	3.2	1.1	0.12	-0.04	0.00	0.58	0.35	1.1	0.97	-0.04	0.00	0.19	0.00	7.4	3.6	16.0	17.1
Italy	2.6	1.7	0.39	0.00	0.00	0.97	0.39	2.1	0.16	-0.04	1.74	0.00	0.19	17.8	3.9	27.4	28.9
Japan	7.7	12.0	3.99	-0.08	3.22	2.56	2.37	---	---	---	---	---	---		5.7	10.6	11.9
Korea	---	---	---	---	---	---	---	---	---	---	---	---	---		3.9	28.4	29.6
Latvia	---	---	---	---	---	---	---	---	---	---	---	---	---			40.3	42.8
Lithuania	---	---	---	---	---	---	---	---	---	---	---	---	---			31.4	32.9
Luxembourg	2.3	2.3	1.98	0.00	0.00	0.35	0.00	1.7	1.32	0.00	0.00	0.19	0.23	-26.7	1.8	9.9	10.4
Malta	---	---	---	---	---	---	---	---	---	---	---	---	---				
Mexico	---	---	---	---	---	---	---	---	---	---	---	---	---			31.5	32.6
Netherlands	2.3	2.5	0.66	0.00	0.00	1.01	0.85	1.6	1.59	-0.04	0.00	0.00	0.04	-35.4	3.6	13.1	13.6
New Zealand	2.3	2.8	0.54	0.00	0.00	1.55	0.70	1.6	0.50	0.00	0.78	0.31	0.00	-42.3		12.9	13.8
Norway	2.7	2.4	1.09	0.00	0.00	0.70	0.62	0.00	0.00	0.00	0.00	0.00	0.00	-100.0	1.7	19.1	20.6

Table 3 concluded

	Average	2002					2006						Change[1]	Thielen (2010), scenario 1	Schneider et al. (2010), Tables 3.3.3 and 3.3.4	
		Total	tgvgdp	wbgs	f2d	f5j	hbf	Total	tgvgdp	wbgs	f2d	f5j	hbf	%		2002	2006
Poland	4.6	5.8	3.12	0.00	1.96	0.76	0.00	6.2	4.05	-0.04	1.65	0.00	0.53	6.9		27.4	28.1
Portugal	4.1	4.3	1.36	-0.04	1.40	1.16	0.43	5.7	3.22	-0.08	1.47	0.78	0.27	31.5	3.4	24.1	24.7
Romania	---	---	---	---	---	---	---	---	---	---	---	---	---			35.4	36.7
Slovak Republic	5.7	5.7	0.27	-0.04	2.94	1.74	0.76	4.1	0.62	0.00	2.72	0.00	0.76	-27.6	5.3	19.2	20.5
Slovenia	---	---	---	---	---	---	---	---	---	---	---	---	---			27.0	28.0
Spain	3.4	3.1	1.05	0.00	1.09	0.62	0.35	3.6	1.43	-0.04	1.36	0.78	0.04	15.0	2.7	22.8	23.4
Sweden	1.4	1.7	0.62	0.00	0.00	0.43	0.66	0.7	0.66	0.00	0.00	0.00	0.00	-61.4	1.5	19.7	20.6
Switzerland	---	---	---	---	---	---	---	---	---	---	---	---	---		1.6	8.6	8.6
Turkey	5.6	8.6	6.24	-0.04	0.94	0.45	0.98	9.2	6.99	0.00	0.49	1.16	0.62	7.8	3.1	31.3	32.9
UK	2.6	2.8	1.24	0.00	0.00	0.70	0.89	1.9	0.23	-0.04	1.05	0.04	0.62	-31.9	3.0	12.7	13.7
USA	1.3	2.1	0.04	0.00	1.12	0.62	0.31	1.2	0.08	-0.04	1.20	0.04	0.00	-41.8	2.6	8.7	9.3

Note:
[1] Change 2006 over 2002 in percent.
Source: authors' calculations.