Shadow Economy
and Its Relations with Tax System and State Budget in Poland

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1. Introduction

For many years economists have been coping with the problem of shadow economy. The evident lack of data prohibits frequently any reliable recommendations for economic policy. Very limited knowledge of the size and causes of shadow economy makes any attempt to reduce it very difficult if not impossible. Therefore official authorities and researchers try to develop definitions and methods of measurement of underground economy. They also try to look into its causes and consequences.

This paper aims at measuring the size of shadow economy in Poland over the period 1995–2007. It also tries to investigate empirically the interactions between informal economy, tax system and state budget. The paper is organized as follows: section 2 presents some definitions, in section 3 an attempt to measure shadow economy in Poland is discussed, section 4 presents the relations between underground economy, tax system and state budget, section 5 concludes.

2. Definitions of shadow economy

There exists a large number of definitions, which differ in range, degree of complication and accuracy. The basic one defines shadow economy as all economic activities that contribute to the officially calculated (or observed) gross national product but are currently unregistered (Schneider, Enste, 2000). Another definition says: shadow economy is used to refer to those economic activities that go unreported or are unmeasured (Feige, 1979). Those definitions are very short and general and can be seen as examples of an approach to define underground economy in a general way.

However, there exist more complicated definitions, which enumerate and describe each part of shadow economy. One of them distinguishes between formal and underground activities depending on whether or not an activity complies with existing institutional rules. Activities, which do comply, are formal, the ones, which do not comply, belong to shadow economy. The latter one are then divided depending on the type of rules, which are not obeyed into following groups (Feige, 1990):

1. illegal economy—consists of activities, which violate legal rules defining the scope of legal economic activities. Illegal activities are i.e. drug trafficking and black market currency exchange;
2. unreported economy—consists of activities, which produce income not reported to fiscal authorities;
3. unrecorded economy—consists of activities, which are not reported to statistical authorities;
4. informal economy—consists of activities which on the one hand circumvent costs incorporated in regulations but on the other hand are excluded from benefits incorporated in those regulations.

However statistical authorities believe that definitions of shadow economy used by economist are too general and not accurate enough. Therefore they use their own definition, which can be found in the *System of National Accounts 1993*.[1]

According to the *System of National Accounts* economic activities are divided into:

a) those, which are observed and can be directly measured in data;
b) those, which are not observed and which form the non-observed economy.

The non-observed economy is then divided into:

1. underground production—consisting of legal activities which are concealed from public authorities for following kinds of reasons: to avoid payment of income taxes; to avoid payment of social security contributions; to avoid having to meet certain legal standards like minimum wage, maximum working hours;
2. illegal production—divided into two categories:
   a) production of goods and services whose production, sale or possession is forbidden by law (drugs);
   b) production that is illegal when carried out by unauthorized producers;
3. informal sector production—the main aim of units involved in this sector is to provide employment and income to people involved. These units usually operate on a small scale, at a low level of organization and with little or no division between capital and labor as factors of production;
4. household production for own final use—divided into:
   a) production of agricultural products, hunting, fishing, forestry, processing of agricultural products, production of everyday items;
   b) paid domestic services;
   c) owner—occupied dwelling services.

The difference between official definitions of shadow economy and those used by researchers is significant. It also complicates empirical studies.

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[1] *System of National Accounts* has been created by UN, IMF, OECD, World Bank and the European Commission. It sets international standards for national account statistics.

3. An attempt to measure shadow economy in Poland

3.1. Available estimates of shadow economy in Poland

First attempts to measure shadow economy in Poland appeared even before the transition to a market economy (Wisniewski, 1985; Bednarski et al., 1988). However those analyses coped with a centrally planned economy and therefore their comparability with results for other countries, let alone Poland after the transformation is rather limited.

After 1989 interest in shadow economy rose resulting in new research. The Institute for Market Research (1995) estimated that about 30% of adolescent Poles work in an undeclared fashion. Due to problems with estimates of labor productivity those results could not be converted to show the size of shadow economy as percentage of GDP.

Some researchers gave detailed description of shadow economy phenomenon including definitions, methods of measurement, causes etc. (Mróz, 2001; Mróz, 2002). However they didn't attempt to measure the size of shadow economy in Poland but only cited existing estimates.

As of today the only available estimates of shadow economy for Poland in the period 1995—2007 are the official estimates by the Central Statistical Office (CSO) and the research results published by Schneider (Schneider, 2005).

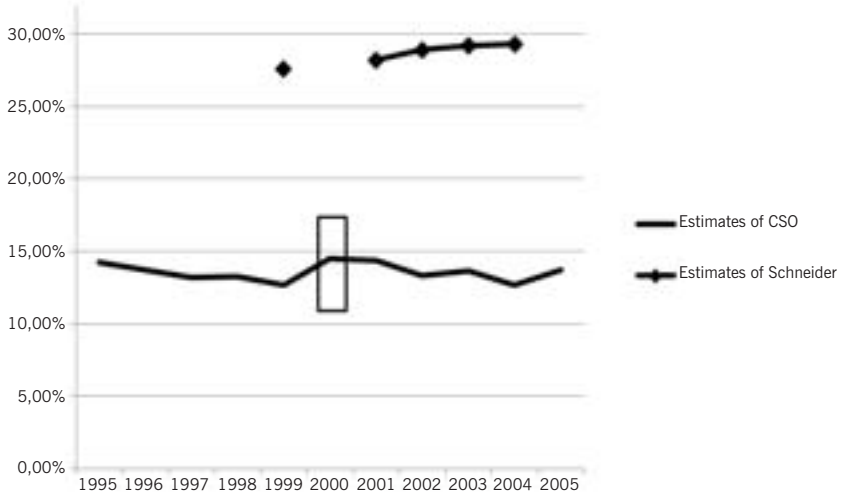
Table 1 and Graph 1 show CSO's and Schneider's estimates of shadow economy.

Table 1.

Size of shadow economy in Poland according to CSO and Schneider 1995–2005

	Size of shadow economy (% of GDP)—CSO	Size of shadow economy (% of GDP)—Schneider
1995	14,24	–
1996	13,72	–
1997	13,2	–
1998	13,27	–
1999	12,67	27,6
2000	14,53	–
2001	14,39	28,2
2002	13,35	28,9
2003	13,65	29,2
2004	12,67	29,3
2005	13,72	

Source: Own calculations on the basis of *National Accounts by Institutional Sectors and Sub-Sectors 2000–2005*, Warsaw 2007, p.538; *National Accounts by Institutional Sectors and Sub-Sectors 1995–2000*, Warsaw 2002, p.546; F. Schneider, *Shadow Economies of 145 Countries all over the World: What do we really know?*, Linz 2005, p.24; F. Schneider, *Shadow Economies and Corruption in Transition Countries: Some Preliminary Findings,* Linz 2007, p. 18.



Graph 1.
Size of shadow economy (% of GDP) in Poland according to CSO and Schneider 1995–2005
Source: Table 1.

According to CSO's estimates shadow economy in Poland decreased during the period 1995—1999 and 2000—2004. The increase in the size of shadow economy in the years 1999—2000 is due to a revision of national accounts for the period 2000—2004. There was no revision for the period 1995—1999 but it can be assumed that if such a revision had been done the size of shadow economy would have been bigger than indicated. Compared to CSO Schneider measures informal economy only for five chosen years. There is a considerable difference between his estimates and CSO's—according to Schneider shadow economy is nearly twice as big as estimated by CSO. Additionally according to Schneider shadow economy moves in an opposite direction (increase in the size of shadow economy) than given by CSO (decrease in the size of shadow economy).

Unfortunately the methodology used by CSO while estimating the size of underground economy is very general and not well known. Therefore a verification of the CSO's estimates is not possible. It is either not possible to comment on Schneider's results, due to a lack of other estimates which could serve as a benchmark. Therefore before proceeding with further research a new attempt to measure shadow economy in Poland over the period 1995–2007 seems to be necessary.

3.2. Model

The model built in this paper is based on the currency method for measuring shadow economy. This method was for the first time used by Cagan (Cagan, 1958) who tried to explain tax evasion as a reason for change in currency demand (he did not speak about shadow economy). The method was

then developed by Gutmann (Gutmann, 1977) who estimated shadow economy in the USA. Gutmann made following assumptions (Feige, 1979):

a) currency is the only mean of exchange in shadow economy;
b) there exists a benchmark period during which shadow economy was equal to 0 (Gutmann chose the years 1937–1941 as this period);
c) velocity of currency in shadow economy is equal to velocity of currency in official economy;
d) the ratio of currency to deposits during the benchmark period would have remained unchanged in later periods if there hadn't been changes in shadow economy.

The method can be described as follows:

1. the ratio of currency to deposits in the benchmark period is calculated:

$$\alpha = \left(\frac{C_0}{D_0}\right)$$

where: C_0—amount of currency in benchmark period; D_0—amount of deposits in benchmark period;

2. using the assumption from point d) the amount of currency in official economy for the year t is calculated:

$$C_{NBt} = \alpha D_t$$

3. assuming that C_t is total amount of currency for the year t, currency used in shadow economy is calculated:

$$C_{Bt} = C_t - C_{NBt}$$

4. using national income (Y_t) and assuming that amount of money in official economy (M_{NB}) is:

$$M_{NBt} = C_{NBt} + D_t$$

the velocity of money in official economy for the year t is calculated:

$$V_t = \frac{Y_t}{\left(C_{NBt} + D_t\right)}$$

5. using the assumption from point c) the size of shadow economy for the year t is estimated:

$$Y_{Bt} = V_t C_{Bt}$$

This method (called also Gutmann's method) has two advantages: it is based on easily available data and is very easy from technical point of view. However, it also has some major disadvantages:

a) currency is not the only mean of exchange used in shadow economy (Schneider, Enste, 2000);
b) a benchmark period when shadow economy was equal to 0 is viewed as unreliable (Thomas, 1990);
c) the assumption of equal velocity of currency in shadow economy and official economy is controversial;
d) the assumption of changes in currency—deposit ratio due only to changes in shadow economy is viewed as incorrect (Thomas, 1990; Hanousek, Palada, 2003).

A further development of the currency method was introduced by Tanzi (1983) who made following assumptions:

a) activities in shadow economy are due to high tax burdens;
b) activities in shadow economy mostly use currency;
c) velocity of currency in shadow economy is equal to velocity of currency in official economy.

Tanzi built a model described by following equation:

$$\ln\left(\frac{C}{M_2}\right) = \alpha_0 + \alpha_1 \ln T + \alpha_2 \ln \frac{WS}{NI} + \alpha_3 \ln R + \alpha_4 \ln Y + \varepsilon \qquad (1)$$

where: C—currency; M_2—measure of amount of money; T—income tax variable; WS—wages; NI—national income; R—interest rate for deposits; Y—real income per capita.

Tanzi estimated equation (1) obtaining results for various years. Then he proceeded as follows:

1. using M_2 and $\frac{C}{M_2}$ he calculated the amount of currency with taxes: $\hat{C}$;
2. he estimated equation (1) assuming that the variable T is equal to 0 and obtained new results for $\frac{C}{M_2}$;
3. using the ratio in point 2 and M_2 he calculated the amount of currency without taxes: $\hat{C}$*;
4. he subtracted $\hat{C}$ from C and called this difference "illegal money";
5. he introduced M_1 defined as the sum of currency and demand deposits in circulation;
6. he subtracted "illegal money" from M_1 and called the difference "legal money";
7. he divided GDP by "legal money" to obtain velocity of money;
8. using the assumption from point c) he multiplied "illegal money" with velocity of money from point 7 and obtained estimates of shadow economy.

Tanzi's method (called also currency demand method) has the same advantages as Gutmann's method. However, it also has some major disadvantages:

a) high tax burdens are not the only causes of shadow economy;

b) there are other means of exchange than currency used in the shadow economy;
c) the assumption of equal velocity of currency in shadow economy and official economy is controversial;
d) econometric methods used by Tanzi are basic.

The model used in this paper is an extension of Tanzi's method made by Shima (Shima, 2004) with the aim of measuring shadow economy in Norway. The model is described by the following equation:

$$\frac{CUR_t}{POP_t} = \alpha_1 \frac{CUR_{t-1}}{POP_{t-1}} + \alpha_2 \frac{EP_t}{POP_t} + \alpha_3 \frac{C_t}{P_t} + \alpha_4 DT_t + \\ + \alpha_5 IDT_t + \alpha_6 HHI_t + \alpha_7 IR_t + \varepsilon_t \quad (2)$$

where:

CUR_t/POP_t—currency in circulation per capita in period t deflated using CPI; an increase in amount of currency in circulation can be viewed as an evidence of growing shadow economy;

EP_t/POP_t—value per capita of transactions made by cards in period t deflated using CPI; includes transactions which can be made in shadow economy not only using currency but also electronic means of payment. It is hard to say what the influence of this variable on CUR_t/POP_t will be: on one hand transactions made by cards substitute transactions made by cash. On the other hand some cards are used to draw money from ATMs;

C_t/P_t—consumption per capita in period t deflated using CPI; an increase in consumption will lead to an increase in currency demand;

DT_t—revenues from direct taxes to wage fund in period t; measures the direct tax burden. It is assumed that a high tax burden drives economic actors into the shadow economy. Therefore the influence of this variable on CUR_t/POP_t is assumed to be positive;

IDT_t—revenues from indirect taxes to GDP in period t; measures the indirect tax burden. Its influence on the dependent variable is the same as the influence of DT_t;

HHI_t—Herfindahl—Hirschmann index in period;[2] measures the complexity of the tax system. More complex tax systems are assumed to facilitate acting in shadow economy through tax evasion;

IR_t—interest rate in period t;[3] measures the alternative cost of holding currency. Its influence on currency demand should be negative.

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[2] Herfindahl-Hirschmann index is a measure of concentration. In his paper it is used to measure complexity of tax system. It can be expressed by the following formula: $\sum_i^n (SB\mathrm{Re}\, v_{it}/SB\mathrm{Re}\, v_t)^2$, where $SB\mathrm{Re}v_{it}$—state budget revenues number i in period t; $SB\mathrm{Re}v_t$—total state budget revenues in period t.

[3] The weighted average interest rate for 3-months deposits.

The data set used for the model covers the period from I quarter 1995 to IV quarter 2007 and was obtained using the *Statistical Bulletin* published by CSO, *Reports on the fulfillment of state budget* (*Sprawozdania operatywne z wykonania budżetu*) and the web page of NBP (www.nbp.pl).

Before the estimation of the model the stationarity of variables was tested using Augmented Dickey—Fuller test and Phillips—Perron test. Only the variables: IDT_t and HHI_t were stationary. All other variables were non-stationary and integrated of order one [$I(1)$]. Therefore cointegration between variables was tested. Using Johansen's procedure the number on cointegration vectors was set as one. Then using Engel-Granger two—step procedure an error correction model (ECM) with cointegrating vector including DT_t and IR_t was built (the relation between these two variables is of statistical nature and doesn't seem to have an economic interpretation). The model is as follows:

$$\Delta\frac{CUR_t}{POP_t} = \beta_1\Delta\frac{CUR_{t-1}}{POP_{t-1}} + \beta_2\Delta\frac{EP_t}{POP_t} + \beta_3\Delta\frac{C_t}{P_t} + \beta_4\Delta DT_t + \beta_5 IDT_t + \\ +\beta_6 HHI_t + \beta_7\Delta IRT_t + \beta_8\left(DT_t - \beta IR_t\right) + \varepsilon_t \tag{3}$$

Results of estimation are show in Table 2.

Table 2.

Estimation results for ECM

Independent variables	Estimates (t-statistics)
$\Delta CUR_{t-1}/POP_{t-1}$	–0,1266 (–1,03)
$\Delta EP_t/POP_t$	0,4074 (5,59)*
$\Delta C_t/P_t$	0,1363 (3,00)*
ΔDT_t	2,857 (3,70)*
IDT_t	16,6084 (2,80)*
HHI_t	–0,9030 (–1,66)
ΔIR_t	–5,5616 (–1,32)
cointegrating vector DT_t, IR_t where β = 1,055	0,4393 (0,53)
constant	–1,1033 (–1,40)
R^2 = 0,5895	
Test statistics Breusch-Godfrey = 2,545 Durbin-Watson = 1,6696	*—variables significant at 5%

Source: Own calculations.

Because three variables, the cointegrating vector and the constant term were insignificant the regression was repeated for significant variables. Results of this estimation are shown in Table 3.

Table 3.

Estimation results of final model

Independent variables	Estimates (t-statistics)
$\Delta EP_t/POP_t$	0,4329 (6,03)*
$\Delta C_t/P_t$	0,1333 (2,84)*
ΔDT_t	2,6044 (3,96)*
IDT_t	12,305(2,14)*
constant	–1,3257 (–2,01)*
$R^2 = 0,5834$	
Test statistics Breusch-Godfrey = 2.084 Durbin-Watson = 1,6026	*—variables significant at 5%

Source: Own calculations.

As can be seen from Table 3 all variables are significant. The signs of the parameters for $\Delta C_t/P_t$, ΔDT_t and IDT_t are as expected. Nothing can be said about the sign for $\Delta EP_t/POP_t$. The Breusch-Godfrey statistic shows no autocorrelation in the model. The Durbin-Watson statistic is inconclusive.

After the model was estimated the following procedure was applied to obtain the size of shadow economy:

1. for every period the amount of real currency in circulation per capita is estimated by including DT_t in the model;
2. the amount of currency from point 1 is multiplied by the relevant size of population and CPI so that currency in circulation, taking taxes into account, is obtained: $CURT_t$;
3. the amount of real currency in circulation per capita is estimated using unchanged parameters of the model but excluding DT_t;
4. replicating point 2 currency in circulation, excluding taxes, is obtained: CUR_t;
5. subtracting CUR_t from $CURT_t$ the amount of currency connected with shadow economy is obtained: $CURSE_t$;
6. GDP in period t is divided by $CURR_t - CURSE_t$ (where $CURR_t$ is the amount of currency actually in circulation) to obtain the velocity of money: V_t;
7. multiplying $CURSE_t$ by V_t estimates for the size of shadow economy are obtained;
8. CSO's estimates of shadow economy for the year 2004 are used to rescale the estimates from point 7 and final estimates of the size of shadow economy are obtained. Rescaling allows for comparison between the dynamics

of the estimated size of shadow economy and the dynamics of shadow economy estimated by CSO.

The advantages of the model are:

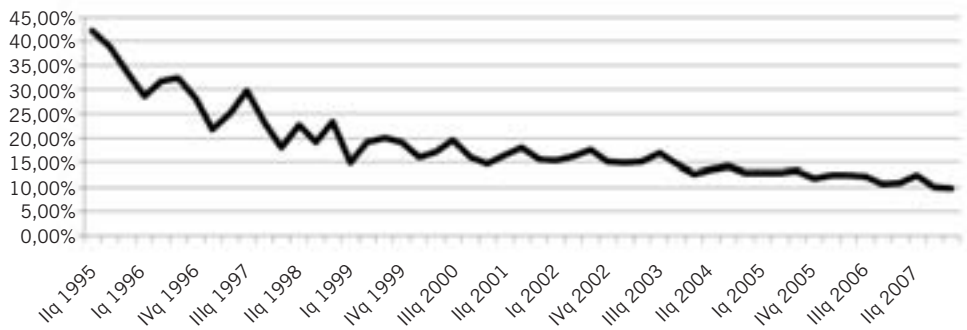
a) easily available data;
b) the use of advanced econometric techniques;
c) the inclusion of a variable, which accounts for payments made by electronic means;
d) the inclusion of a variable, which accounts for the complexity of tax system.

Points b)–c) refer also to advantages over Gutmann's and Tanzi's methods.

Disadvantages of the model are to a large extent equal to those of Gutmann's and Tanzi's method:

a) high tax burdens are not the only causes of shadow economy;
b) the assumption of equal velocity of currency in shadow economy and official economy is controversial;

Graph 2 shows estimates of shadow economy.



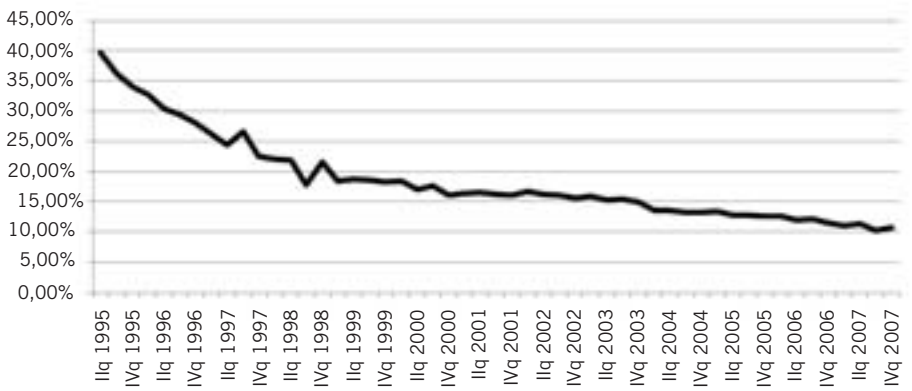
Graph 2.

Size of shadow economy (% of GDP) in Poland IIq 1995–IVq 2007
Source: Own calculations.

Using TRAMO/SEATS the presence of seasonality in the estimates was tested and the estimates were seasonally adjusted. The final estimates are shown in Graph3.

According to Graph 3 the size of shadow economy in Poland was biggest at the beginning of the research period—about 40% of GDP. Later the size of shadow economy declined (with few exceptions) reaching about 10% of GDP in the fourth quarter of 2007. The obtained results are in line with CSO's estimates for the period 2002–2007 and differ significantly from the results obtained by Schneider. This could suggest that Schneider's estimates are too high. Severe doubts about the method used by Schneider for estimating the size of shadow economy (who applies this method for about 145 countries around the world) and his results are raised by several authors (Breusch

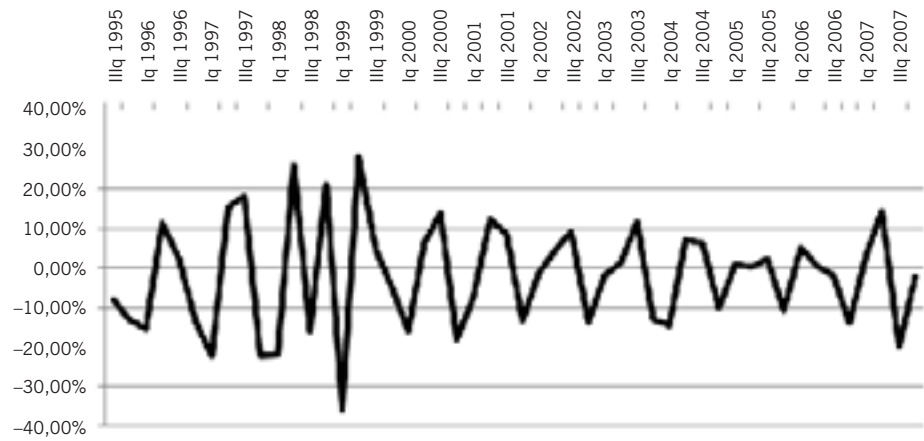
2005; Breusch, 2006; Feige, Urban, 2008). The main problems underlined by those authors concern the poor definition of shadow economy used by Schneider, the unfitness of Schneider's model for measuring the size of shadow economy and the inability to reconstruct his results from the documentation provided by him.



Graph 3.

Size of shadow economy (% of GDP) in Poland IIq 1995–IVq 2007—seasonally adjusted
Source: Own calculations.

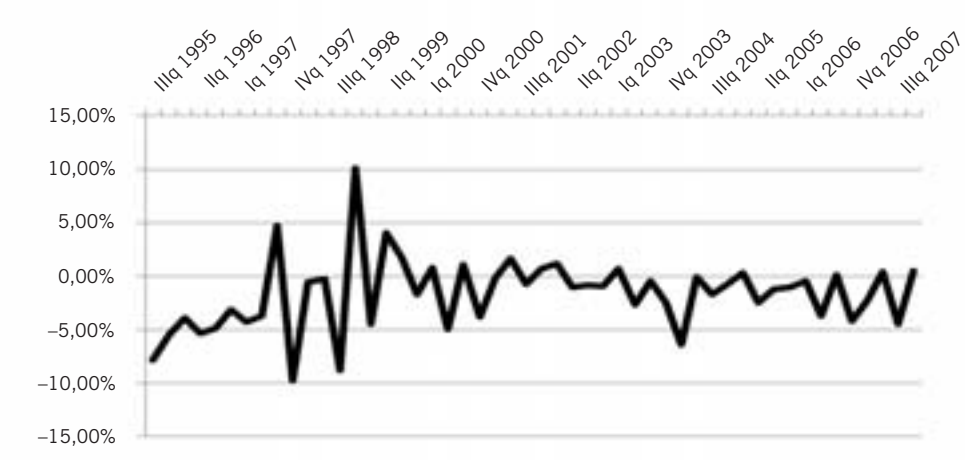
Due to disadvantages of methods used to measure shadow economy, special care should be paid to the obtained estimates of the absolute size of shadow economy. What seems to be more important and credible is its dynamics shown in Graph 4.



Graph 4.

Dynamics of shadow economy (in %) IIIq 1995–IVq 2007
Source: Own calculations.

Next the presence of seasonality in the dynamics was tested and the dynamics were seasonally adjusted. The final dynamics is shown in Graph 5.



Graph 5.

Dynamics of shadow economy (in %) IIIq 1995–IVq 2007—seasonally adjusted
Source: Own calculations.

As can be seen in Graph 5 shadow economy declined for most of the period 1995—2007. The biggest decrease was a) in the fourth quarter of 1997: about 10%; b) in the third quarter of 1998: about 9%. There were also some periods when the dynamics was positive—the biggest increase in the size of shadow economy was in the fourth quarter of 1998: about 10%. The obtained results are in accordance with CSO's estimates and in opposition to Schneider's estimates regarding the direction in which the size of shadow economy is changing.

4. Shadow economy, state budget and tax system

According to stylized facts a relation between the size of shadow economy, state budget and tax system does exist. It is believed that high tax burden pushes economic agents into shadow economy. A bigger size of shadow economy decreases the tax base and thus tax revenues and state budget decline (this phenomenon is described by the Laffer curve). Fiscal authorities react to a decline in tax revenues and state budget by increasing tax burden, which leads to a further increase in the size of shadow economy and drop in tax revenues. A vicious circle between tax system, state budget and shadow economy is created.

Some economists described this hypothesis and tested it by using models (Johnson et al., 1997; Johnson et al., 1998; Friedman et al., 2000). However, they did not test the models for each country of their data set separately but for a cross-country sample. Some other economists investigated the relations

between shadow economy, tax system and state budget for one country (Schneider, Neck, 1993). Separate empirical studies of these relations for Poland do not exist, which leaves room for further research.

Before investigating the relations between shadow economy, tax system and state budget appropriate variables should be chosen. A variable illustrating the size of shadow economy should be included. Also variables for state budget should be present. However the question is which of them are suitable i.e. budget incomes, expenditures and public debt or tax revenues and debt of the Treasury. Most variables for government finance can be included in other variables illustrating state budget, for example tax revenues are included in budget incomes, debt of Treasury is included in public debt etc. Therefore these variables can be used interchangeably.

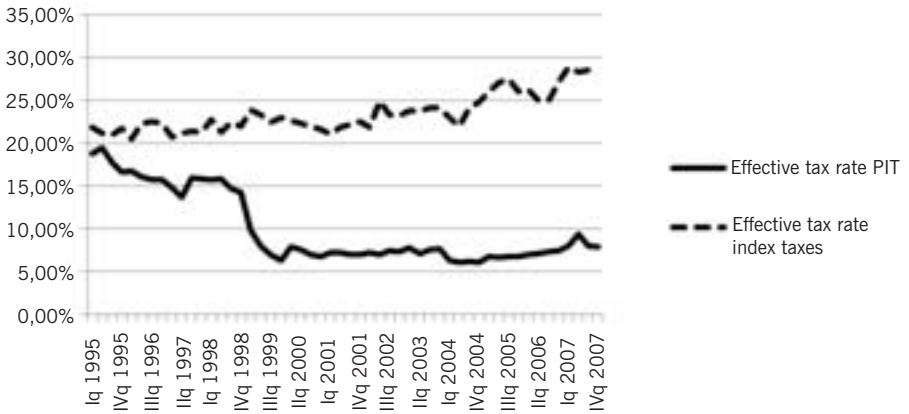
The biggest problem arises while looking for variables concerning tax system. The easiest solution would be to include nominal tax rates for various taxes. On the other hand nominal tax rates are not suitable variables because they only show nominal tax burden, which is not equal to real tax burden. Nominal tax rates exclude any information about tax deductions etc. which have an influence on real tax burden and therefore on shadow economy. Therefore including only nominal tax rates misses out important information on tax system. The problem could be very significant for Poland where tax deductions were quite important (especially in the 90's) and therefore the nominal tax burden was different from the real one.

A solution to this problem is taking effective tax rates as variables. Those are calculated as the ratio of tax revenues for a specific tax to the relevant tax base. For example an effective tax rate for personal income tax (PIT) is calculated by dividing tax revenues for PIT by the total of population income. Effective tax rates include information about tax deductions etc. and therefore can be perceived as a good proxy of real tax burden. One would expect rising effective tax rates to lead to an increase in the size of shadow economy.

Eventually the variables chosen are: size of shadow economy as calculated in section 3, effective tax rate for personal income tax, effective tax rate for indirect taxes (calculated as the ratio of revenues from indirect taxes to value of retail sale) and state budget balance.[4] Graph 6 shows effective tax rate for PIT and effective tax rate for indirect taxes (seasonally adjusted).

As can be seen on Graph 6 the effective tax rate for indirect taxes increased over the period 1995—2007 from about 22% to 29%. The effective tax rate for PIT decreased in the period 1995—1998 from 19% to 15%. In 1999 there was a sharp drop in this tax rate (due to a reform in social security contributions): from 14% down to 7%. From 1999 to 2006 this tax rate remained between 6% and 10%.

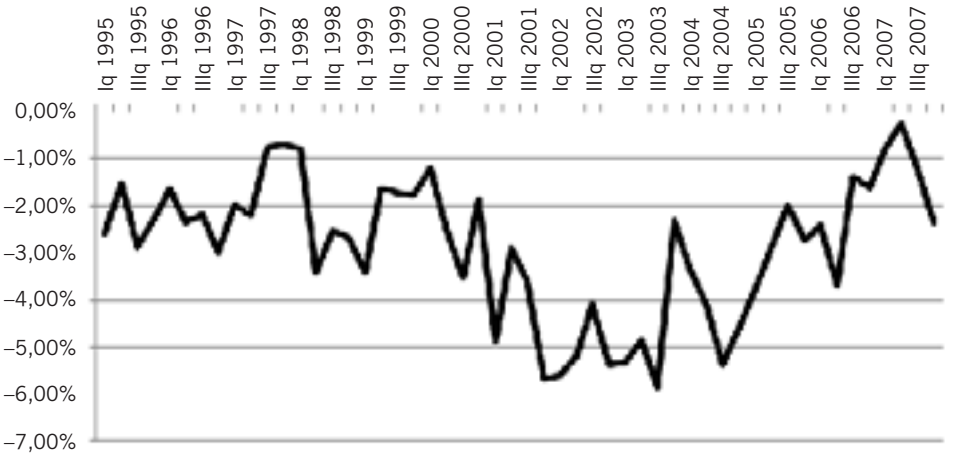
[4] Effective tax rate for Corporate Income Tax was not included due to its small significance for state budget—revenues from CIT were only about 9–13% of state budget revenues in the period 1995–2007, compared with revenues from PIT: 14–27% and direct taxes 39–66%.



Graph 6.

Effective tax rate for PIT and effective tax rate for indirect taxes (%) in Poland Iq 1995–IVq 2007—seasonally adjusted
Source: Own calculations.

Graph 7 depicts the state budget balance (seasonally adjusted).



Graph 7.

State budget balance (% of GDP) in Poland Iq 1995–IVq 2007—seasonally adjusted
Source: Own calculations.

As can be seen on this graph budget balance was mostly negative during the period 1995–2007: government spending exceeded revenues.

The first attempt to investigate the relations by building a structural model did not give plausible results. Therefore a Vector Autoregressive model was built. The model is described by following equations:

$$SE_t = \mu_1 + \sum_{i=1}^{i=4} \alpha_{1i} SE_{t-i} + \sum_{i=0}^{i=4} \beta_{1i} EPIT_{t-i} + \sum_{i=0}^{i=4} \gamma_{1i} EIDT_{t-i} + \sum_{i=0}^{i=4} \theta_{1i} BB_{t-i} + \lambda_1 DynGDP + \varepsilon_{it} \quad (4)$$

$$EPIT_t = \mu_2 + \sum_{i=0}^{i=4} \alpha_{2i} SE_{t-i} + \sum_{i=1}^{i=4} \beta_{2i} EPIT_{t-i} + \sum_{i=0}^{i=4} \gamma_{2i} IDT_{t-i} + \sum_{i=0}^{i=4} \theta_{2i} BB_{t-i} + \lambda_2 DynGDP + \varepsilon_{jt} \quad (5)$$

$$EIDT_t = \mu_3 + \sum_{i=0}^{i=4} \alpha_{3i} SE_{t-i} + \sum_{i=0}^{i=4} \beta_{3i} EPIT_{t-i} + \sum_{i=1}^{i=4} \gamma_{3i} EIDT_{t-i} + \sum_{i=0}^{i=4} \theta_{3i} BB_{t-i} + \lambda_3 DynGDP + \varepsilon_{kt} \quad (6)$$

$$BB_t = \mu_4 + \sum_{i=0}^{i=4} \alpha_{4i} SE_{t-i} + \sum_{i=0}^{i=4} \beta_{4i} EPIT_{t-i} + \sum_{i=0}^{i=4} \gamma_{4i} EIDT_{t-i} + \sum_{i=1}^{i=4} \theta_{4i} BB_{t-i} + \lambda_4 DynGDP + \varepsilon_{lt} \quad (7)$$

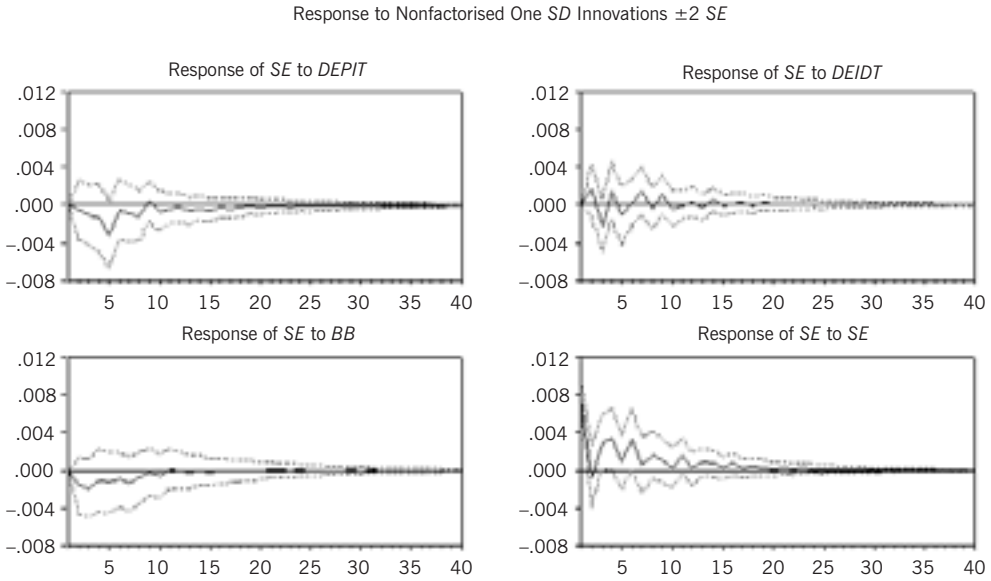
where:
SE_t—size of shadow economy in period t;
$EPIT_t$—effective tax rate for PIT in period t;
$EIDT_t$—effective tax rate for indirect taxes in period t;
BB_t—state budget balance in period t;
$DynDP_t$—dynamics of GDP (exogenous variable);
i—number of period;
μ_1, μ_2, μ_3, μ_4—constant terms;

The data set used for the model covers the period from II quarter 1995 to IV quarter 2007 and was obtained using the *Statistical Bulletin*, *Internal Trade* (both published by CSO) and *Reports on the fulfillment of state budget* (*Sprawozdania operatywne z wykonania budżetu*).

After estimating the model Impulse Response Functions were drawn. *SE* was chosen as response, which allowed for the estimation of the reaction of the size of shadow economy to changes in tax system and the situation of state budget. The first differences of *EPIT* and *EIDT* (the first differences were used because *EPIT* and *EIDT* were non-stationary and integrated of order 1 [I(1)]), *BB* and *SE* were chosen as impulses. The size of each impulse was chosen as one standard deviation and the number of periods was set equal to 40. The functions are depicted in Graph 8.

As can be seen from the Impulse Response Functions shadow economy grows when effective tax rate for indirect taxes increases: an increase in real tax burden causes some economic agents to move into shadow economy. The response of shadow economy to an impulse of effective tax rate for direct

taxes leads to a decrease in the size of the shadow economy. The same is true for an impulse of budget balance. As can be seen from the last Impulse Response Function the VAR model is stable.



Graph 8.

Impulse Response Functions for *SE* as response
Source: Own calculations.

5. Conclusion

The first part of this paper attempts to measure shadow economy in Poland in the period 1995–2007 due to problems with existing CSO's and Schneider's estimates. There is a considerable amount of shadow economy definitions, which differ in their range, degree of complication and accuracy. Therefore special care should be paid to what exactly is measured. Methods of measuring shadow economy are not ideal either. This leads to the conclusion that absolute estimates of shadow economy are not flawless. One should look more closely on the dynamics of shadow economy which shows that shadow economy decreased in Poland in the period 1995–2007.

The second part of the paper studies relations between shadow economy, tax system and state budget. Special care should be taken when choosing appropriate variables for tax burden and state budget. The estimated VAR model and drawn Impulse Response Functions show that there exists a positive relation between shadow economy and tax burden for indirect taxes (an increase in the tax burden leads to a bigger size of shadow economy) and a

negative relation between shadow economy and a) effective tax rate for personal income tax; b) budget balance.

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Abstract **Shadow Economy and Its Relations with Tax System and State Budget in Poland**

There are controversies regarding existing estimates of the size of shadow economy in Poland. Therefore this paper focuses on the measurement of shadow economy in Poland over the period 1995–2007. On the basis of monetary methods, an econometric model for currency demand is built. Using estimation results, the size of shadow economy is assessed. According to the estimates shadow economy declined in the period 1995–2007 starting from 40% of GDP in 1995 and reaching about 10% of GDP in 2007.

The paper also analyses relations between shadow economy, state budget and tax system. A Vector Autoregressive model is estimated and Impulse Reaction Functions are drown, showing that an increase in indirect tax burden enlarges shadow economy. A contrary effect arises due to an increase in: a) direct tax burden; b) budget balance.