

A Cross Section Approach to Measuring the Shadow Economy

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ABSTRACT

The size of the shadow economy has been investigated by a number of different methodologies. A common approach is the use of macroeconomic data to investigate, for example, the relationship between the money supply and GDP and associate the error term with the shadow economy. We extend this approach to the use of cross section survey data based on individual responses to estimate the relative size of shadow economy household income as a proportion of declared income in 2002. The analysis suggests that the relative figures for Slovakia and the Czech Republic are 23.2% and 21.8% respectively.

JEL Classification: O17, H26,

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1. Introduction

There are various definitions of the hidden or shadow economy. On occasion it is used to refer to all transactions not included in the official statistics, thus including e.g. production within households (Feige, 1979, Carter, 1984). Our concern in this paper is with a narrower definition relating to activities, which should be recorded, and hence taxed, but are not either because they are not reported in full or because they are not reported at all (Tanzi, 1980 and Macafee, 1980). The shadow economy as we are interpreting it is therefore the source of a potentially serious loss of revenue to governments, resulting in the possible under funding of public service and an 'unfair' burden on honest citizens. It represents the part of economic activity, which goes unrecorded primarily for reasons related to criminal activity. The most frequent example is people simply trying to evade the payment of taxes.

Estimates of the size of the hidden economy vary both between countries over time and also for different countries at the same time. According to Dixon (1999) the size of the hidden economy in 1990 varied from 5.1% of GNP for Austria to 23.4% for Italy, whilst in 1980 the respective figures were 3.1% and 16.7%. There is a general consensus that the hidden economy has been growing in recent years and that it is highest in countries with a large tax burden. But simply because the hidden economy is hidden, its measurement is difficult. Techniques, frequently sophisticated, have been devised to allow such measurement, some of which are discussed below. But different techniques often differ substantially in their estimates of the size of the hidden economy. Inevitably all such methods make assumptions and it is in these assumptions where their weakness lies. This also will be discussed below.

Yet the area is of a considerable importance for several reasons. Firstly, with significant errors in the data, testing economic relationships such as the consumption function and building macroeconomic models based on these estimated relationships, is a hazardous business. More pertinently from a country's point of view, governments are being deprived of revenue, with the probable result that the size of the public sector and public transfers falls below its 'optimal' level and also the burden of financing of the public sector falls unfairly on the 'honest' part of society. Moreover illegal activity in one area, such as avoiding taxes, may have knock on effects in other areas, such as the taking of illegal drugs, breaking speed limits and so on. With the process of European integration the policy

implications of tax evasion are also important. It has impacts on the process of tax harmonization, but it is also central to competitive policy. There is little point in achieving harmonization of nominal taxes if effective taxes vary widely between the member countries. Other things being equal there will be the tendency for both firms and workers to move from low tax evasion to high tax evasion countries. This may prove a particular problem in border areas. The other problem to mention in this respect is that both the contributions of member countries and their share of the EU budget along several dimensions depend upon their measured GDP. Understating GDP can lead to smaller contributions and greater benefits for the country, which may undermine support for the EU amongst those other countries with a relatively small hidden economy.

The subject is closely related to tax evasion. Andreoni et al. (1998) estimate that in the US over 25% of all taxpayers underpaid their taxes by \$1,500 or more in 1988. In developed countries tax evasion is frequently estimated to be at about 20% level of tax revenue. In the USA in 1992 lost revenue through underpaid federal income taxes was estimated at \$95.3 billion. In developing countries the problem appears worse. Krugman et al. (1992), for example, estimate tax evasion to be 50% for income tax in the Philippines. The literature has revolved around several different focal points. Virtually all theoretical models of tax evasion conclude that tax evasion increases with income, i.e. richer people are more likely to evade than poorer people, although there is no clear theoretical indication of how tax rates affect the evasion decision. Yitzhaki (1974) using a variant on the Allingham and Sandmo (1972) model comes to the opposite conclusion that tax evasion declines with income. Clotfelter's (1983) empirical study found evidence that evasion increased with both income and tax rates. Pommerehne and Frey (1992), using data from Swiss cantons, found similar results, as did Joulfaian and Rider (1996). However, the evidence is not unambiguous, and Alm, Bahl and Murray (1993) find, in a study based on Jamaican data, the less intuitively plausible result that evasion declines with marginal tax rates. Feinstein (1991) also finds a significant *negative* relationship between marginal tax rates and evasion and *no* relationship with income. As with the shadow economy itself, one of the problems is obtaining data on evasion. To circumvent this problem, several economists have used laboratory experiments where individuals are asked hypothetical questions about their behavior (e.g. Webley et al, 1991 and Alm, Jackson and McKee, 1992). Typically these results find a positive association between tax rates and evasion.

The purpose of our research is to measure the size of the hidden economy in two selected central European countries: the Czech Republic and the Slovak Republic. These countries share a common past but have faced independent evolution of their systems after the split of their common country. The paper proceeds as follows. First, there follows a theoretical discussion of the determinants of shadow economy participation. A key aspect of this will be the role of law abidance or the law-abiding citizen. We then discuss a traditional approach, based on macroeconomic data, to the task of measuring the size of the shadow economy after which we suggest an alternative, more micro-orientated approach. An empirical section will follow based on a specially commissioned survey in the Czech and Slovak Republics. Finally, a brief concluding section examines some implications of our analysis.

2. Theory

2.1 Participating in the Shadow Economy

Recent work on measuring the shadow economy can be found in Dixon (1999), Bhattacharyya (1999), Tanzi (1999), Thomas (1999) and Giles (1999). More specifically with respect to the transition countries there is the work of Lacko (1998, 2000) and Hanousek and Palda (forthcoming). Participation in the shadow economy is, as we have said, closely linked to tax evasion and for this there is the recent survey by Andreoni, Erard and Feinstein (1998). The gist of this research is that participation in the shadow economy will increase with tax rates, decline with the probability of being caught and the severity of the consequences of being caught. Recent research (Orviska and Hudson, 2003) also suggests that it is linked with law abidance.

The concept of law abidance, or the law-abiding citizen, can be found in the legal and political science literatures. In what we regard as an important paper, Nance (1997) argues that current economic analysis of the law is a product of standard microeconomic analysis heavily influenced by American Legal Realism, resulting in an analysis based on the perspective of Holmesian (1897) “bad man” who sees prohibited legal actions as merely costs or benefits to be taken into account. This is fully reflected in the economics literature on the shadow economy. In general, a maximizing individual brings into his or her calculations the probability of being caught and the penalties of being caught, and the question of honesty seldom figures explicitly in discussions of the shadow economy or tax evasion. However, without being mentioned in any detail honesty does seem to underlie many of the

discussions on tax evasion. For example, Andreoni et al. (1998) mention variations on the word 'honesty' several times, but never devote as much as a single sentence to discussing how basic attitudes to honesty may impact on tax evasion. We find this difficult to understand. Much of mainstream economics is predicated on the assumption that economic agents act within the law (see Nance, 1997, for examples). The standard economics literature on criminal activities has been heavily influenced by Becker (1968). However, not all economic analyses of wrong doing have adopted the Beckerian approach. For example, Brennan and Buchanan (1985) argue against this position concluding that the legislated punishment is not to be construed simply as the "price" of an alternative course of action; it also symbolizes that a "wrong" has been committed and it is to be expected that the "moral dimension" will itself moderate illegal behavior. Thus, given that tax evasion is illegal, it seems reasonable to question how concepts of honesty can be brought into the analysis, both theoretically and empirically.

Until recently, the clearest reference to honesty within the context of tax evasion came in the work of Erard and Feinstein (1994) who link together the twin concepts of guilt and shame as relevant in the tax evasion decision. Shame is closely linked to the concept of stigma, as Erard and Feinstein write about it being triggered by others learning of the tax evasion. Guilt is defined as arising when "an individual realizes that he has acted irresponsibly and in violation of a rule or social norm he has previously internalized either by committing a specific wrongful act or by failing to fulfill a recognized ethical duty". This seems to encompass both the concepts of law abidance and civic duty, and, being as the latter has been recognized in the literature (Frey, 1997), it also seems reasonable to recognize the former.

In a recent paper Orviská and Hudson (2003) have explicitly explored the link between tax evasion and law abidance. They use sample survey data from a randomly chosen group of people in the UK to analyze this problem using hypothetical questions on tax evasion. The results suggest that evasion is condoned by a large proportion of the population, who are particularly ready to take advantage of someone else's evasion. There is evidence that people are deterred from tax evasion by the consequences of being caught. But most critically from our current perspective they find empirical analysis, which supports the importance of 'law abidance' in deterring tax evasion. The evidence seems clear the law abiding citizen appears considerably less likely to engage in tax evasion and thus

the shadow economy, not simply out of fear of the consequences of being caught, but also because he/she is basically law abiding.

2.2 Measuring the Shadow Economy: Traditional Approaches

The first attempt at estimating unrecorded national income was done by Kaldor (1956). Over the years the methodology has got steadily more sophisticated. The methodology employed by Bhattacharyya (1990) assumes that an economic activity M (frequently narrow measures of the money supply) is required in all k sectors/regions or industries of an economy and the level of activity M is determined by the income and other variables (\mathbf{Z}_{jt}) related to the k sectors. The assumption is then made that:

$$M_{jt} = f_j(Y_{jt}, YH_{jt}, \mathbf{Z}_{jt}) \quad (1)$$

In general the j 'th sectoral/regional observations on M are unavailable and hence we estimate:

$$M_t = \sum f_j(Y_{jt}, YH_{jt}, \mathbf{Z}_{jt}) \quad (2)$$

Y is 'legitimate' or measured income, YH_{jt} , hidden income. YH_{jt} is, of course, unobservable. Instead various proxies are used, which are expected to result in the best fitting equation chosen [Bhattacharyya (1990) effectively used, within the context of a loglinear equation applied to the whole economy; Ramsey's (1969) RESET procedure]. In effect this involved a linear combination of powers (2 to 4) of Y_t . This approach does have its weaknesses, not least in the use of the RESET variable. In addition this type of approach frequently ignores the possibility that money demand (or whatever proxy is used) may be changing for reasons unrelated to the size of the hidden economy. Other papers, which use or discuss methods based on currency demand, include Marelli (1984), Tanzi and Shome (1993) and Schneider (1997).

In what is in reality a variation on this theme Kaufmann and Kalibera (1996) estimate the size of the hidden economy on the assumption that the difference between the growth rates of measured GDP and electricity consumption can be attributed to the growth in the shadow economy. Under this and other

simplifying assumptions they found that the size of the shadow economy varied between 5.8% and 17.6% in Slovakia and 6% and 17.6% in the Czech Republic. Hanousek and Palda (forthcoming) report that people perceive that 42.7% of people in Slovakia and 38.3% in the Czech Republic participate in the shadow economy. Lacko (2000) in an innovative paper also used time series data on aggregate electricity consumption for ten central and east European countries in an econometric analysis. On this basis the estimates for Slovakia varied between 21.7% and 34.1% and for the Czech Republic from 21.7% to 31.8%. This approach is subject to the criticisms that (i) not all shadow economy activities require a considerable amount of electricity and other energy sources can be used and (ii) that shadow economy activities do not take place solely in the household sector. In more recent years the figure for the Czech Republic was consistently less than that for Slovakia and by 1995 the gap had risen to 6.6%. Schneider and Enste (2000) give estimates on the demand for electricity and money of a shadow economy somewhere between 9%-16% in both Slovakia and the Czech Republic.

An alternative approach was pioneered by Frey and Weck-Hannemann (1984), when using the MIMIC (Multiple Indicators, Multiple Causes) approach first introduced by Zellner (1970). Essentially this approach treats the size of the underground economy as an unobservable 'latent variable'. The latter is linked on one hand to a set of observed 'causal variables', which are believed to be key determinants of the hidden economy. Frey and Weck-Hannemann used the following determinants of the hidden economy: direct tax share, indirect tax share, share of social security contributions, increase in direct tax share, share of public officials, tax immorality, rate of unemployment, per capital disposable income. The 'indicator' variables they used, all of which are assumed to be partly constituted by the latent variable 'the hidden economy', were the male participation rate, hours worked and the growth of real GDP. Of course the effectiveness of this approach is determined by the appropriateness of the indicator and determinant variables. With respect to the latter, we note that most, perhaps all, are 'push' variables, i.e. variables, which push people towards the hidden economy. Few are 'pull', or 'opportunity' variables.

2.3 Measuring the Shadow Economy: A Microeconomic Approach

Our approach is based on generalizing the essentially aggregate time series approach to cross section data on individuals. It is based on the demand for money, although it could be generalised to

alternative approaches. We assume that the demand for money of the i 'th person (M_i) will be a function of disposable income after tax (Y_i), income from the shadow economy (S_i):

$$M_i = \beta_0 + \beta_1(Y_i + S_i) + \beta_2\mathbf{X}_i + v_i \quad (3)$$

Where v_i is the residual error term. S_i is of course undeclared, certainly to the authorities and we assume in answer to our questions. Thus in a regression of M_i on observed income it is part of the error term:

$$M_i = \beta_0 + \beta_1 Y_i + \beta_2 \mathbf{X}_i + (\beta_1 S_i + v_i) \quad (4)$$

$$= \beta_0 + \beta_1 Y_i + \beta_2 \mathbf{X}_i + Z_i \quad (5)$$

A high (positive) value for the combined error term ($Z_i = \beta_1 S_i + v_i$) will be indicative of a high shadow economy income. The error term will, of course, be greater for those engaged in the shadow economy than those who are not. If we can differentiate between these two groups of the population then we will be able to estimate the extension of tax evasion. Let Z_H be the average value of the residual for those who do not engage in the shadow economy and Z_S for those who are engaged in the shadow economy. Then for the latter group an estimate of the excess money supply due to participation in the shadow economy (M_S) can be given by:

$$M_S = Z_S - Z_H \quad (6)$$

For the individual to hold this excess of money his/her income should be:

$$\text{Estimate of Shadow Economy Income} = M_S / \beta_1 \quad (7)$$

If we average this across all those individuals identified as being involved with the shadow economy we can then get an average measure of such involvement within the sample. This can be compared with actual declared income to get an estimate of the size of the shadow economy versus the legitimate economy. However, we will be using a log linear demand for money function rather than a linear one:

$$\ln(M_i) = \beta_0 + \beta_1 \ln(Y_i * S_i) + \beta_2 X_i + v_i \quad (8)$$

where S_i now is now interpreted as the ratio of total income (declared and from shadow economy) to declared income. Hence $Z_i = (Y_i + \beta_1 \ln S_i)$. In this case our estimate of this ratio for those engaged in the shadow economy is:

$$\text{Estimate of ratio of total to declared income} = \exp(M_S/\beta_1) \quad (9)$$

This is an estimate of course for those engaged in the shadow economy.

The problem is of course how to separate the two types of individuals, those engaged in the shadow economy and those not so engaged. It is possible that this could be done on the type of job engaged in. Possibly certain types of workers involved in the public sector, for example, have little chance to opportunity to engage in the shadow economy and skills, which are also not conducive to this. However, in this study we will use the information on the question relating to the law abiding citizen. Those who identify themselves as such will be assumed not to engage in shadow economy activities, whilst those who do not identify as such will so engage. The empirical justification for this has already been discussed and can be found in work by Orviska and Hudson (2003), which identified law abidance as being a key indicator of those who engage in the related activity of tax evasion and those who do not. The definition of law abidance used in this research is virtually identical to the one used in that paper.

3. The data and empirical results

3.1 The data

The data was commissioned partially by ourselves and conducted by the Czech firm *Median*. It was carried out in 2002 on 1089 respondents in the Czech Republic and 501 in the Slovak Republic. Respondents were chosen randomly from the population of those aged between 18 and 65. A full copy of the questionnaire is available from the authors on request. Summary data is presented in Table 1 and the variables used in the empirical analysis are defined in an appendix.

Insert table 1 about here

3.2 Regression Results

The regression results are shown in Table 2. In the first regression we regress the log of cash holdings on the log of household income (LHINC), gender, the log of education (LEDU) employment status (i.e. employed or not, which is insignificant) respondents income (LRINC) age and a dummy variable operative for respondents answering in the Czech Republic. Household income, education levels, respondent's income and age have all been logged as has the left hand side variable and hence the coefficients can be viewed as elasticities. The results are as might be expected with cash holdings increasing with both household and respondent's income and the level of education. GENDER is defined in such a way that the positive coefficient implies women hold significantly more cash than men – which is perhaps not unreasonable given that they are often responsible for the household shopping.

In the second regression we added a variable relating to whether people feel the law should be obeyed or not (OBEYLAW). This was coded in such a way that higher values were indicative of less respect for the law. It can be seen that this is very significant (at the 1% level) and strongly supports our dual hypothesis that (i) people who disrespect the law are more likely to engage in the shadow economy and that (ii) such involvement will be associated with higher income than they openly admit to be earning, resulting in higher holdings of cash than we would otherwise expect. The other variables retain their earlier pattern of significance.

Insert table 2 about here

In order to facilitate estimation of the size of the shadow economy we repeated the first regression with just household income, rather than household income and respondent's own income. The results are shown in column three of Table 1. The residuals from this final regression form the basis for further analysis. The average value of this residual for those who said they strongly agreed the law should always be obeyed was -0.128 . For others it was 0.111 . This represents a difference of 0.239 . This implies that the latter have $\exp(0.239) = 1.27$ or 27.0% more cash in their pockets than law abiding citizens. If we assume that people who say the law should always be obeyed never engage in

the shadow economy, this means that those that do typically have 27.0% more in their pockets than law abiding citizens. In order for the *log of declared household income* to lead to this much more cash in people's pockets it would need to rise by $0.239/0.667 = 0.357^1$, which implies an increase in income of 42.9%. Given that 46.9% of people were law abiding this leads to an estimate of tax evasion, which suggests that income is on average 22.8% greater than declared. This then is our measure of the size of the shadow economy in both economies. This is equivalent to using equation (9). Repeating the calculations for the Czech and Slovak economies separately gives measures of the shadow economy in Slovakia and the Czech Republic of 23.2% and 21.8% respectively.

The Ramsey RESET test statistic is a test for functional form and is insignificant in all the equations at the 5% level. There may be a problem if variables linked with the propensity to hold cash (such as gender and income) are also linked to the propensity to engage in the shadow economy. If this is the case then we will wrongly attribute the influence of gender to legal reasons to holding cash and underestimate the amount of shadow economy participation. The F statistics in the Table test this possibility. They test the joint restrictions that the coefficients on household income, gender and, where appropriate, respondents income are significantly different in a regression based only on law abiding respondents who we have assumed not to engage in the shadow economy. If the impact of these coefficients is in part due to their impact on participation in the shadow economy then the two sets of coefficients should be significantly different. They are not, and although we do not report the statistics neither are they significant when tested individually rather than jointly.

4. Conclusions

The size of the shadow economy has been investigated by a number of different methodologies. A common approach is the use of time series data on some commodity such as the money supply or electricity production to investigate the relationship between the money supply and GDP and associate the error term with the shadow economy. In this paper we examine such a relationship but using cross section survey data. When we distinguish between likely tax evaders and non-tax evaders on the basis of whether or not they are law abiding we are able to estimate the relative sizes of the shadow economy in individual households budgets in Slovakia and the Czech Republic at 23.2% and 21.8% of declared income respectively. This implies that the shadow economy forms 18.8% and 17.9% of total income

¹ The value of 0.667 comes from Table 3, equation 3. It is the coefficient on logged income.

respectively. Of course the methodology is open to criticism on several grounds. Firstly, it relates primarily to engagement in the shadow economy by households. Engagement, if any, by larger corporate enterprises and also perhaps large-scale criminal activities will probably not be well covered by this measure. Secondly, there is the critical assumption, albeit with some empirical support from previous research, that the law abiding citizen does not engage in shadow economy activities. In reality this is only likely to be approximately true and future studies might use other measures, which allow the researcher to distinguish between those who are unlikely to be engaged in shadow economy activities such as occupation. However, the estimates are plausible and in line with those of other estimates.

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Appendix: Data Definitions

Dependent Variable:

CASH What amount of cash do you carry on average in your wallet during the week? [In Czech and Slovak Crowns]

Independent Variables:

GENDER Coded 1 if a female and 0 if male.

AGE Respondent's age in years.

EDUC The age at which the respondent left full time education; coded from 1 [primary] to 6 [higher].

HINC Household Income: Into which group would you put net monthly income of your family including social security payments? Coded from 1 [less than 10,000 Crowns] to 7 more than 100,000 Crowns [for both countries].

RINC Respondent's Income: Into which group would you put your net monthly income including social security payments? Coded from 1 [less than 10,000 Crowns] to 8 more than 50,000 Crowns [for both countries].

EMP Are you currently economically active - earn money? Coded 1 for no and 0 for yes.

OBEYLAW Do you agree that the law should always be obeyed? Coded from 1 [agree strongly] to 5 [disagree strongly].

CZECH Dummy variable, Coded 1 for those residing in the Czech Republic, otherwise 0.

Appendix: Tables

Table 1: Summary data from the Survey

Czech Republic

% of men	49.3%	% law abiding	42.7%
%18-30	28.6%	% Average amount of Cash	1450CK
% 30-60	64.9%	% HH Income < 20,000 CK	57.1%
% 60+	6.4%	% 20,000 CK < HH Income <30,000 CK	33.0%
% with higher education	9.9%	% HH Income >30,000 CK	9.9%

Slovak Republic

% of men	51.9%	% law abiding	55.6%
%18-30	49.3%	% Average amount of Cash	904.3SK
% 30-60	24.8%	% HH Income < 20,000 SK	67.9%
% 60+	2.4%	% 20,000 CK < HH Income <30,000 SK	26.9%
% with higher education	12.4%	% HH Income >30,000 SK	5.1%

Notes: Figures relate to after tax monthly income.

Table 2 Regression Results of Logged Cash Holdings

	Eqn. 1	Eqn. 2	Eqn. 3
Constant	5.684 (18.63)	5.126 (15.90)	5.133 (17.43)
Ln(HINC)	0.394 (5.14)	0.406 (5.31)	0.667 (10.00)
Ln(RINC)	0.465 (6.67)	0.450 (6.54)	
GENDER	0.161 (3.28)	0.165 (3.37)	0.0427 (0.90)
Ln(EDUC)	0.194 (2.21)	0.229 (2.65)	0.349 (4.05)
Ln(AGE)	-0.0302 (0.73)	0.0442 (0.60)	0.0662 (0.94)
CZECH	0.115 (2.25)	0.036 (1.63)	0.181 (3.59)
EMP	-0.0734 (0.73)	0.0798 (0.79)	-0.0902 (0.87)
OBEYLAW		0.153 (5.23)	
Observations	1368	1368	1380
R ²	0.144	0.163	0.112
RESET	3.26	2.86	9.07
F(3,629)	1.028	0.865	1.088

Notes: Equations estimated using OLS. Figures in parentheses are t statistics obtained using White's correction for heteroscedasticity.