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DP11229

**'FLATTENING' THE TAX EVASION:
EVIDENCE FROM THE POST-
COMMUNIST NATURAL EXPERIMENT**

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***LABOUR ECONOMICS and PUBLIC
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Discussion Paper 11229

Published 15 April 2016

Submitted 15 April 2016

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www.cepr.org

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Abstract

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JEL Classification: C34, H26, E26

Keywords: Flat tax, tax reform, tax evasion, underreporting, consumption-income gap

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Acknowledgements

The authors gratefully acknowledge the support of the National Science Foundation of the United States under grant #SES-0752760 to the Research Foundation of the City University of New York. All opinions are those of the authors and should not be attributed to the NSF, CUNY or CERGE-EI. We wish to express thanks for valuable comments to seminar participants at CERGE-EI, IZA (Bonn) and the Armenian National Bank. All remaining errors and omissions are entirely ours.

‘Flattening’ the Tax Evasion: Evidence from the Post-Communist Natural Experiment

Randall K. Filer^{1,2}, Jan Hanousek^{*2,3}, Tomáš Lichard², Karine Torosyan⁴

Abstract

We analyze the response of tax evasion to the introduction of a flat tax in several transition economies. Using a novel estimator based on household level data, we show that in most of the studied countries there was no discernible effect on the measured size of unreported income following flat tax reform. This may imply that decreases in marginal tax rate may frequently have been accompanied by parallel deterioration in attitudes towards public services and these countries’ government in general as the only countries that show a response to the flat tax reform appear to be those where satisfaction with government services increased. Additionally, our results show a pro-cyclicality of the size of the shadow economy that is in line with previous research.

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The authors gratefully acknowledge the support of the National Science Foundation of the United States under grant #SES-0752760 to the Research Foundation of the City University of New York. All opinions are those of the authors and should not be attributed to the NSF, CUNY or CERGE-EI. We wish to express thanks for valuable comments to seminar participants at CERGE-EI, IZA (Bonn) and the Armenian National Bank. All remaining errors and omissions are entirely ours.

Introduction

This paper analyzes a unique natural experiment involving substantial changes in tax systems in the post-communist countries in Central and Eastern Europe. In several sets of structurally and culturally closely-related economies, at least one country adopted a variant of a flat tax reform while one or more otherwise highly similar neighboring countries retained a complex, progressive tax code. This pattern of reform enables difference-in-difference estimates of the impact of major tax system simplification and lower top tax rates on the decision to hide income from authorities.

In recent decades economists and policy makers have paid increasing attention to the hidden economy. Although several researchers have introduced subtle distinctions (see Bloem & Shrestha, 2000), we will not attempt to differentiate among what others have called the hidden economy, shadow economy, underground economy, unreported economy, unofficial economy, and grey economy. For our purposes, the hidden economy refers to all productive activities that are not recorded in formal statistical collection by government agencies. We do not distinguish between activities that are hidden from the authorities because they are illegal in and of themselves, and those that are illegal only because they are unreported to tax authorities. In the words of Feige to a session of the American Economics Association in 1980:

The observed sector of the economy consists of those economic activities that are regularly caught in the net of our official statistical accounting mechanism. It is this observed sector that furnishes us with our perceptions of the fundamental facts of economic life. Not only does it function as the basis for generating the questions that the economics profession seeks to answer, it also provides the fodder for our forecasting industry, our empirical tests, and our policy prescriptions. Thus, any major systematic discrepancy between our observations of macroeconomic life and actual macroeconomic activity serves to generate misguided questions, to produce erroneous answers, and perhaps most damagingly, to disseminate systematically false information among citizens and policy makers alike.... The unobserved sector, being the complement of the observed sector, consists of those activities (legal or illegal, market or non-market, monetary or barter) that escape the purview of our current societal measurement apparatus (Cited in Feige & Urban, 2003, p. 4).

Recently, recognizing that the lack of exhaustive coverage of GDP results in severe shortcomings both for users and for producers of national accounts (Bloem & Shrestha, 2000, p. 3), official statistical agencies have devoted considerable attention to measuring various parts of the hidden economy OECD (2002) while scholars and policy makers alike have investigated the factors that lead individuals and firms to hide economic activity.

These factors are obviously complex and varied. Illegal activity is likely to be hidden from statistical agencies in the belief that information may be shared with law enforcement authorities. Participation in the hidden economy is also a way of escaping regulatory burdens in either the labor or product market (including restrictions on various production technologies for environmental or other reasons) Friedman, Johnson, Kaufmann, and Zoido-Lobaton (2000); Johnson, Kaufmann, and Zoido-Lobaton (1998). For post-communist countries, there is also evidence that a lack of political stability and the existence of corruption promote unrecorded economic activity (May, Pyle, & Sommers, 2002).

Researchers and policy makers originally associated participation in the shadow economy to rationale economic motifs. People avoid taxes when the pay-off exceeds its costs, i.e. when the benefits from tax avoidance are higher than the penalty times the probability of being caught (Sadmo 1972). Recently, there has been increased discussion whether cost-benefit model of studying shadow economy should be augmented by “tax-morale” incentives (see, for example, Alm and Togler, 2011, Togler, 2012). To put it simply, tax evasion may not only be a product of greed, but may also be a form of protest by citizens against a government they find to be inefficient and unresponsive to their needs.¹

Tax evasion has been considered a primary motivation for the existence of unrecorded activity from as early as Kaldor (1956). Past theoretical work has produced ambiguous conclusions regarding the impact of tax rates and structures on incentives to hide economic activity. Allingham and Sandmo (1972) and Yitzhaki (1974) assert that reduction in tax rates may alter penalties for noncompliance and, therefore, cost/benefit calculations such that workers conceal a greater share of income. Similar results have been found for tax rates by Pencavel (1979) and tax progressivity by Koskela (1983). Adding decreasing absolute and non-increasing relative risk aversion to such a model, however, implies that increases in either tax rates or progressivity will cause a growth in the underground economy (Trandel & Snow, 1999). Other works showing a positive theoretical relationship between taxes and hidden economic activity

¹ Hanousek & Palda (2004), in a survey of the Czech and Slovak Republics, Hungary, and Poland, find strong evidence that citizens will avoid taxes if they do not believe they are getting quality government services for the taxes levied upon them.

include Kesselman (1989), Cowell (1985) and Watson (1985). A summary of this literature is provided by Sandmo (2005), or Feldman and Slemrod (2007).

Empirical work on the link between taxes and the size of the hidden economy is also mixed. While some studies (Friedman et al., 2000; for example) find no, or even a negative, relationship between taxes and the size of the hidden economy, the vast majority of studies find that higher average and/or marginal tax rates as well as greater complexity of the tax system are associated with an increase in the size of the hidden economy. Examples include Giles and Johnson (2002), Thießen (2003), Cebula (1997), Hill and Kabir (1996), Lacroix and Fortin (1992), and Schneider (1986).

The Natural Experiment of Flat-Tax Reform in Post-Communist Europe

Among the tax reforms most commonly suggested for regularizing the hidden economy is a move to a flat (uniform rate) tax. Post-communist Central and Eastern Europe provides an unprecedented opportunity to test the ability of flat tax reforms to reduce the extent of the hidden economy. The countries of the region began the transition with progressive and, typically, high rates of personal income tax as well as traditionally large hidden economies. Over the period of transition most of these tax regimes have also become increasingly complex.² In recent years, however, some post-communist countries have adopted simplified, flat-tax regimes.³ Even more fortuitously, several of these flat-tax adopters are closely linked to structurally and economically similar countries that have not adopted such reforms.

This linkage occurs because of the unique experience of country formation in the years following the collapse of communism. During the 1990s all three federated states in the region (Czechoslovakia, the Union of Soviet Socialist Republics and Yugoslavia) split into multiple successor states. In each of these groupings, some countries moved to a flat tax system while

² In the Czech Republic, for example, the length of the tax code increased from under 14,000 words in 1993 to over 81,000 in 2005. During this period there were more than 50 revisions of the tax code. Similarly, the original income tax law contained the phrase with the exception of 50 times while the 2005 law used this phrase 254 times (Dušek and Žigić 2005, p. 41)

³ See (Grabowski 2005); and (Keen, Kim, & Varsano 2006) for discussion of these reforms.

others did not (or did so at a significantly later time). This situation provides a ready set of difference-in-differences comparisons among countries that share similar backgrounds, legal structures, institutions and economic situations. In Table 1 we summarize the personal income tax systems and flat tax reforms in the sets of countries we analyze.⁴

Several important facts are evident in Table 1. Although the best previous estimates of the hidden economies share of national income are likely to be inaccurate (Hanousek & Palda, 2004), it is informative that they are highly similar within each country group but vary widely across groups. Where implemented, flat tax rates are similar across countries and typically are substantially below top rates either prior to reform or when compared to other countries within the group that did not implement a flat-tax reform. There is, however, substantial variation in the top marginal rate prior to reform across the four country groups, ranging from 20 percent in Serbia to 40 percent in Ukraine.

Table 1: Chronology of Flat Tax Reforms in Selected Post-Communist European Countries

Country	Period	Personal Income Tax Rate*	Estimated Size of Hidden Economy 1999-2000** (% of GDP)
Czech Republic	Prior to 1/1/2008	Progressive 12% - 32%	19.1%
Czech Republic	After 1/1/2008	FLAT 15%***	
Slovakia	Prior to 1/1/2004	Progressive 10% - 38%	18.9%
Slovakia	After 1/1/2004	FLAT 19%	
Croatia	Entire Period	Progressive 15% - 45%	33.4%
Montenegro	Entire Period	Progressive 0% - 23%	36.4%
Serbia	Prior to 1/1/2003	Progressive 10% - 20%	36.4%y
Serbia	After 1/1/2003	FLAT 14%	
Ukraine	Prior to 1/1/2004	Progressive 10% - 40%	52.2%
Ukraine	After 1/1/2004	FLAT 13%	
Russia	Prior to 1/1/2001	Progressive 12% - 30%	46.1%
Russia	After 1/1/2001	FLAT 13%	

⁴ Lithuania, Latvia and Estonia were leaders in flat tax reforms, but they were early and simultaneous adopters, making comparative analysis impossible. Romania also adopted a flat tax reform in 2005 but was not part of a formerly federated state.

Armenia	Entire Period	Progressive 10% - 20%	46.3%
Georgia	Prior to 1/1/2005	Progressive 10% - 20%	67.3%
Georgia	After 1/1/2005	FLAT 12%	

Notes:

*Tax rates are for the current year or at the time of flat tax implementation. There may have been either increases or decreases in rates at various points during the period examined.

**Figures are estimates using multiple-indicator/multiple-cause estimates in Schneider (2004).

***Taxation of wage workers and salaried workers in the Czech Republic is based on the so-called 'super-gross salary'—individual salary plus health and social insurance contributions paid by employers.

† Figures are not available independently for Serbia and Montenegro

Although all of the post-communist reforms differed in important ways from a pure Hall-Rabushka (1995) flat tax, each involved substantial simplification of the tax system combined with significant reductions in marginal and, generally, average tax rates.⁵ Proponents of flat-tax reforms have endorsed each enthusiastically, claiming major success in reducing the size of the hidden economy. According to Rabushka (2005):

Russia is the big story. It took the tax reform world by storm in 2000 with a 13 percent flat tax, replacing its previous three-bracket system that topped out at 30 percent. The results have been spectacular. The economy has enjoyed four years of sustained growth. Real (inflation-adjusted) ruble revenue from the personal income tax rose 25.2 percent in 2001, 24.6 percent in 2002, 15.2 percent in 2003, and 16 percent in the first half of 2004. By year end, total receipts will have more than doubled; the share of consolidated budget revenue received from the personal income tax increased from 12.1 percent in 2000 to 17 percent at the end of 2003.

Proponents assert a causal relationship between the flat-tax reform and reduction in the size of the hidden economy, claiming that the constant expansion of the government tax revenue [in Russia] is the result of less tax evasion and increased incentives to work, save and invest” (Grecu, 2004). There have been very few rigorous economic analyses that could justify the claims of advocates. Ivanova, Keen, and Klemm (2005) use household data from the Russian Longitudinal Monitoring Survey and find that while there is no evidence of a strong supply side

⁵ It is important to recognize that income taxes generate only a fraction of revenue in the counties examined. The degree to which other taxes including Value Added Taxes (VAT), payroll taxes and corporate profits taxes were reformed along with income taxes varies across countries and will be an important consideration, as will the changes in the tax base for income taxes on items such as investment income that were typically included in the reforms. Georgia, interestingly, is the only flat tax adopter to remove all elements of progressivity by eliminating all exclusions from income, even basic allowances for very low levels of earned income.

effect from the reform, compliance does appear to have improved substantially (by about one third). This increase in compliance was concentrated among households in the top two tax brackets before the introduction of the flat tax. Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter (2009) estimated a lower effect, finding that tax evasion decreased by between 9 and 12 percent. Gaddy and Gale (2005), on the other hand, speculate that the observed increase in compliance is more likely attributable to changes in the administration and enforcement of tax laws and other structural changes than to lower rates (p. 983). Chua (2003) reaches a similar conclusion.

More recently, the flat tax was introduced in Hungary between 2010 and 2013. This reform was studied by Tóth and Virovác (2013) in a static microsimulation model, finding that tax revenues decreased as a result of the flat tax. In Georgia, Torosyan and Filer (2014) find evidence that the extent of income underreporting decreased following flat tax reform.

We extend previous work by comparing patterns following reform with those in arguably similar countries that did not undertake a parallel reform, using trends in non-reforming countries the CEE region as a control for general trends in the region. Such a comparison will provide evidence regarding whether or not tax flattening and simplification do, in fact, have the ability to reduce the hiding of economic activity.

Methodology

To estimate the shadow economies in the selected countries, we use the endogenous switching regression methodology developed in Lichard, Hanousek, and Filer (2013). This methodology allows us to relax the assumption that wage and salary workers do not evade that is still crucial in most recent tax evasion studies based on microeconomic data.⁶ This identifying assumption is arguably especially untrue for countries in our sample.⁷ Although the difference-in-differences methodology used by Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter (2009) does not

⁶ The seminal study whose identification strategy hinges on this assumption is Pissarides and Weber (1989). Other examples of the use of this identification include Lyssiotou, Pashardes, and Stengos (2004; Engström and Holmlund, 2009; Tedds, 2010; Ekici and Besim, 2014; Hurst, Li, and Pugsley, 2014; Kukk and Staehr, 2014)

⁷ For the evidence about the extent of the ‘envelope’ or ‘under the table’ wages problem in the EU, see Commission (2007)

need this assumption it relies on a panel data that is not widely available in other countries. Even more critically, their difference-in-difference methodology only estimates the change in the size of the shadow economy, not its levels as we as we are able to do.

Below we briefly summarize our methodology.⁸ The most important identifying assumptions are that: 1.) evaders underreport their income both on tax returns and in household budget surveys, and 2.) consumption is measured without systematic error. Both of these assumptions are not only common in the literature cited above, but also are supported by empirical evidence (see e.g. Brewer and O’Dea, 2012; Kreiner, Lassen, and Leth-Petersen, 2013 and Hurst, Li, and Pugsley, 2014). Under these assumptions we can argue, as Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter (2009) do, that evaders have a higher consumption-income gap (the difference between log-consumption and log-income) than non-evaders. Thus, the system to be estimated consists of three equations: two equations describing the consumption-income gap for the evading and non-evading groups, respectively, and a switching equation that describes the decision to evade. These can be specified as:

Consumption gap for evaders:

$$(\log C_i - \log Y_i^R)_e = \mathbf{X}_i \boldsymbol{\beta}_e + \varepsilon_{e,i} \quad (1)$$

Consumption gap for non-evaders:

$$(\log C_i - \log Y_i^R)_{ne} = \mathbf{X}_i \boldsymbol{\beta}_{ne} + \varepsilon_{ne,i} \quad (2)$$

Equation for switching between evading and non-evading regime:

$$y_i^* = \mathbf{Z}_i \boldsymbol{\delta} - \varepsilon_{s,i} \quad (3)$$

$$\log C_i - \log Y_i^R = \begin{cases} (\log C_i - \log Y_i^R)_e & \text{iff } y_i^* \geq 0, \\ (\log C_i - \log Y_i^R)_{ne} & \text{iff } y_i^* < 0, \end{cases} \quad (4)$$

where \mathbf{X}_i is the matrix of characteristics of household i that determine its consumption-income gap (with small variation between countries, these contain these contain preference shifters such as age of head and spouse (if any) and their squares, number of children, number of elderly, and education of head and spouse) while y^* is a latent (unobserved) variable that can

⁸ For a more detailed justification and explicit derivation of these equations, see Lichard, Hanousek, and Filer (2013).

be thought of as the propensity to evade. Households will evade if the returns from evasion are higher than the costs (including psychic costs, such as disutility coming from risk aversion or dishonesty). Both costs and returns are heterogeneous across households.

To help in identification, we maintain exclusion restrictions such that \mathbf{Z}_i contains a sub-set of variables that \mathbf{X}_i does not.⁹ Under some assumptions about the error term, in particular joint normality, we can estimate the coefficients in Equations (1)-(4) using maximum likelihood techniques.

$$\ln \sum_{i=1}^N \ln \left\{ \frac{L(\boldsymbol{\beta}_e, \boldsymbol{\beta}_{ne}, \delta, \sigma_e, \sigma_{ne}, \sigma_{e,\delta}, \sigma_{ne,\delta})}{\sigma_e} \Phi \left(\frac{\mathbf{z}_i \boldsymbol{\delta} - \frac{\sigma_{e,s}}{\sigma_e^2} e_{e,i}}{\left(1 - \frac{\sigma_{e,s}^2}{\sigma_e^2}\right)^{.5}} \right) \phi \left(\frac{e_{e,i}}{\sigma_e} \right) + \frac{1}{\sigma_{ne}} \left[1 - \Phi \left(\frac{\mathbf{z}_i \boldsymbol{\delta} - \frac{\sigma_{ne,s}}{\sigma_{ne}^2} e_{ne,i}}{\left(1 - \frac{\sigma_{ne,s}^2}{\sigma_{ne}^2}\right)^{.5}} \right) \right] \phi \left(\frac{e_{ne,i}}{\sigma_{ne}} \right) \right\} \quad (5)$$

The magnitude of income underreporting can be computed as the average difference between the consumption-income gaps of evaders and non-evaders weighted by the estimated probability of being in the evading regime:¹⁰

$$Ev\hat{a}sion = \frac{1}{N} \sum_{i=1}^N (\mathbf{X}_i \hat{\boldsymbol{\beta}}_e - \mathbf{X}_i \hat{\boldsymbol{\beta}}_{ne}) \cdot \hat{P}_{e,i}. \quad (6)$$

This probability can be computed based on Bayes' rule as:

$$\hat{P}_{e,i} = \frac{\frac{1}{\hat{\sigma}_e} \Phi \left(\frac{\mathbf{z}_i \hat{\boldsymbol{\delta}} - \frac{\hat{\sigma}_{e,s}}{\hat{\sigma}_e^2} e_{e,i}}{\left(1 - \frac{\hat{\sigma}_{e,s}^2}{\hat{\sigma}_e^2}\right)^{.5}} \right) \phi \left(\frac{e_{e,i}}{\hat{\sigma}_e} \right)}{\frac{1}{\hat{\sigma}_e} \Phi \left(\frac{\mathbf{z}_i \hat{\boldsymbol{\delta}} - \frac{\hat{\sigma}_{e,s}}{\hat{\sigma}_e^2} e_{e,i}}{\left(1 - \frac{\hat{\sigma}_{e,s}^2}{\hat{\sigma}_e^2}\right)^{.5}} \right) \phi \left(\frac{e_{e,i}}{\hat{\sigma}_e} \right) + \frac{1}{\hat{\sigma}_{ne}} \left[1 - \Phi \left(\frac{\mathbf{z}_i \hat{\boldsymbol{\delta}} - \frac{\hat{\sigma}_{ne,s}}{\hat{\sigma}_{ne}^2} e_{ne,i}}{\left(1 - \frac{\hat{\sigma}_{ne,s}^2}{\hat{\sigma}_{ne}^2}\right)^{.5}} \right) \right] \cdot \phi \left(\frac{e_{ne,i}}{\hat{\sigma}_{ne}} \right)}.$$

⁹ Lichard, Hanousek and Filer (2013) show, however, that results of our estimation technique are invariant to identification using functional form alone.

¹⁰ Under the initial assumption of correct consumption reporting, the expected value of the difference in the gaps for both regimes of household i is equal to: $\mathbb{E}[(\log C_i - \hat{\log} Y_i^R)_e - (\log C_i - \hat{\log} Y_i^R)_{ne}] = \mathbb{E}[(\log \hat{Y}_{t,e}^R - \log \hat{Y}_{t,e}^R)]$.

In order to make our results robust to outliers and initial conditions, we employ Monte Carlo methods. Bootstrap samples are formed by drawing with replacement N households from the original sample where N is set to be equal to original sample size. We then approximate an initial value of consumption-income gap that splits the sample between evaders and non-evaders by dividing the sample along the sample mean and first, second, and third sample quartiles of the consumption-income gap. A dummy indicator of this split is then regressed on \mathbf{Z}_i in a probit model to obtain initial values of δ . To get initial values of β , we estimate Equations (1) and (2) through OLS separately for each group split by this initial guess. These estimates are used as initial values for the maximization of maximum likelihood equation (5). Finally, we choose the results with the highest log-likelihood ratio as the value for that sample as final. This procedure is repeated 250 times to get 250 estimates of the shadow economy for each country and year. We then compute mean and standard errors of these estimates, which represent the final estimate of the size of the shadow economy for the given country-year pair and its confidence interval.

Data

The methodology describes in the previous section is applied to household budget surveys collected by the statistical offices of respective countries, with exception of Russia where the estimate is obtained using the Russia Longitudinal Monitoring Survey conducted by Higher School of Economics and ZAO Demoscope together with Carolina Population Center of the University of North Carolina at Chapel Hill and the Institute of Sociology of the Russian Academy of Sciences.¹¹ A summary of the data for each country can be seen in Table 2.

Table 2: Summary of the Household Budget Surveys of respective countries

Country	Sample size (Households with working heads)	Years used in this study
Czech Republic	2,138-2,572	2000-2010
Slovakia	1,345-2,991	2000-2002; 2004-2010
Croatia	406-1,222	2000-2005; 2007
Serbia	988-2,494	2002; 2003; 2007

¹¹ RLMS-HSE sites: <http://www.cpc.unc.edu/projects/rlms-hse>; <http://www.hse.ru/org/hse/rlms>

Ukraine	3,958-4,739	1999-2007
Russia	2,108-3,498	1998; 2000-2007
Armenia	4,527-5906	2004; 2007
Georgia	3,388-3,833	2003-2007

When choosing the variables contained in \mathbf{X}_i and \mathbf{Z}_i , our goal was to include similar characteristics for all countries (as the information set differs between the datasets). Thus, following our earlier work (Lichard, Hanousek, and Filer 2013), \mathbf{X}_i contains information on preference shifters such as the age of household head and spouse/partner (if any) and its square, number of productive-age adults, retirees and children, education of head and spouse/partner and whether the head of household is female. \mathbf{Z}_i includes information from \mathbf{X}_i plus job characteristics for the head and spouse (whether they are public/private employees or self-employed, whether they are blue or white collar workers, and the size of the employer and whether it is foreign or domestic where available).

We define disposable income Y_i^R as the total gross income of the household from all sources minus all taxes and obligatory payments (such as health insurance, which is technically a tax in the Czech Republic). To account for possible consumption smoothing and precautionary saving (which may be greater for certain types of households), net dissavings were included in income. We define consumption C_i as the sum of expenditures on non-durable goods, more specifically, expenditure on food both at home and away from home, alcohol and tobacco,¹² clothing and footwear, rents, utilities and other services. The implicit assumption in Equations (1)-(4) is that the preferences over nondurables and durables are homothetic. This assumption is often used in the literature (see Eichenbaum & Hansen, 1990; Ogaki & Reinhart, 1998; or Gorodnichenko, Martinez-Vazquez, & Sabirianova Peter, 2009). Moreover, in our previous work (Lichard, Hanousek, & Filer, 2013) we studied the sensitivity of our methodology to different measures of consumption (such as food only, nondurables excluding rent etc.) and to different

¹² We recognize that consumption of alcohol and tobacco is likely to be under-reported (Stockwell et al. 2004) but have no reason to believe that this under-reporting is correlated with under-reporting of income.

exclusion restrictions including identification by functional form alone and found that estimates of the shadow economy were robust to these modifications.

Results

The evolution of the shadow economy over time in the pairs of countries can be seen in Figures 1-4¹³. These figures show the evolution of the shadow economy over time as a share of income reported in the survey and as a share of estimated true income, respectively.¹⁴

The results of t-tests of difference in differences estimators (Table 3) do not seem to support the claims of flat tax proponents about its effect on tax evasion. With the exception of Russia (where there is 7 percentage points decrease) and Serbia (with a 14.8 percentage point decrease), the shadow economy either stayed the same or slightly increased, as in case of Slovakia (by 4.2 percentage points). It should be noted that our estimate for the effect of Russian flat tax reform (a 7 to 11 percentage point decrease with standard errors of 1.7 points) is not significantly different from the result obtained by Gorodnichenko, Martinez-Vazquez, and Sabirianova Peter (2009), who found between a 9 and 12 percentage point decrease (depending on specification) with standard errors of approximately three points.

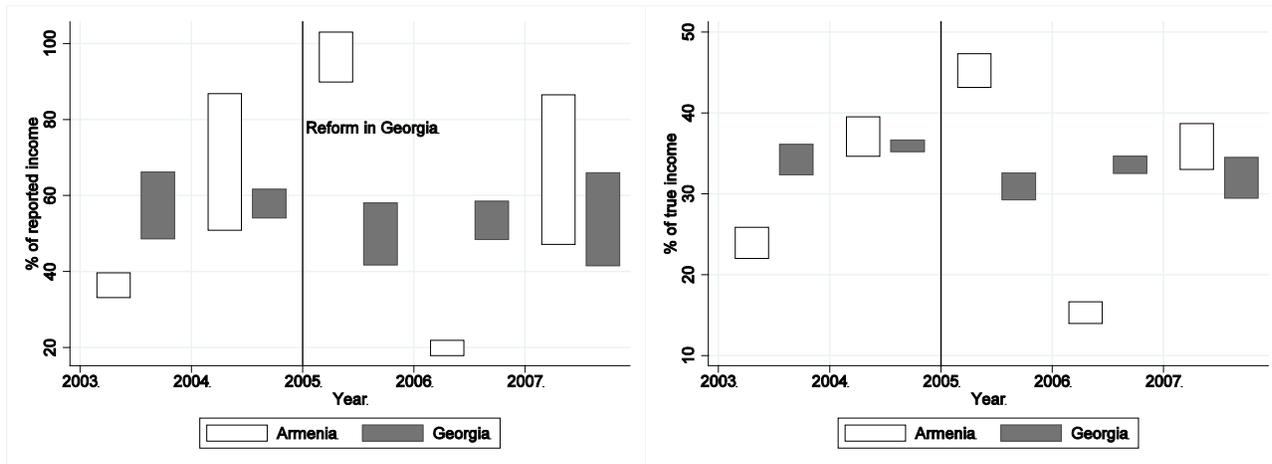
¹³ Detailed results of the maximum likelihood estimations for all countries are available upon request.

¹⁴ The relationship between reported and true income is $share_{true} = \left(1 - \frac{1}{(share_{reported}+1)}\right)$.

Figure 1: Shadow economy in Armenia and Georgia

a) as a percentage of reported income

b) as a percentage of total income

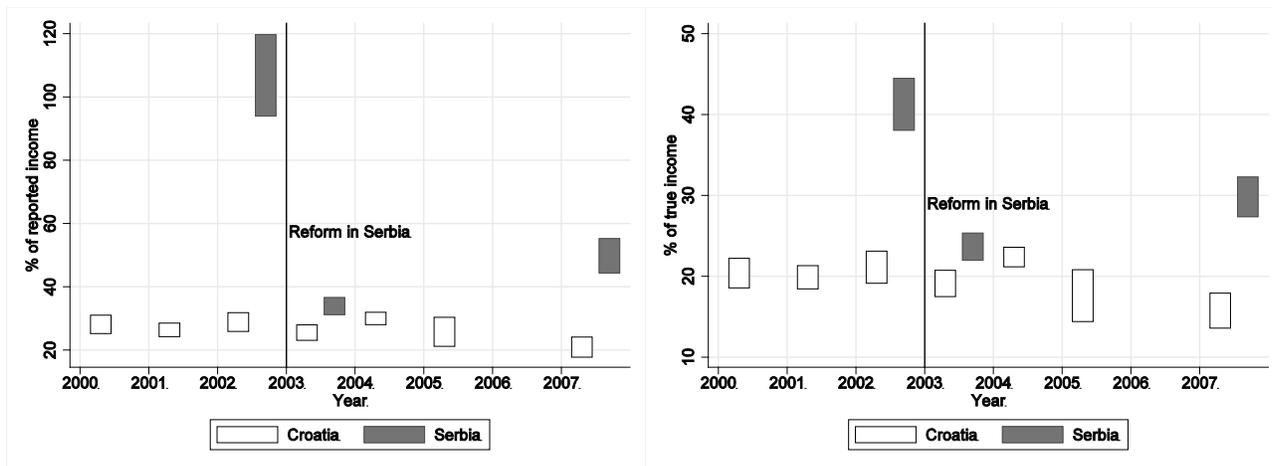


Bars represent 95% confidence interval

Figure 2: Shadow economy in Croatia and Serbia

a) as a percentage of reported income

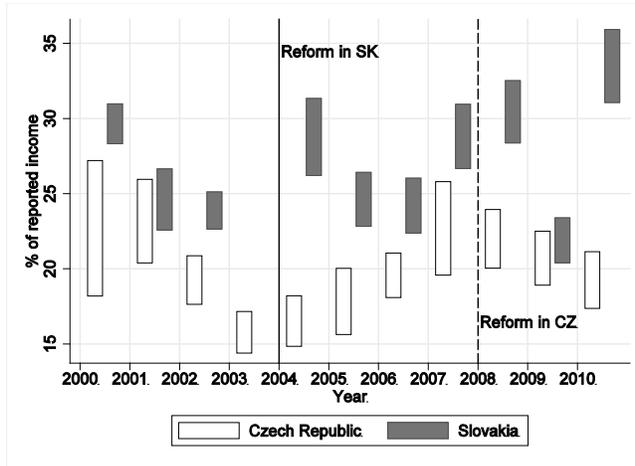
b) as a percentage of total income



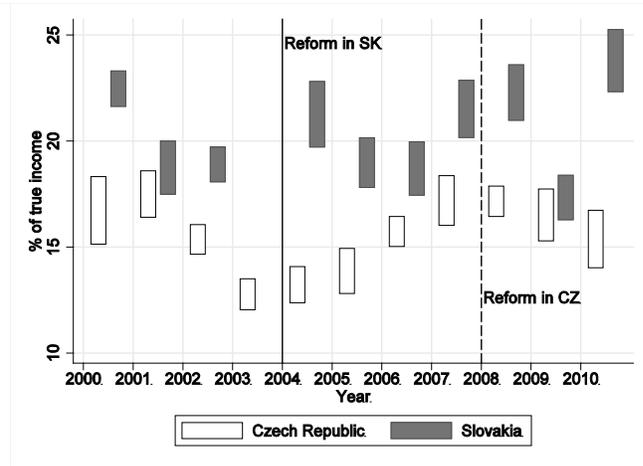
Bars represent 95% confidence interval

Figure 3: Shadow economy in Czech Republic and Slovakia

a) as a percentage of reported income



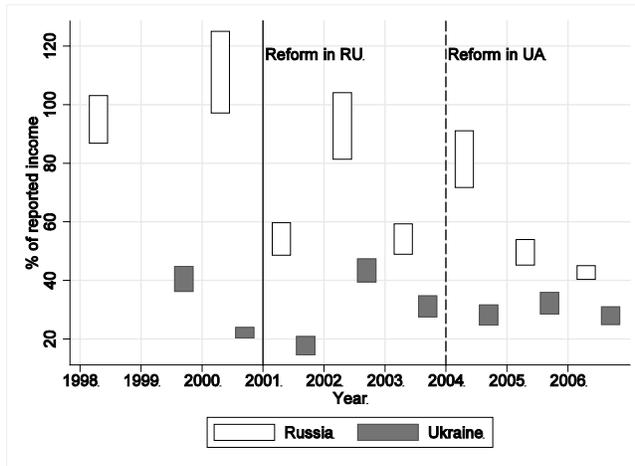
b) as a percentage of total income



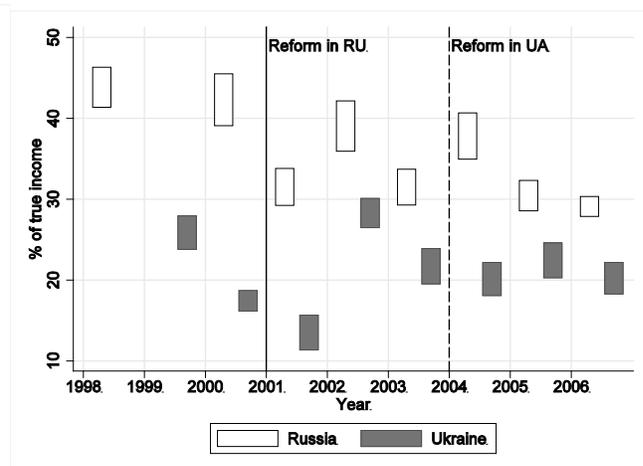
Bars represent 95% confidence interval

Figure 4: Shadow economy in Russia and Ukraine

a) as a percentage of reported income



b) as a percentage of total income



Bars represent 95% confidence interval

Table 3: Estimates of the changes in the size of the shadow economy

	Year of the reform included			Year of the reform excluded		
	Difference in differences	SE	p-value	Difference in differences	SE	p-value
Czech Republic	0.675	0.806	0.402	-0.965	0.823	0.241
Slovakia	4.180	0.781	0.000	1.649	0.747	0.027
Russia	-7.039	1.674	0.000	-11.150	1.667	0.000
Ukraine	2.573	1.661	0.121	-1.815	1.525	0.234
Georgia	-3.271	14.015	0.815	-2.032	14.015	0.885
Serbia	-14.791	2.461	0.000	-9.525	2.494	0.000

Possible interpretations

Our results suggest that the marginal tax rate may not be the most important driver of the size of the shadow economy, as our estimates do not show a significant decrease of tax evasion after the flat tax reform in most countries. Hanousek and Palda (2004) argue that tax evasion is highly correlated with satisfaction of taxpayers with the government. This would imply if taxpayers' satisfaction with public sector is decreases at the same time as taxes are reformed, effects may be offsetting. To investigate this possibility, we turn to widely used European Value Survey (EVS 2011). Table 4 summarizes the main variables of interest from the third (1999) and forth (2008) rounds of this survey. Unfortunately, two out of the five countries that adopted a flat tax reform are not present in the third round of the EVS, making any rigorous statistical analysis almost impossible. Thus, our discussion here should be taken at best as indicative.

In Table 4 we compare changes in responses between two waves of the EVS. We analyze how views on government, civil service, justification of accepting a bribe, cheating on taxes and paying cash to avoid taxes changed between 1999 and 2008. We conducted two tests. The first is a classical difference in mean test (where the sign of this test indicates the direction of the change) conducted using Kendall's tau-b statistic presented on the first line of each cell while the second line contains the p-value of the corresponding (non-parametric) Pearson chi-square test.

The first three columns correspond to different measures of a satisfaction with the governmental services. Because we analyze difference V4-V3, negative values indicate an improvement in satisfaction. The remaining three columns describing justifications of bribery, cheating on taxes and paying cash to avoid taxes have the same trend interpretation. Again, positive values show worsening while negative values indicate improvement.

Table 4. Test of changes in attitudes concerning satisfaction with government, cheating, evasion, and corruption.

	Civil service	Government	Democracy	Accepting a bribe	Cheating on Taxes	Paying cash to avoid taxes
	(a)	(b)	(c)	(d)	(e)	(f)
Armenia	.	.	.	.	.	.
Croatia	0.061 0.304	-0.665 ^a 0.000	-0.174 ^a 0.000	0.029 0.243	-0.095 0.338	0.398 ^a 0.006
Czech Rep	-0.131 ^a 0.008	-0.474 ^a 0.000	-0.008 0.070	0.444 ^a 0.000	0.578 ^a 0.000	1.006 ^a 0.000
Georgia	.	.	.	.	.	.
Russia	-0.307 ^a 0.000	-2.714 ^a 0.000	-0.731 ^a 0.000	0.504 ^a 0.000	0.280 ^b 0.014	0.314 ^b 0.030
Serbia	.	.	.	.	.	.
Slovakia	-0.276 ^a 0.000	-1.674 ^a 0.000	-0.392 ^a 0.000	-0.322 ^a 0.614	0.307 ^a 0.000	-0.299 ^b 0.684
Ukraine	0.156 ^a 0.000	0.375 ^a 0.023	0.051 0.075	-0.340 ^a 0.000	-0.973 ^a 0.000	-0.856 ^a 0.000

Notes: First row contains the results of the standard test of mean differences in responses between two consecutive European Value Surveys (Waves 3 and 4). Second row contains p-values of the Pearson chi-square test for non-parametric testing of the same H_0 hypothesis, i.e., that there was not change in country responses between two consecutive European Value Surveys (Waves 3 and 4).

Symbols ^a and ^b denote statistical significance at the 1% and 5% level, respectively.

Armenia, Georgia and Serbia were not included in the wave 3.

The columns correspond to the following survey questions:

- How much confidence in: civil service (1-most – 4-none)
- View government (1-very good – 10-very bad). Note that survey responses were inverted from the phrasing of the question for consistency
- Are you satisfied with democracy (1-most satisfied – 4-least satisfied)
- Do you justify: accepting a bribe (1-never – 10-always)
- Do you justify: cheating on tax (1-never – 10-always)
- Do you justify: paying cash to avoid taxes (1-never – 10-always)

From Table 4 we see that Russia (a country that exhibited a significant fall of the size of the shadow economy after the reform) tends to exhibit the biggest improvements in satisfaction with civil service and government. On the other hand in the Czech Republic the attitude towards unjustified claim of benefits, tax evasion and corruption slightly improved, while the change in other dimensions is insignificant in contrast to Slovakia where the attitudes in all dimensions but unjustified claiming of benefits worsened significantly. This may have affected the relative propensities to hide income in a way that counteracted the effects of the change in Slovak relative marginal tax rates.

The results presented in Table 4 suggesting that satisfaction with the public services may offset moderate changes in the marginal tax rate are corroborated by Table 5, which presents Transparency International's Corruption Perception Index and our estimates of the size of the shadow economy for year 2007. The Spearman correlation coefficient between these two measures is -0.55^{15} implying that countries with a higher CPI (with less perceived corruption) tend to have lower sizes of the shadow economy. Of course, we are unable to make any claims about causality. It is quite possible that knowledge of the size of the hidden economy affects survey responses regarding the existence of corruption.

Table 5: Shadow economy estimates and CPI in 2007

Country	% of reported income	CPI
Armenia	67%	3
Croatia	21%	4.1
Czech Republic	23%	5.2
Georgia	54%	3.4
Russia	43% (2006)	2.3
Serbia	50%	3.4
Slovakia	29%	4.9

¹⁵ Although due to the low number of observations, the coefficient is slightly insignificant at 10% level, so any conclusion here is made with caution.

Cyclical of the shadow economy

Another pattern evident in our results is an apparent cyclical of the relationship between unreported income and actual income levels. This could suggest a connection to the business cycles as measured by the official income statistics. Many theoretical models imply that the share of declared income is such a function of actual income, although these models often find the sign of the relationship ambiguous¹⁶

Empirically, however, there is strong previous evidence that cyclical components of the hidden and official economies are not only positively correlated, but that there may be Granger causality going from measured to hidden GDP (Giles, 1997a; Gilles, 1997b, Giles, 2002; Bajada 2003). Our results exhibit a similar positive association, as can be seen in Figures 5 through 8, which show plotted cyclical component of GDP estimated using a Hodrick-Prescott filter¹⁷ and our estimates of the shadow economy for countries for which we had at least six years of data. But because not even these countries have a sufficient number of observations to implement more sophisticated Granger causality tests as in the above studies, we provide only a simple correlation between the cyclical component and our estimates. Table 6 shows that most countries exhibit a positive correlation, in line with the previous research. The only country exhibiting negative association is Russia, which is probably due to the decrease in tax evasion, which is probably caused by the already estimated effect of the flat tax reform.

¹⁶ For example, in the seminal Allingham and Sandmo's model, the sign of the effect depends on whether the relative risk aversion is constant, decreasing, or increasing.

¹⁷ Given the annual periodicity of our data, we used a smoothing parameter of 6.25, as recommended by Ravn and Uhlig (2002).

Figure 5: Croatia

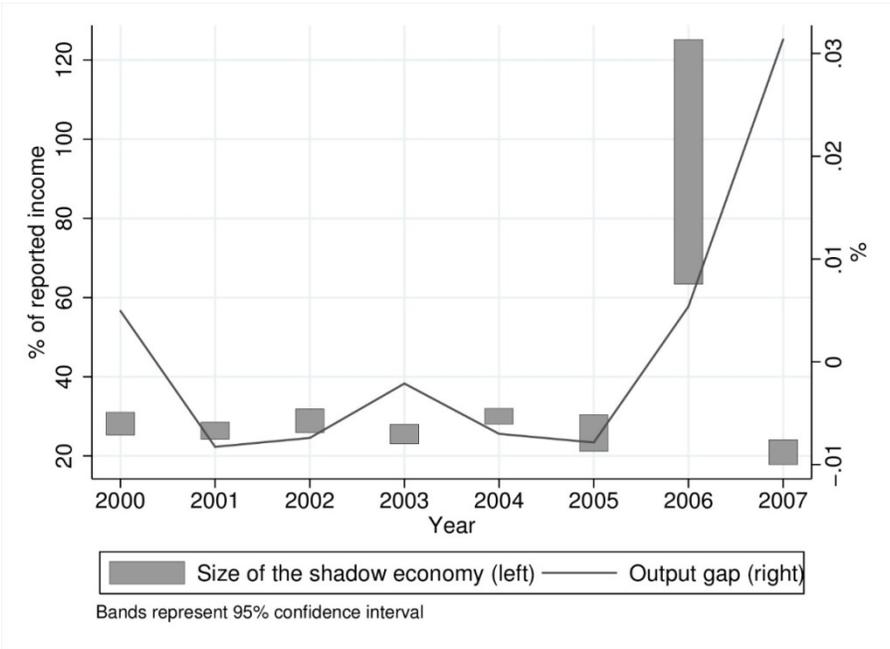


Figure 6: Czech Republic

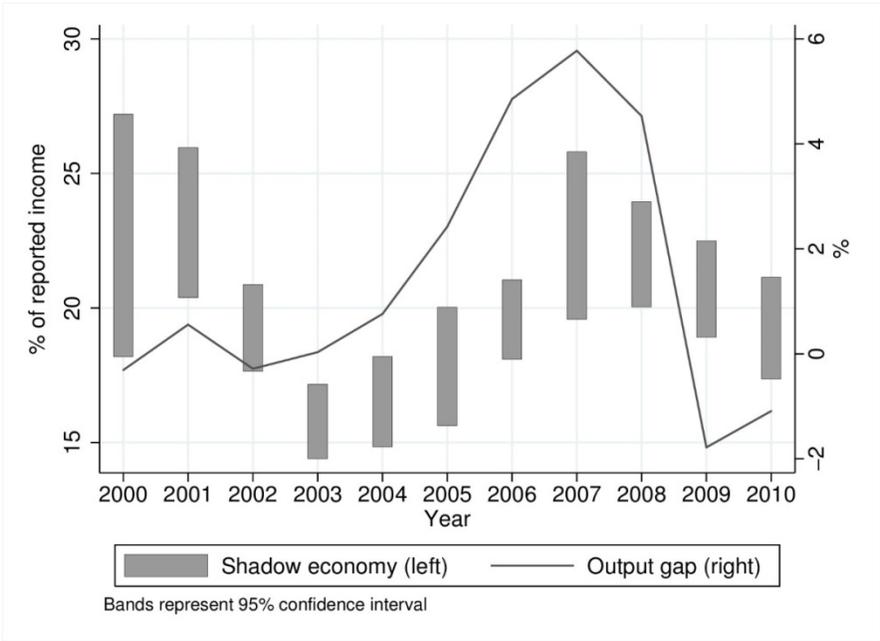


Figure 7: Russia

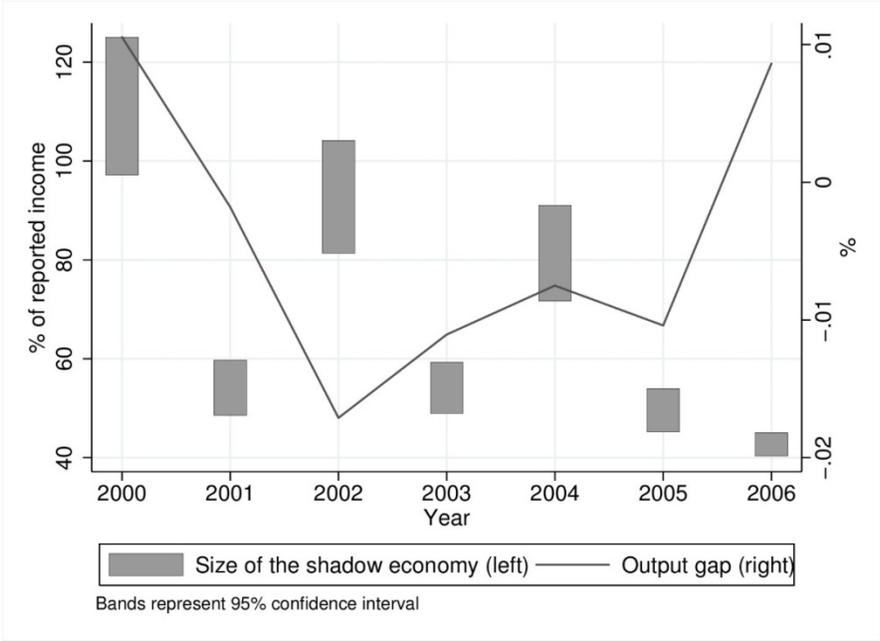


Figure 8: Slovakia

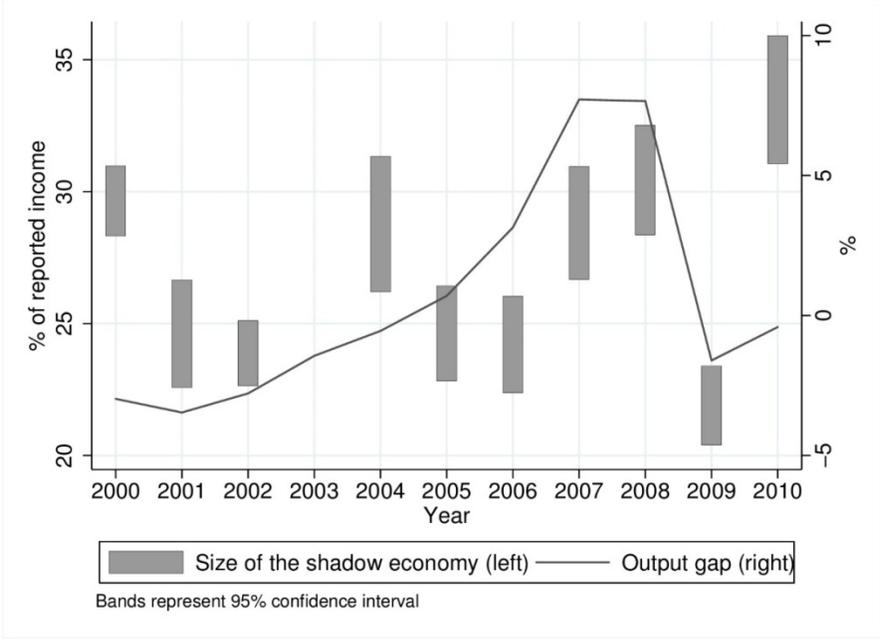


Table 6: Correlation between the cyclical component of GDP and the hidden economy

Country	Correlation
Croatia	0.246
Ukraine	0.419
Russia	-0.663
Czech Rep	0.324
Slovakia	0.299

Conclusion

This paper contains estimates of the tax evasion effect of flat tax reforms in selected transition countries. Our results do not provide a great deal of empirical support for the often-proposed advantage of the flat tax reform in leading to a decrease in tax evasion. The main insight for policy is that the flat tax reforms are not a surefire way to decrease the size of the shadow economy, as there seems to be an interaction between the satisfaction of individuals with public policies and moderate decreases of the marginal tax rate. In countries, where the satisfaction went down and corruption grew, flat tax reform does not seem to have a large effect. This suggests that a fight against shadow economy may need to combine lower marginal tax rates (flatter taxes) with efforts to increase the perceived efficiency and quality of public services, and to decrease the perceived corruption.

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