MEASUREMENT AND
DETERMINANTS OF THE HIDDEN
ECONOMY IN REGIONS OF
UKRAINE AND RUSSIA: MIMIC
APPROACH

by

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Abstract

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The author applies MIMIC ("Multiple Indicators – Multiple Causes") model to measuring the hidden economy as percentage of gross regional product (GRP) in regions of Ukraine and Russia and determining the main causes of the hidden activity in 2001-2003. Among chosen causes of the hidden economy, namely, tax pressure, specialization of the region (industrial or agricultural), unemployment, criminality, number of small enterprises, immigration the first three appeared to be significant in most specifications of the model. Real GRP per capita and employment rate are used in the model as indicators of the hidden economy. The author finds that tax pressure has a significant positive effect on the hidden economy. Agricultural and industrial specializations both have significant positive impacts on the hidden sector almost equal in size. Unemployment has a significant negative effect on the hidden economy, which may be explained by the fact that today's hidden economy is mostly maid up of the officially employed economic agents, who use different schemes to avoid taxation. The author concludes that given the set of causes and indicators outlined, the MIMIC model predicts less deviations of the hidden economy across regions as compared to the results obtained in other studies on the field, which were using the electricity consumption method to measure regional hidden economy size. Based on finding no substantial deviation of the hidden economy size across regions, the author comes to the conclusion that policy targeted at reducing the hidden economy size may suffice at the country's level without going deeply into region's specifics.

TABLE OF CONTENTS

LIST OF FIGURES

ACKNOWLEDGMENTS

GLOSSARY

Hidden economy - all the activity that adds value, but escapes the official channels of measurement.

GRP – gross regional product.

INTRODUCTION

> "estimation of the shadow economy can be considered as
> a scientific passion for knowing the unknown"
> Friedrich Schneider

Today in economics and social sciences the notion "hidden economy" looks as a trite expression. The huge amount of literature on its measurement, causes and impact on the official economy seems not leaving any room for new investigations. But the importance of the above studies and the challenges still create incentives for new insights into the hidden sector. Significance of the considered researches lies in the fact that uncounted hidden economy distorts statistical indicators, which leads to inadequate policy actions (Maurin et al., 2003). Other authors considered foregone tax revenue to be the main reason for the hidden economy analysis (Giles, 1999). The government can not gather taxes from the hidden sector; the funds for social policy decrease and often as a result tax pressure for formal sector increases. The firms operating in the shadow have limited or no access to official sources of funds. High risk of shadow business makes entrepreneurs plan their activities only in the short-run. Also, hidden economic agents can not use advantages of formal institutes (court, police etc.) (Komarova, 2003). For transition countries size and dynamics of shadow sector are important since it can serve as an indicator of successfulness of transformation reforms, and also can be a constituent of investment climate.

For today's Ukrainian government fight against illegal activity takes on special significance. President Yushchenko in his appearance on 17.02.2005 stressed that the starting point of his actions was decrease of the shadow economy in Ukraine.[1] The President of Russia Putin in his Message to the Federal Meeting of the Russian Federation on the 25th of April 2005 also emphasizes the importance of decrease of the hidden economy in the country[2].

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[1] http://www.utr.ukrintell.com.ua/news

[2] http://www.kremlin.ru/text/appears/2005/04/87049.shtml

In my work I will apply MIMIC ("Multiple Indicators – Multiple Causes") approach to measuring of the hidden economy as percentage of gross regional product (GRP) in regions of Ukraine and Russia and determine factors which cause some regions to be more involved in hidden activity than others. I do not aim to give accurate measures of the hidden economy in regions, but to rank regions.

I test the hypothesis whether policy against hidden economy should be carried out at the level of a whole country or at the regional level, taking into consideration specifics of the given region. Komarova (2003) on the basis of electricity consumption method discovered substantial deviations in hidden economy across regions of the Russian Federation and concluded that macroeconomic factors were not enough for explanation of these differences and here the importance of regional factors came. If MIMIC model predicts significant variability of the hidden economy across regions I will conclude about the necessity to implement policy of the hidden economy reduction at the regional level. Before deepening into hidden economy analysis I should identify what I understand under this term. I refer to Maurin et al. (2003) who defines hidden economy as "all the activity that adds value, but escapes the official channels of measurement".

My application of a MIMIC model, which treats the size of the shadow economy as a "latent" variable, is not new in itself, but applying this methodology to the measurement of the hidden economy in Ukraine and Russia on the basis of regional data and discovering the main factors for regional differences in hidden economy size distinguishes my work from other papers on hidden economy.

The estimation of the MIMIC model is done as an estimation of seemingly unrelated regressions in Stata software following the procedure described by Breusch (2005) on the cross-section data on 26 Ukrainian and 79 Russian regions for 2001-2003 years.

LITERATURE REVIEW

In the given section of the work I will first briefly describe what methods for measurement of the hidden economy exist and what their advantages and disadvantages are. Later it will help to understand why actually the MIMIC approach has been chosen. Then I will analyze literature in two main directions: foreign studies of the hidden economy in post-soviet countries and contribution of Ukrainian and Russian researches to the investigation of the informal sector. For the latter direction I will pay special attention to regional studies since they are the most important for my work, which considers hidden economy from the angle of regions. The literature review proceeds in section of model description where I will discuss main findings of foreign researches, which I will use in developing of economic theory for inclusion particular variables in my model.

1.1. METHODS OF THE HIDDEN ECONOMY ESTIMATION

There are as many methods to measure hidden economy as there are definitions of it. I use similar choice and structuring of existing approaches as Maurin et al. (2003) and Schneider (2002) do. Generally all methods can be divided into two parts: i) direct methods, which are micro approaches and rely on surveys of tax payers sample, ii) indirect methods, which are basically macro approaches and involve different macroeconomic indicators which signal about hidden economy development over some period.

i) Direct approaches:

a) *The Voluntary Survey approach* is special questioning techniques for interviewing a representative sample of individuals about their participation in hidden activity as buyers/ sellers of goods or labor services. Method was applied

by Censis (1976), Isachsen et al. (1982). The approach presents rather detailed information about the structure of hidden sector, but obtained results substantially depend upon the way in which questions are formed. The main drawback is that respondents are often not so eager to confess their hidden activity, thus results of survey are not much reliable [Schneider, 2002].

b) Under *The Compliance method* information about hidden economy is obtained through audit - individuals and firms selected on the basis of suspicion of the tax authorities or some methodology are forced to reveal their real profits otherwise they will be punished (Frey and Pommerehne, 1984). This method also gives quite detailed information about hidden sector activities and structure. Since sample of tax payers is selected on the basis of submitted tax reports and suspicion of tax administration about some fraud, i.e. it is not random, the method creates a bias in hidden economy estimates. Also, obtained values of hidden economy depict only that part of a shadow sector which authorities managed to reveal, that surely underestimates a shadow sector [Schneider, 2002].

ii) Indirect approaches:

a) discrepancy methods:

* *Discrepancy Between Incomes and Expenditures* (the size of the hidden economy is estimated as the excess of expenditures over incomes). This method seems to be easy in application because all data is provided by state statistical agencies. But the researcher should be aware that discrepancy might be also due to measurement errors and omissions, thus presenting robust estimates of the hidden economy. This method was used by Smith (1985) for estimation of the hidden economy in Great Britain, Petersen (1982) in Germany etc.

* According to method of *Discrepancy Between Official and Actual Participation Rates* decrease in labor participation rate is an indicator of its flow from formal economy into informal one (Contini, 1981). Though it is easy to observe the trend of official participation rate, the decrease in it is not necessarily due to

movement into the informal sector. Also, a person may be employed simultaneously in both sectors.

       * *Discrepancy in Physical Inputs (Electricity Consumption).* Under the assumption that elasticity of electricity consumption to GDP growth is one the difference between the growth rate of official GDP and the growth rate of total electricity consumption is considered as the indicator of the hidden economy growth (Kaufman and Kaliberda, 1996). It is also a very simple in application method, but it has the following drawbacks: firstly, some hidden activities do not require much electricity, secondly, alternative energy sources can be used, therefore some part of hidden activity is not measured, thirdly, technical progress undermines the assumption about unity elasticity of electricity consumption to GDP, and finally, the given elasticity fluctuates considerably among countries and over time.

       * *Discrepancy in the Monetary Balances.* Under F*ixed Ratio method* the surplus of currency in use is compared to a "normal expected level" as indicator of the hidden economy size, assuming that cash serves informal sector as a medium of exchange (Gutman, 1977). The weaknesses of the given approach lie in assumptions behind the method. First of all, assumption that normal currency-demand deposit ratio is constant is not very reliable since there are many factors influencing the ratio (interest rate, income etc.), thus it is difficult to refer only to changes in the hidden sector as causes for changes in the above ratio. Also, assumption that changes in transactions are fully reflected in cash payments in shadow sector is not quite valid because payments by cheques and barter are possible in the hidden economy too. Finally, the assumption that velocity of circulation is the same for official and unofficial sectors is also very strong. [Schneider, 2002]

       According to *Transactions approach* under the assumption of a constant relationship between currency and transactions the total stock of money serves as indicator of total transactions in formal and informal economy; total nominal GNP is related to total transactions and difference between total GNP and

officially measured one is the hidden economy size (Feige, 1989). The drawbacks of the given approach are the assumption of base year with zero hidden economy and like in the previous model the assumption of a constant normal ratio of transactions to nominal GNP. Also, changes in transaction ratio can not be fully attributed to fluctuations in the informal sector.

Methods of discrepancy of monetary balances look appealing in theory, but because of omission of variables that can influence currency-to-deposits or transactions-to-official GNP ratios they can lead to biased estimates and should be improved through extension of regression equations with inclusion of omitted variables, which are done in the below given econometric methods.

b) econometric methods:

 * *Tanzi's Currency Demand method* (1983) is the improvement of the above fixed ration method by incorporating other causes of currency demand (interest rate, income, tax burden, government regulation) to guarantee that currency surplus is really imputed to the hidden economy. The currency demand model is one the most often encountered in the literature on methods of hidden economy measurement, but it has the same weaknesses as fixed ratio method, namely, assumption about zero hidden economy in base year, the same money velocity in both formal and informal sector and only cash transactions in hidden sector. Also, most studies include only tax burden in regressions as cause for the hidden economy. [Schneider, 2002]

 * *MIMIC/DYMIMIC method (Multiple Indicators –Multiple Causes, DY* stands

for dynamic) was first presented by Zellner (1970), developed by Joreskog and Goldberger (1975). The given method explicitly incorporates numerous causes of appearance and increase of the hidden economy simultaneously with numerous indicators of the hidden sector. I will consider MIMIC approach in detail in methodology section.

 Frey and Weck (1983a, 1983b), Frey and Weck-Hanneman (1984) were the first who applied MIMIC approach to measurement of the hidden economy; they

used cross-section data for twenty-four OECD countries. Modern applications of the MIMIC methodology are found in works by Loyaza (1997), Giles (1999), Tedds (1998), Schneider and Enste (2000), Schneider (2004). In light of economic reasoning behind my model (in section of model description) I will discuss what variables the above mentioned authors included in their estimation of the hidden economy for different countries and what results they obtained.

1.2. FOREIGN STUDIES OF THE HIDDEN ECONOMY IN TRANSITION COUNTRIES

Now consider contribution of foreign researchers to investigation of the hidden economy in transition countries. Schneider (2004) applied DYMIMIC approach to the measurement of the hidden economy in 109 transition (including Ukraine and Russia), developing and developed OECD countries. His average estimates of the hidden sector size for 1990/91, 1994/1995 and 1999/2000 years are correspondently 43.3, 47.3, 52.2 % of GDP for Ukraine; and 37.5, 41.3, 46.1% of GDP for Russia. He restricted estimation of the shadow economy causes to burden of taxation, state regulation, unemployment and GDP per capita. In my research I will extend the number of causes and analyze the hidden economy in Ukraine and Russia in the context of regions.

Kaufman and Kaliberda (1996) made one of the first attempts of comparative analysis of the hidden economy in post-soviet countries and countries of Central Europe. They analyzed Ukrainian hidden economy in details having applied micro-surveys and electricity consumption method and found correspondence between these methods. The study shows that share of the hidden economy in GDP of Ukraine increased from 16.3% in 1990 to 36.6% in 1994. The authors were the first to apply electricity consumption method for transition countries. Westin (2002) on the basis of electricity consumption method estimated the hidden economy share in Russia at the level of 37% of GDP. He came to the conclusion that the shadow sector in Russia after reaching peak in 1998 (45% of GDP) started to decline to official sector.

1.3. UKRAINIAN AND RUSSIAN STUDIES OF THE HIDDEN ECONOMY.

Among Ukrainian studies of the hidden sector I would mark Mel'ota(2001) and Kravchenko (2001). Mel'ota and Gregory (2001) studied the hidden economy through currency demand estimation and compared estimates with official calculations of Derzhkomstat, and concluded that now official statistics adjusts for the hidden economy and discrepancy between official GDP and adjusted for the hidden sector one isn't substantial. So, if so-far hidden economy were included in official GDP already adjusted for informal sector it would raise GDP only by 12%. Kravchenko (2001) presumes that the shadow economy exists because of increasing tax burden and measures the hidden economy share with electricity consumption method and comes to the conclusion that hidden economy began to increase in 1991-1993 years and since 1996 its share persistently exceeds 50% of GDP. There are no studies with application of the MIMIC model to investigate the hidden economy in Ukraine from the perspective of regions.

In contrast to Ukraine, there are regional studies of the hidden economy in Russia. Nikolayenko et al. (1997) estimated hidden sector in Russian regions in 1995 with the methods of discrepancy between incomes and expenditures, official and actual participation rates, official tax base and tax base from which actual taxes are collected. The OLS regression outputs show that hidden economy share negatively depends on gross regional product per capita and criminality level, and positively on barter volume. Komarova (2003) estimated hidden economy share in Russian regions in 1995-2000 with electricity consumption method and tested hypothesis about reasons of the hidden economy like tax burden, excessive administrative pressure, influence of increasing number of small enterprises, private sector and kind of economic activity. The usage of MIMIC approach to hidden economy analysis in regions of

Russia is new. Running separate regression on Russian regions gives the possibility to compare MIMIC estimates with results of electricity consumption method and possibly check the appropriateness of MIMIC model to hidden economy measuring. In my study I will mostly refer to Komarova's work while comparing estimated results of the MIMIC model to results of electricity consumption method.

MIMIC METHODOLOGY

In the given section I will focus on MIMIC model, present its theoretical framework and discuss pros and cons of the approach.

Why have I decided in favor of MIMIC methodology? The MIMIC approach is "the most comprehensive and builds on a well-structured behavioral model" (Maurin et al., 2003). Since the shadow economy affects simultaneously different markets (production, labor, money market etc.) and has numerous determinants (Schneider, 2004), the MIMIC model, which explicitly considers multiple causes, as well as multiple indicators of informal economy, is the most suitable for my research. Also, different alternatives or complementary indicators of the hidden economy can be incorporated in a one estimation process (Loayaza, 1997). Through the application of the MIMIC model not only measures of the hidden economy in regions of Ukraine and Russia can be obtained, but also effects of the certain policy changes during transition period can be estimated.

The MIMIC approach represents a measurement model which connects unobserved variables to observed indicators. It consists of two parts:

$$I = \beta'X + \varepsilon \quad (1)$$

$$Z = \phi I + \mu \quad (2)$$

$E\ (\varepsilon\mu')=0',\ var(\ \varepsilon)=\psi,\ E\ (\mu\mu')=\theta=(\theta 1,\ ...,\ \theta m)$- *diagonal matrix (disturbances are all mutually independent)*

The latent variable I (hidden economy) is linearly determined by observable exogenous causes X, subject to a disturbance. In the second equation I linearly determines a set of observable endogenous indicators Z, subject to disturbances.

By substituting the first equation into the second one we obtain a reduced form equation.

$$Z = \phi(\beta X + \varepsilon) + \mu = \Pi X + \nu \quad (3)$$

$$\nu \sim (0, \Omega) \quad \Omega = \phi\phi'\psi + \theta$$

The MIMIC model then looks like a multi – variate regression model (Giles, 1999). Generally, structural parameters are estimated with imposing restrictions on coefficient matrix Π and the covariance matrix of the error term ν. Therefore, I can not obtain cardinal estimates of all parameters, only relative values. The estimation of (1) and (2) equations in MIMIC model needs normalization for (2), i.e. constraining one element of ϕ to some pre-assigned value. Since both X and Z are observable data the multi-equation model is estimated by limited-information Maximum Likelihood Procedure (recognizes the structure of one equation of a system, while taking the other equations in their reduced form and not imposing any restrictions on var-cov matrix) (Breusch, 2005).

The model assumes that indicators in Z vector are measures of the same thing – hidden economy I, so if there are no disturbances μ (and disturbances are mutually independent), then two indicators will have correlation 1. The main idea of the model is that I accounts fully for the intercorrelations of the indicators in Z. It means that as the effects of causes X via I are removed, there will be no intercorrelations among indicators in vector Z. (Joreskog and Goldberger, 1975) It's rather strong assumption since practically it's hard to account for all possible causes X on the hidden economy I, i.e. the problem with omitted variables may appear.

From the estimated values of the causes' coefficients β we will obtain normalized estimates of a latent variable I, but the levels of I will be undetermined until we incorporate additional information (Joreskog and Goldberger, 1975).

18

Limited information ML takes the same information about the structure of the model as two-stage least squares, to which it converges asymptotically (Breusch, 2005). I take two indicator variables in order the estimation of the MIMIC model can be done as estimation of seemingly unrelated regressions in Stata software using GLS procedure ("sureg" command) further following the procedure described by Breusch (2005).

Now I take the general reduced form equation (3) and derive the equations which will be estimated in Stata 8.2 according to Breusch (2005) for 2 indicator variables and 7 causes.

In the reduced form equation (3) I can normalize the first variable to 1 (by convention) ($\phi_1 = 1$), then matrix Π looks the following:

$$\Pi = \phi \times \beta' = \begin{bmatrix} \phi_1 \\ \phi_2 \end{bmatrix} \times \begin{bmatrix} \beta_1 & \beta_2 & \dots & \beta_7 \end{bmatrix} =$$

$$= \begin{bmatrix} 1 \\ \phi_2 \end{bmatrix} \times \begin{bmatrix} \beta_1 & \beta_2 & \dots & \beta_7 \end{bmatrix} = \begin{bmatrix} \beta_1 & \beta_2 & \dots & \beta_7 \\ \phi_2\beta_1 & \phi_2\beta_2 & \dots & \phi_2\beta_7 \end{bmatrix}$$

Now I write the reduced form in the way of system of two equations:

$$\begin{cases} z_1 = \beta_1 x_1 + \beta_2 x_2 + \dots + \beta_7 x_7 + v_1 & (4) \\ z_2 = \phi_2\beta_1 x_1 + \phi_2\beta_2 x_2 + \dots + \phi_2\beta_7 x_7 + v_2 & (5) \end{cases}$$

$$var\begin{bmatrix} v_1 \\ v_2 \end{bmatrix} = \begin{bmatrix} \psi + \theta_1 & \phi_2\psi \\ \phi_2\psi & \phi_2^2 + \theta_2 \end{bmatrix}$$

The coefficients in the equation (5) are proportional to the coefficients in the equation (4). Note, I don't impose additional restrictions on the var-cov, since once estimated ϕ_2, there are three elements in var-cov matrix and I need to estimate three parameters (ψ, θ_1, θ_2). Let's multiply (4) by ϕ_2 and subtract from (5):

$$\phi_2 z_1 = \phi_2 \beta_1 x_1 + \phi_2 \beta_2 x_2 + \ldots + \phi_2 \beta_7 x_7 + \phi_2 v_1$$

$$z_2 - \phi_2 z_1 = v_2 - \phi_2 v_1$$

Denote $u = v_2 - \phi_2 v_1$

We obtain the system:

$$\begin{cases} z_1 = \beta_1 x_1 + \beta_2 x_2 + \ldots + \beta_7 x_7 + v_1 & \text{(6)} \\ z_2 = \phi_2 z_1 + u & \text{(7)} \end{cases}$$

Actually, we obtained 2-equations linear simultaneous model, with 2 endogenous and 7 exogenous variables.

Now consider var:

$$var\begin{bmatrix} u \\ v_1 \end{bmatrix} = var\begin{bmatrix} v_2 - \phi_2 v_1 \\ v_1 \end{bmatrix} = \begin{bmatrix} \phi_2^2 \theta_1 + \theta_2 & -\phi_2 \theta_1 \\ -\phi_2 \theta_1 & \psi + \theta_1 \end{bmatrix}$$

After estimation of variances u and v_1 and coefficient ϕ_2 I can obtain ψ, θ_1, θ_2 as follow:

$$\theta_1 = -\text{cov}(u, v_1)/\phi_2$$

$$\theta_2 = \text{var}(u) - \phi_2^2 \theta_1$$

$$\psi = \text{var}(v_1) - \theta_1$$

Coefficients in β show how hidden economy changes with change in causes X. Also Stata gives ϕ_2 (remember ϕ_1 is normalized to 1), i.e. how change in hidden economy size is reflected in change of Z_2. In order to obtain the predicted values of the hidden economy (indices, not yet absolute values) from reduced form equations I obtain in Stata predicted values of the first indicator variable (with coefficient normalized to 1). The predicted values of the second indicator variable are rescaled values of the predicted values of the normalized indicator, where ϕ_2 is proportionality coefficient. Therefore, it doesn't matter

what variable to choose for normalization, since I obtain only change in scale (Breusch, 2005).

The practical question is what indicator variable to choose for normalization. Breusch (2005) suggests using model with normalized endogenous variable where R-squared is higher, in such a case (if the reduced form equations have substantially different fits by OLS) "the iterations will be found to converge faster and more reliably". In Appendix 4 I present two SURE outputs with different normalization (on real GRP per capita and employment rate).

The challenge that accompanies MIMIC model in case of regions is that it gives not level, but index for hidden economy as a latent variable, and it's supposed to use a "benchmark" value of regional hidden economy from alternative studies/sources to convert ordinal indexes into cardinal ones.

Breusch (2005) has showed how different ways of benchmarking change final inferences of the model, namely he has explained that if benchmarking is multiplicative the proportional relationships in indices will be preserved, then final inferences will not depend on the choice of the particular indicator variable for normalization ("This is analogous to the familiar treatment of an index of prices, where the series is set in a base period to an arbitrary value of one or 100, and the rest of the series is scaled accordingly"), but if benchmarking is for example additive as in Bajada and Schneider work (2005) then choice of indicator for normalization is not just computational convenience, but substantially influences the final results. Hence, I will use multiplicative benchmarking (detailed explanations see at description of results of the MIMIC model estimation, Chapter 5).

MIMIC model is growing in popularity, because its application in sphere of the hidden economy is rather new and unexplored, and that's why evokes critics and permanent discussions. Thus, Breusch (2005) besides strict critics on time-series data transformations of Giles and Tedds (2002), Bajada and Scnheider (2005), Dell'Anno and Schneider (2003) (which I avoid when using cross-section

statistics) doubts the possibility of MIMIC model application to the hidden economy measurement as itself. Original psychometric application of MIMIC model is suitable, because most variables like intelligence are really latent and can be a subject of some subjective conventional measures. But the usage of the discussed model for measuring the hidden economy is not appropriate, because hidden economy is difficult to observe, but it still has definite numerical units of measurement as official one and can not fit whatever convenient for researcher scale. My response to the above critics is that all methods of the hidden economy measurement have drawbacks just because of the nature of the hidden activity, which stipulates evasion of any control and measurement. But the alternative to reject any methods of the hidden economy measurement is worse than usage of different methods and comparison of their results. Also, without applying any benchmark in MIMIC model we still can see the rank of regions or countries, which brings useful information about distribution of the hidden economy.

Schneider (2004) points out the following drawbacks of MIMIC model: sensitivity of estimated coefficients to sample size changes and to different specifications, difficulty of getting reliable data on cause variables, reliability of dividing variables on causes and indicators for explaining hidden economy changeability. I will try to cope with sample size and specification issues through running different regressions on panel data 2001-2003 for pooled regions, for panel data separately for regions of Ukraine and Russia, for cross-section data of pooled and separate Ukrainian and Russian regions for each year, and see whether the results change substantially, it will provide a robustness check. I should be aware of the endogeneity problem in specification of the MIMIC model (I will talk about endogeneity problem after description of variables in the model).

I will use cross-section data on 26 Ukrainian and 79 Russian regions (see Appendix 2). The reason for this is necessity of more observations to be able to rely on asymptotic theory. It's possible to pool Russian and Ukrainian regions,

because both countries are in transition, neighbors with tight economic and socio-political relations, and they face similar problems in their fight against the hidden economy. Also, if other authors who applied MIMIC model could pool different countries, like Schneider (2004) pooled 109 transition, developing and OECD countries, I can do the same for regions of two transition countries.

MODEL DESRCIPTION

In the given section I list and discuss possible indicators and causes of the hidden economy relying on the findings of previous works on the field and own economic intuition.

Hidden economy can reveal itself in three markets: labor market, market of goods and services, and money market. I focus on the first two, because of possibility to get necessary statistics and use limited-information MLE, which is appropriate for 2 indicator variables. Therefore, possible **indicators** for MIMIC model are: 1) regional employment (as hidden sector increases less workers are employed in official sector); 2) real gross regional product (GRP) per capita (hidden economy entices inputs, especially labor force, from official economy, which causes depressive impact on growth of official economy).

The above indicators are common for works with application of the MIMIC model. For example, Tedds (1998) uses such indicator as real GDP and male labor force participation rate (in shares, 15 years of age and older), Schneider (2004) uses employment quota (in % of population of age 18-64) and annual growth of GDP.

Difference in the size of the shadow economy among regions may be determined by the following **causes**: 1) share of tax income of regional budget in GRP as proxy for tax burden variable, 2)unemployment, 3) share of industrial production in total sum of agricultural and industrial production, 4) share of agricultural production in total sum of agricultural and industrial production, 5)quantity of little enterprises, 6)immigration, 7)criminality level.

Assuming rational behavior of economic agents, we can predict that the firm (or employer) decides to go into the shadow if his utility (or profit) is higher in hidden sector than in official one, as it is stated in below inequality. The inequality is taken form Komarova (2003) with little modifications and used just to see the intuition how different causes create incentives to move into the shadow.

$$u(R_h - C_h - p*S + I) > u((1-t)*R_{of} - C_{of} - g(t*R_{of} + t*R_{others}, G) - I)$$

$u(.)$ – utility function of economic agent (u'(.)>0, u"(.)<0);

R_h, R_{of} - incomes of economic agent in hidden and official sector;

C_h, C_{of} - expenditures of economic agent in hidden and official sector;

t- tax rate;

I – start income of the firm or employee;

p – probability to detect the hidden activity of economic agent;

S – punishment in case of detect of the hidden activity;

g – function of production of public good, which depends on total sum of collected taxes and government expenditures (G).

I expect a more aggressive regional fiscal policy (higher tax pressure, or t in above inequality) causes higher hidden economy percentage of GRP, because higher tax payments decrease profits of enterprises and incomes of households (R_{of}) creating the incentives to move into the shadow. Though a negative relationship can also exist, because with higher tax revenues the production of public goods might also increase. For example, Friedman et al. (2000) discovered that effect of an increased availability of public goods on the decision whether to move into the shadow or no exceeds the effect of decreased profits due to increased tax rates.

Higher level of unemployment is also positively correlated with hidden economy size, because unemployed people failed to find official means for

support of being need to find hidden sources for survival, taking into consideration that in Ukraine and Russia unemployment allowances are small. The unemployment can be connected with initial income I in the above inequality, assuming that unemployed people have low I and that's why need to find job in the hidden sector. Economic agents start unregistered entrepreneurship, organize so-called handicraft production. Also official enterprises exploit the high unemployment situation and hire workers without their registration or paying the actual wages in "envelopes" avoiding taxation. Workers don't object to such situation being afraid to loose the job or/and being also interested in getting higher wage that is not taxed, even though they loose contributions to their future pensions and can not be protected by local authorities in cases of some conflicts with employer.

The previous studies confirm a positive correlation between tax pressure, unemployment and hidden economy. Thus, Tedds (1998) has found a positive iimpact of tax burden (proxied by ratio of total goods and services tax revenue to total disposable income, total provincial sales tax revenue), unemployment rate on increase of the hidden economy in Canada. The same positive impact of tax pressure (the highest corporate income tax rate in the country) was discovered by Loayza (1997) for Latin America. Also, Loyaza found a positive effect of labor market restrictions (Rama index as an average of eight variables connected to labor market, for example, min wage, social security contribution percentage in wage etc.) and a negative impact of strength and efficiency of government institutions on informal sector. In most specifications of MIMIC models of Giles (1999) such causal variables of the hidden economy in New Zealand as ratios of corporate and other kinds of taxes to GDP, unemployment rate appeared to be significant. The authors by themselves note that results are not strong since the sample size is small. Finally, Schneider (2004) in his survey of 110 developing, transition and developed OECD countries confirms the above findings that

increasing tax burden with expanding state regularity activities boosts the growth of the hidden economy share.

Agricultural or industrial specialization of the region determines the difference between costs of operating in official (C_{of}) and hidden sectors (C_h). It's believed that ceteris paribus costs of operating in agricultural hidden sector are lower than in industrial one, meaning that it's easier to hide activity in agricultural sector. Ercolani (2000) contends that while in countries with developed tax-gathering the underground economy is connected with criminal activity, in developing countries, with problematic taxation the hidden sector mostly consists of agricultural economy, which is hardly taxed directly, because the costs of taxation exceed the revenues. Also, Maurin et al. (2003) assert that "economic sectors with low capital intensity tend to gravitate quite naturally to hidden economic activity". Komarova (2003) says that specific of economic activity influences the gap between the costs of operating in official and non-official sectors and therefore determines hidden economy size and dynamics. Nevertheless, I think for transition countries it's hardly possible to determine in advance whether dominant agricultural or industrial production in region causes larger hidden sector in economy; it's a question of econometric estimation. I will estimate this factor through including percentage of agricultural and industrial added values in their total sum as cause variables in the MIMIC model.

International experts consider structure of the hidden economy in Ukraine to be unusual, because mostly large enterprises are involved into the hidden activity contrary to more common hidden economy concentration in households and small enterprises. (Kaufmann and Kaliberda, 1996). Komarova (2003) argues that for small enterprises it's easier to make informal agreements than for large ones, because they are less controlled by the authorities. In terms of the considered inequality the probability of being caught (p) for a small enterprise is lower than for a large one, thus ceteris paribus the utility of operating in the

shadow is more likely to exceed the utility of working officially. But also, Komarova considers the opposite effect: large enterprise can have better unofficial relationships with authorities than small ones, therefore large enterprises may be more involved into the hidden economy. Thus, Komarova (2003) considers the latter reasoning dominating by the former, and tests the hypothesis whether the hidden economy in regions of Russia rises with increase of small enterprises. In my research I will check this statement for regions of Ukraine and Russia through including number of small enterprises in the region as additional variable among causes of the regional hidden economy in MIMIC model.

Pooling of data on Ukraine and Russia has a drawback, because there is the difference in definitions of small enterprise in two countries. In Ukraine enterprise can be considerer as a small if the number of employees is up to 15 – 200 people depending on the industry, for Russian small enterprises this measure is up to 30-100 people depending on kind of activity.

Maurin et al. (2003) point out the high probability of foreign workers being involved in unregistered activity. Emigrants usually face bureaucratic problems of registration (costs of legal work C_{of} increase) and finding the job, so they are more inclined to hidden activity. I will statistically test whether regions with higher immigration from abroad tend to be more involved in the hidden economy. Note that I am able to use official statistics only on legal immigration in the regions.

The start income I in the inequality, on the basis of which economic agent decides whether to operate in the shadow, can also be considered as aggregate indicator of regional welfare. Regions with low welfare are more inclined to the hidden activity. The welfare may be characterized by the level of criminality, as welfare in the region decreases the number of crimes increases (Komarova, 2003). Also, according to a survey carried out in Russia by the Institute of

Strategic Analysis and Enterprise Development (1998) in 1995-1997 18% of the cases when enterprise owners decided to come underground were because of intent to avoid criminal pressure, i.e. there is a positive correlation between criminality level and hidden economy size. However, Nikolayenko et al. (1997) found that criminality undermines incentives to be in the shadow, i.e. there is a negative correlation. I will check how criminality level influences the hidden economy in regions.

Finally, our model can be sketched as in Appendix 1.

DESRCIPTION OF VARIABLES

In the given section I will consider statistics on variables in 2002. In Appendix 3 I present description of variables. To avoid influence of the size of the region, all variables are presented in shares, per capita, per 100 000 of population. In Appendix 4 I present the data summary for Ukrainian, Russian regions and pooled data for 2002, for 2001 see Appendix 8, for 2003 – Appendix6.

To proxy tax pressure variable I use share of tax incomes of regional budgets in GRP (gross regional product). It's a usual way to proxy the tax burden. For example, Schneider (2004) takes share of direct and indirect taxation with custom duties as % of GDP in estimation of MIMIC model for hidden economies in 110 developing, transition and developed OECD countries. Tedds (1998) uses ratio of total federal tax revenue to total GDP in measuring of the hidden economy share in Canada.

From data summary I can conclude that in 2002 the tax pressure in Ukraine was a little bit lower than in Russia (0.07 and 0.11 correspondently). The summary for pooled data shows that mean tax pressure is about 0.10.

Concerning share of agricultural production in total sum of agricultural and industrial production I can conclude that on average Russian regions have higher share of agriculture than Ukrainian ones (0.24 for Russian and 0.16 for Ukrainian regions), for pooled data I have 0.22. Note that among min values for agriculture there are zero values, it because statistical committee of Russia doesn't present such information for Moscow-city and St. Petersburg and I can assume that in these cities the agricultural production is insignificant, though Ukrainian

committee gives the value for agricultural production in Kiev, that actually includes not the agriculture itself, but some servicing of it (see Appendix 3 for description of agricultural production). Thus, I obtain some discrepancy in agricultural production in Russian and Ukrainian regions, but it is not significant to change the final inferences of the pooled regression.

Industry share in total sum of agricultural and industrial production is higher for Ukraine than for Russia (0.84 vs 0.76) (see Appendix 3 for description of industrial production). Note that shares of industrial and agricultural production sum up to 1, therefore I don't to include the constant into regressions.

For immigration variable I use share of immigrated from abroad the country in total quantity of people arrived at the given region. To see pure effect of foreign immigration on the hidden economy size, if the data allowed, it would be better to include work immigration, not general foreign one, because foreigners who came for short time with aim to earn money, especially if they face some bureaucratic problems, are more inclined to hidden activity than those who decided to change the place of living forever or for a long period of time, having taken care about sources of income. For Russia this factor is lower than for Ukraine (0.08 and 0.13), meaning that in Russia migration among regions is prevalent over foreign migration.

On average criminality level in Ukraine is less than in Russia (860 against 1704 crimes per 100 000 population). The average number of small enterprises per 100 000 population is higher in Ukraine (494,6) than in Russia (475,5). Real GRP per capita in Russian regions is substantially bigger than in Ukrainian regions (8584,39 UAH against 3815,68 UAH).

Note that unemployment and employment rates are computed differently: the former is share of unemployed to quantity of economically active population of 15-70 age and the latter is share of employed to total quantity of population of 15-70 age. Unemployment rate in Ukraine is on average a little bit bigger than in

Russia (0.11 against 0.09). Employment rate in Russia is slightly bigger than in Ukraine (0.59 and 0.55 correspondently).

Concerning possible multicolinearity problem I can conclude that according to the correlations between cause variables (see Appendix 4) the explanatory variables don't correlate much with each other. The highest correlation is between agricultural/industrial shares and unemployment (0.52).

ENDOGENEITY PROBLEM

There is possible endogeneity problem with variables-causes. Concerning the tax pressure the problem of causation appears, because the higher the tax pressure is, i.e. the higher tax income fraction in GRP is, the lager will be the hidden economy in the given region, because economic agents will prefer to avoid high taxation operating in the shadow. But on the other hand the larger the hidden economy is fewer taxes will be transferred to the regional budget, the less will be the share of tax incomes in GRP.

Also, the above proxy for tax pressure has another disadvantage. The low fraction of tax income in GRP doesn't necessarily mean low tax rates, because according to the Laffer's curve with increasing of the tax rate tax gatherings also increase, but starting from some so called optimal tax rate further increase in tax rate leads to decrease of tax incomes. Taking it into consideration, even though tax pressure is considered to be cause of the hidden economy according to many works, basically I will investigate not causation, but correlation between tax pressure and hidden economy size.

Endogeneity problem can be also connected with criminality level expressed as number of crimes for 100 000 population, since the higher the number of crimes is the more criminalized the region is the more incentives there are for enterprises to be involved in informal activity (see model description above). But on the other hand, if already there is large informal economy then the formal institutions have weak power which facilitates development of criminal in the region.

It's surprising that authors applying MIMIC method don't point out the endogeneity problem.

DATA SOURSES

The following years will be considered: 2001, 2002 and 2003.

Ukraine: 26 regions, including Kyiv and Autonomous Republic Crimea (including Sevastopol).

Main sources: State Statistical Committee of Ukraine. Ukraine in figures in 2001-2004: CD-ROMs;

Additional source: www.ipa.net.ua, www.sta.gov.ua

Russia: 79 regions, including Moscow, St. Petersburg, not including Chechenskaya Republic.

Main source: Goskomstat of Russia. Regions of Russia -2004: CD-ROM.

Additional source: www.sci.aha.ru

RESULTS OF THE MIMIC MODEL ESTIMATION OF THE HIDDEN ECONOMY IN REGIONS OF UKRAINE AND RUSSIA

5.1. RESULTS 2002

The outputs of the MIMIC model for 2002 are presented in Appendix 4. In regression with normalization on real GRP per capita only coefficient of the ratio of tax incomes to GRP is significant at 5% significance level and has an expected sign. According to Breusch (2005) normalization should be made on the indicator unrestricted OLS regression of which has the highest R sqr. I have run two OLS regressions with dependent variable employment rate and real GRP per capita (see Appendix 4) and obtained that the normalization should be made on **employment rate** since R sqr = 0.75 (> than 0.28). Recall that shares of industrial and agricultural production in the region sum up to 1, which is the same as to include the constant into regression.

In regression with normalization on employment rate only β parameters of tax pressure, unemployment, industry and agriculture shares are significant (see Figure 1). Note that coefficients in outputs give impact of the causes on indices of the hidden economy, not percent of the hidden economy in GRP. As expected, tax pressure has a positive impact on the hidden economy size. Agricultural and industrial production both are inclined to hidden activity and industry has a slightly bigger impact (0.63) than agriculture (0.55) (test shows that their difference is statistically significant), though the size of their impacts on the hidden economy index does not differ much. So, for transition countries in 2002 it does not hold that agriculture more tends to gravitate to the hidden activity than industry. Unemployment rate has an unexpected negative sign. This can be

explained be the fact that bigger part of hidden GRP is produced by officially employed agents, who may use different ways to avoid taxation.

Cause	2001	2002	2003
Tax pressure		0.46	0.21
Unemployment	-0.66	-0.74	-.75
Number of small enterprises			
Criminal			
Immigration	----		
Industry share	0.59	0.63	0.66
Agriculture share	0.57	0.55	0.55
Dummy for Ukraine	0.04		-.02

Note: only statistically significant (at 5% significance level) coefficients are reported in the table

Figure 1. MIMIC Estimation of the Hidden Economy for Pooled Ukrainian and Russian Regions in Separate years.

Other variables appeared to be insignificant. Also, note that dummy for Ukrainian regions in 2002 is not significant, meaning that given other variables constant the fact that region belongs to Ukraine does not influence the hidden economy index.

I have also run separate regressions for Russian and Ukrainian regions (see Figure 2). For Ukraine since the sample sizes is small (26 observations) I do not make any strong conclusions, though as output shows in comparison with pooled regression the tax pressure for Ukrainian regions is not significant, but number of small enterprises per 100 000 population has a significant positive impact. It supports the previous hypothesis that being less controlled by the government small enterprise is more inclined to conceal its activity. The share of agriculture has bigger impact (0.77) on the hidden economy index than industry (0.67), though the difference is not substantial.

Cause	2001		2002		2003	
	Ukraine	Russia	Ukraine	Russia	Ukraine	Russia
Tax pressure	-0.66			0.44		0.20
Unemployment	-1.36	-0.60	-1.37	-0.67	-0.86	-0.73
Number of small enterprises	0.00006*		0.00009*		0.00008	
Criminal						
Immigration	---					
Industry share	0.70	0.60	0.67	0.63	0.595	0.66
Agriculture share	0.79	0.56	0.77	0.53	0.597	0.54

Note: only statistically significant (at 5% significance level) coefficients are reported in the table

* - significant at 10% significance level.

Figure 2. MIMIC Estimation of the Hidden Economy Separately for Ukrainian and Russian Regions in Each Year.

For Russia (79 observations) I can conclude that significant causes are as in pooled regression and have the same signs. The share of industrial production has bigger impact (0.63) on the hidden economy index than agriculture (0.53).

After estimation of the MIMIC model with normalization on employment rate I have obtained predicted values that are expected values of the indicator variable normalized to 1, i.e. employment rate. But these values give me only the possibility to conclude about the ratios of the hidden economy between regions. To obtain the values of the hidden economy expressed as percentage of GRP I need to incorporate so-called benchmark. I calculate the average of the hidden economy indices for regions (Ukrainian regions) and make this average correspond to the value of the hidden economy for whole country as percentage of GDP gotten from a valid source. I chose Ukraine as a benchmark country because of availability of valid sources of the hidden economy estimation. I understand the differences between Ukraine and Russia, though in many sources estimates for two countries do not differ substantially, for example, Schneider

(2004) gives percentage of the hidden economy in GDP in average 1990/91, average 1994/95, average 1999/2000 correspondently for Ukraine - 43.3, 47.3, 52.2 and for Russia – 37.5, 41.3, 46.1.

For 2002 the benchmark is the World Bank's estimation of the hidden economy in Ukraine -**52,2%** of GDP.[3] Therefore, the estimates of the hidden economy for pooled regions are done by proportion. For example:

Region	Hidden index	Hidden economy in % of GRP
Chukotka	0.703687	x
Ukraine	0.551529	52.2

x=0.703687*52.2/0.551529=66.60% of GRP (see Appendix 5)

According to Appendix 5 such regions as Chukotka, Moscow-city, St.Petersburg have the highest hidden economy 63-66%. The lowest values of the hidden economy are 28.85% in Ingushetia and 40.76% in Dagestan, which is unexpected (the discussion of this finding is done after description of outputs for all three years). The biggest number - 51 regions have hidden economy percentage of GRP in interval [55-60), 37 regions in interval [50-55), 7 regions in interval [45-50%) and almost the same number (6 regions) are contained in interval [60-65%) (see Figure 3).

I have also tried to take benchmark as an average of the hidden economy indices for Russian regions and the rank of pooled regions did not change, though absolute values can vary. Estimates of the hidden economy in Russia are very controversial, for example, Goskomstat of Russia gives estimates of the hidden economy as percentage of GDP within interval 22-25%[4], though other authorities give substantially higher values, for example, the Federal Financial Monitoring gives estimates 40-50% of GDP [5]. Also, in contrast to Ukraine there is no some special research on the hidden economy estimation in Russia made by

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[3] www.business.kiev.ua/ #25, 23.06.2003

[4] www.strana-oz.ru, www.rg.ru

[5] www.kfm.ru

a respectful international organization. Given the above reasons I left Ukraine as a benchmark.

As compared to finding's of Komarova (2003) the MIMIC model's results show less variability in the hidden economy among regions given the set of causes and indicators in the model, because notice that 89 regions, which actually constitute the major part of the considered sample, have hidden economy in interval [50-60%]. Though I can not directly compare two estimates, since they are done for different years, but 2000 is the most recent year in Komarova's estimation of the hidden economy as percentage of GRP (see Figure 4). In Komarova's work approximately equal number of regions are concentrated in interval (30-35] and (40-45], also such intervals as (20-25], (45-50] and (50-55] are roughly equal by contained number of regions. The biggest number of regions (29) is concentrated in interval (35-40]. Therefore, in Komarova's work regions are spread in interval (20-55%) and MIMIC model predicts accumulation of regions in interval [50-60%].

Also, interesting comparison is that estimations of the MIMIC model, namely, that such regions as Ingushetia, Dagestan, Kabardino-Balkaria have the lowest values of the hidden economy in the total rank, correspond to the predictions of the electricity consumption method, namely, in Komarova's work (2003) (though the values of the hidden economy as percentage of GRP and years differ, but the rank is the same) the lowest values of the hidden economy are reported for Ingushetia, Kabardino-Balkaria (20.2-32.7%), Dagestan (32.7-36.3%). On the other hand, such regions as Republic Komi, Khabarovsk, which fall into the same lowest interval as Ingushatia, Kabardino-Balkaria in Komarova's work, according to my estimation have very high rank – Khabarovsk (the 6th – 60.09%), Republic Komi (the 16th – 58.62%) (see Appendix 5).
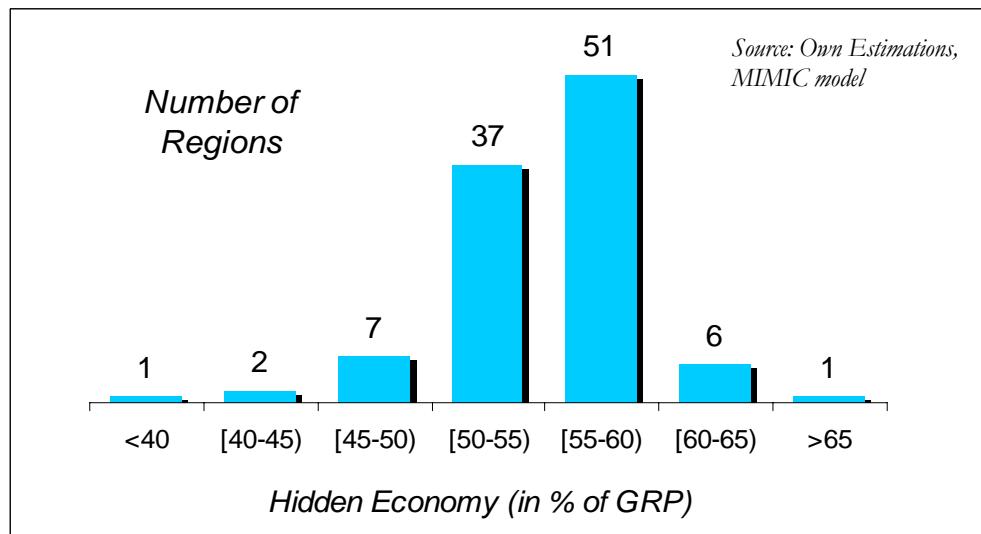
Figure 3. Distribution of Ukrainian and Russian Regions According to the Hidden Economy Size in 2002.
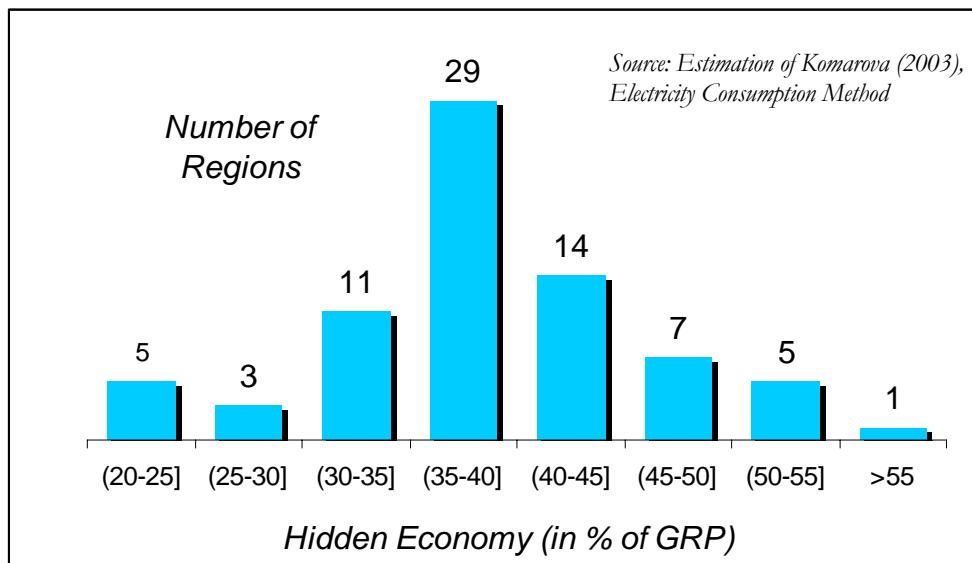
Figure 4. Distribution of Russian Regions According to the Hidden Economy Size in 2000.

Schneider 's (2004) estimates of the hidden economy for different countries on the basis of DYMIMIC model may vary considerably if countries from different groups are compared, for example, in average 1999/2000 average size of the hidden economy among African countries is estimated at 41.2% of GDP, while among Asian countries – 26.3%, East and Central European and Former Soviet Union Countries – 37.9%, OECD countries -16.8%, Central and South American countries – 41.5%. Within one group distribution of the countries according to the hidden economy size varies from group to group. For example, within group of African countries there is no large variability of the hidden economy, because 14 out of 24 African countries have the hidden economy size in the range [35-45%). In the group of 23 East and Central European and Former Soviet Union Countries higher variability is observed, since 4 countries fall into the range [20-30%), 9 countries – [30-40%) and 5 countries – [40-50%).

5.2. RESULTS 2003

For 2003 the output of pooled regression looks similar as for 2002, which actually was expected since causes and indicators of the hidden economy should not vary much from year to year (see Figure 1). As output shows tax pressure, shares of agriculture and industry have significant positive impacts on the hidden economy in the region as expected. Unemployment has a negative impact as in 2002 and the size of impact on the hidden economy index does not change much (-0.75 in 2003 vs -0.74 in 2002). Industry still has higher impact on the regional hidden economy index (0.66) than agriculture (0.55). The influence of tax pressure decreases in 2003 (0.21) in comparison with 2002 (0.46) two times.

Interesting observation is that in 2003 dummy for Ukrainian regions became significant and coefficient has a negative sign. It means that in 2003 the hidden economy index in region decreases by 0.02 if the region is in Ukraine. This difference might be connected with policy according to the Decree of the President of the 5th of March 2002 #216/2002 "Measures of the hidden economy reduction in Ukraine for 2002-2004", which stipulated reforming of the system of

tax privileges, deregulation of entrepreneurship, though today we used to say that under the Kuchma's presidency the economy was highly hidden.

Separate regression for Ukraine repeats the corresponding output for 2002 (see Figure 2). It shows that the number of small enterprises has a significant at 5% positive impact on the hidden economy. Unemployment has negative influence on the hidden economy index, though size of the impact decreases to -0.86. The agricultural and industrial shares have significant positive and almost equal impacts on the hidden economy index (0.597 and 0.595).

For Russian regions the output repeats the pooled one in 2003. Industrial share has bigger effect on hidden economy index (0.66) than agricultural one (0.54).

Converting of the hidden indices into values of the hidden economy expressed as percentage of GRP for 2003 is done as for 2002. The benchmark for 2003 is 50% of GDP in Ukraine.[6] In 2003 Moscow-city, Chukotka and St.Petersburg keep leading positions in hidden economy rating with the hidden economy size about 60% of GRP (see Appendix 7). Ingushetia stands out for the lowest hidden economy (18.54% of GRP). The biggest number of regions (60 regions) has the hidden economy in interval [50-55%). The picture of the distribution of the regions also shows less variability of the hidden economy among regions on the basis of MIMIC model as compared to the results obtained on the basis of electricity consumption method (see Figure 5).

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[6] www.intellect.org.ua – the Center of Social Research "Diamatik"
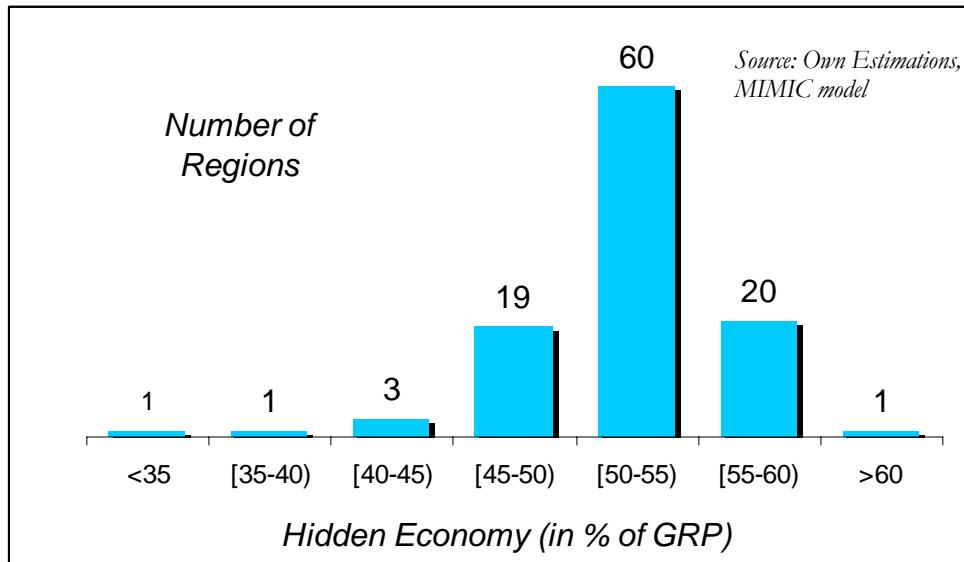
Figure 5. Distribution of Ukrainian and Russian Regions According to the Hidden Economy Size in 2003.

5.3. RESULTS 2001

The description of the obtained results for 2001 is done after estimation of regressions for 2002 and 2003, because it differs, since there is no immigration variable in set of causes due to the Population Census 2001 in Ukraine, though this cause appeared to be insignificant in the previous two regressions.

In 2001 for pooled regression tax pressure appeared to be insignificant (see Figure 1). Unemployment has significant negative influence on the hidden economy index. Shares of agriculture and industry have significant positive effects, and industry share influences the hidden economy index a little bit more than agriculture share (0.59 vs. 0.57).

The benchmark for converting estimated indices into the hidden economy estimates expressed as percentage of GRP is 52,2% of GDP for Ukraine in 2001 according to the Institute of Labor Market survey (Germany) of the hidden economy in Ukraine in 2000-2001[7]. In 2001 the leaders in the hidden economy

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[7] ICPS, 'Legalization of Personal Incomes of Citizens', Analytical report

list are Moscow-city, Kyiv and St. Petersburg with the hidden economy about 55-57% of GRP (see Appendix 9). The lowest values belong to Ingushetia (31.71%) and Dagestan (35.83%). The biggest number of regions (50) fall into the interval of the hidden economy [50-55%), 45 regions have the hidden economy at the level [45-50%) (see Figure 6).

Source: Own Estimations, MIMIC model
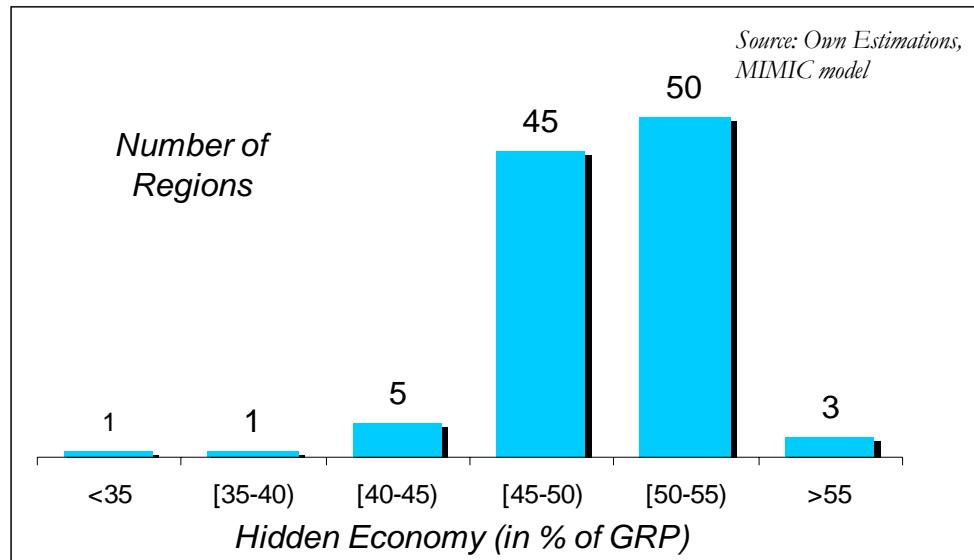
Figure 6. Distribution of Ukrainian and Russian Regions According to the Hidden Economy Size in 2001.

5.4. CHANGES IN DISTRIBUTION OF UKRAINIAN AND RUSSIAN REGIONS ACCORDING TO THE HIDDEN ECONOMY PERCENTAGE IN 2001-2003.

In Appendix 10 I present outputs for regressions on pooled regions in 2002 and 2003 without immigration variable to make estimations of the hidden economy in three years comparable. In Appendix 11 the estimates of the hidden economy of pooled regions of Russia and Ukraine for all three years are presented.

The general picture is that there is no large variability among regions given the causes and indicators of the model. The hidden economy percent of

GRP is within approximate interval (19-66%). The leading positions in rating of regions according to the hidden economy value is kept by capital Moscow; St.Petersburg is always at the 3rd place during 2001-2003; Chukotka being at the 74th place (49.02%) in 2001 jumped to the 1st place in 2002 (66.42%) and the 2nd (59.87%) in 2003. Ukrainian capital Kyiv shows decreasing trend in pooled rank: in 2001 – the 2nd place (55.80%), in 2002 – the 16th place (58.40%), in 2003 – the 31st place (54.02%).

Another trend is that in 2001 Ukrainian regions (primarily East and South of the country – Dnipropetrovska oblast, Crimea, Poltavaska, Donetska, Odesska, and Zaporizka oblasts) are in the top ten regions, but in 2002 and 2003 they became far below Russian regions, and top ten was occupied by Russian regions, mostly form the West of the country (Yaroslavskaya, Moscowskaya, Lipetskaya, Vologodskaya, Samarskaya oblasts, though Magadanskaya oblast and Khabarovskiy kray are large by territory eastern regions).

The lowest in the rank hidden economy values correspond to Ingushetia (31.71% in 2001, 29.057% in 2002, 18.85% in 2003) and Dagestan (35.83% in 2001, 40.80% in 2002, 39.77% in 2003). But we should not understand these results as in the given regions economies are more transparent. The more real explanation is that due to the destruction of economy because of war actions there are no normal economic relationships and statistics given by Goskomstat of Russia doesn't describe the real situation in regions.

5.5. ESTIMATION OF THE HIDDEN ECONOMY OF POOLED UKRAINIAN AND RUSSIAN REGIONS ON THE BASIS OF PANEL DATA IN 2001-2003.

I have run SURE regression for panel data, pooling regions for two countries and for three years (see Figure 7). The same variables as in the previous regressions are significant with the same signs. Industry share has a little bit higher impact on the hidden economy index (0.63) than agriculture (0.56). Also,

on the basis of the MIMIC model for panel data estimates of the hidden economy in regions are made (see Appendix 13). The leaders of the rank remain the same: Moscow-city, St. Petersburg, Chukotka, and the lowest values of the hidden economy again correspond to Ingushetia and Dagestan. Interesting observation is that now there are no substantial jumps of regions in the rank from year to year. For example, if in the previous case (see Appendix 11) Chukotka being at the 74th place (49.02%) in 2001 jumped to the 1st place (66.42%) in 2002 and the 2nd 59.87%) in 2003, now for panel estimation the region changes place from the 3rd (58.70%) in 2001 to the 2[nd](61.81%) in 2002 and remains the 2nd (60.60%) in 2003.

Cause	Coefficients
Tax pressure	0.24
Unemployment	-0.74
Number of small enterprises	
Criminal	
Immigration	----
Industry share	0.63
Agriculture share	0.56
Dummy for Ukraine	

Note: only statistically significant (at 5% significance level) coefficients are reported in the table

Figure 7. MIMIC Estimation of the Hidden Economy for Pooled Ukrainian and Russian Regions on Panel Data (without fixed effects).

I have also incorporated fixed effects into the estimation of the regional hidden economy on the basis of panel data (see Appendix 15). For 105 dummies for each region of pooled sample of Russian and Ukrainian regions 56 dummies appeared to be significant with positive and negative signs. It means that for some regions there are specific determinants of the hidden economy that were not incorporated in the set of causes. The tax pressure became insignificant.

Number of small enterprises is significant at 10% and positively influences the hidden economy. As in the previous regressions industry and agriculture shares have significant positive impact on the hidden economy in the region with industry influence dominating over agriculture influence (industry share coefficient (0.69) vs. agriculture share coefficient (0.47)). Criminality level has a significant at 5% negative impact on the hidden economy supporting the hypothesis that economic agents do not want to switch business into the shadow because of possible criminal pressure in the hidden sector, which supports findings of Nikolaenko (1997). There is no immigration variable in the panel data because of unavailable data on immigration in Ukraine in 2001 due to the Population Census.

In Appendix 16 the estimations of the hidden economy on the basis of panel data for pooled Russian and Ukrainian regions for 2001-2003 with dummies for each region are presented. Moscow-city and Chukotka remain the leaders in the rank, though St. Petersburg in 2001 is at the 9th position (57.94%), in 2002 in the 5th position (60.54%) and only in 2003 it becomes the 3rd (57.71%) in the rank. Ingushetia still has the lowest hidden economy, though Dagestan now has higher rank, and the lowest positions are occupied by Ternopil, Chernivtsi, Tyva in 2001; Chernivtsi, Ternopil, Kabardino-Balkaria in 2002; Kabardino-Balkaria, Karachaevo-Cherkesia, Chernivtsi in 2003. Changes in the distribution of regions after incorporation of regional dummies are logical, since now the omitted specific regional causes, which difficult to incorporate in one model, take on significance in the hidden economy estimation.

Also, I have included dummies for years in estimation of the hidden economy and obtained that 2002 and 2003 influence positively the hidden economy index, though the sizes of their effects are much lower than the sizes of other variables effects (see Figure 8). Including dummies for years did not influence the coefficients of the other variables much if compared to the regression on the basis of panel data without dummies for each region (Figure 7).

Cause	Coefficients
Tax pressure	0.22
Unemployment	-0.71
Number of small enterprises	
Criminal	
Immigration	----
Industry share	0.60
Agriculture share	0.53
Dummy for 2002	0.028
Dummy for 2003	0.023

Note: only statistically significant (at 5% significance level)
coefficients are reported in the table

Figure 8. MIMIC Estimation of the Hidden Economy for Pooled Ukrainian and Russian Regions on Panel Data (with dummies for years).

5.6. ESTIMATION OF THE HIDDEN ECONOMY SEPARATLY FOR UKRAINIAN AND RUSSIAN REGIONS ON THE BASIS OF PANEL DATA IN 2001-2003

The estimation output on the basis of panel data of Ukrainian regions for 2001-2003 (see Figure 9) confirms my previous findings that unemployment negatively influences the hidden economy index, shares of agriculture and industry have significant positive impacts, with agriculture having a little bit higher impact than industry (0.72 vs 0.66) for Ukraine. Also, with bigger number of small enterprises the hidden economy in Ukrainian region increases. Tax pressure is significant at 10%, though it has a negative sign, which might be explained by the intuition of the model that increased tax revenues lead to more supply of public goods, which exceeds the effect of decreased profits due to higher tax pressure on the decision to operate in the shadow, though for Ukraine

it sounds unrealistic. Criminality level is insignificant. I again point out that even using panel data sample size is not big (26 regions for three years - 78 observations).

Regression on panel data of Russian regions (see Figure 9) shows that tax pressure has a significant positive effect on the hidden economy index and the coefficient (0.26) corresponds to the one estimated on the basis of panel data of pooled regions in 2003 and separately Russian regions in 2003. The same correspondence is observed for unemployment variable, which has a negative effect on the hidden economy index (-0.73). As in the previous estimations, industry share has slightly bigger influence on the hidden economy index than agriculture (0.66 vs. 0.57) for Russian regions. Criminality level in the region has a significant at 10% negative impact, which corresponds to the regression on the basis of panel data for pooled regions including fixed effects. Immigration being insignificant in the previous estimations now has a significant at 5% negative influence on the hidden economy index (-0.19), which contradicts the hypothesis of the model that predicts that regions with higher foreign immigration have higher hidden sector.

Cause	Ukraine	Russia
Tax pressure	-0.47*	0.26
Unemployment	-1.13	-0.74
Number of small enterprises	0.00006	
Criminal		-0.000008*
Immigration	----	-0.19
Industry share	0.66	0.66
Agriculture share	0.72	0.57

Note: only statistically significant (at 5% significance level) coefficients are reported in the table

* - significant at 10% significance level.

Figure 9. MIMIC Estimation of the Hidden Economy Separately for Ukrainian and Russian Regions on the Basis of Panel Data for 2001-2003.

Hence, in most regressions of the MIMIC model tax pressure, unemployment and regional specialization (agricultural or industrial) appeared to have significant impacts on the hidden economy. Tax pressure has a positive effect on the hidden economy in major cases as theory predicts. Unemployment has an unexpected negative influence. Agricultural and industrial specializations have positive, almost equal in size impacts on the hidden economy.

C h a p t e r 6

POLICY IMPLICATIONS

At first, I would like to discuss policy implications connected with determinants of the hidden economy that appeared to be insignificant in most MIMIC estimations. Note, because of not perfect proxies for certain causes and sample size constraint, I would not suggest just to disregard those insignificant factors in elaborating policy of the hidden economy reduction in regions of Ukraine and Russia. Though it is also possible to see some practical evidence why such causes as criminality level, immigration and number of small enterprises became insignificant.

CRIMINALITY

The problem of the hidden economy started to be investigated in the 70's and historically has a criminal origin. In the 90's when the hidden economy size increased highly the main point of the policy was struggle against the very criminal activity. For example, according to the analytical report of the Ukrainian Center of Economic and Political Research "Hidden economy and organized crime: today's situation and issues of the fight against them" for 1991-1995 criminal part of the hidden economy constituted about 50% of the latter.[8] It's not surprising that the war against the criminal activity was in the center of the state policy in Ukraine and Russia in those years. There were many restructurings of the law-enforcement authorities, the law background of operating of the above authorities was strengthened, and the government pinned its hope on operative investigating bodies of the General Office of Public Prosecutor.

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[8] www.zerkalo-nedeli.com - #6(71), 10-16 February, 1996

Though the absolute values of the hidden economy did not fall down, but the forms of it have changed. Today hidden economy is mostly not the mafia's business, but activity of legal firms that conceal their profits to avoid high taxation. Also, the criminal pressure is not the main factor determining the decision of today's enterprises whether to come into the shadow. Since forms of the hidden economy in the 90's and today differ, policies against the hidden economy in the 90's and in the 21st century are also not the same.

IMMIGRATION

After the USSR's collapse in newly appeared countries there was no necessary experience of immigration policy, an appropriate migration law and institutions, so hidden economy increased rapidly and demanded labor force of immigrants. At present moment the issues of immigration policy are relatively settled. The laws about citizenship, refugees, legal status of foreigners and people without citizenship were adopted. In august 2001 the Law of Ukraine "About Immigration" joined into force according to which there is an immigration quote determined by the government. In 2004 this quote constituted 15 thousand while in 2003 it was 24 thousand. The State committee on nationalities and migration elaborated the program of regulation of migration processes, approved by the Cabinet of Ministers of Ukraine of 20.08.2003 #1296. In the Russian Federation the most important law about the legal status of the foreign citizens joined into force in 2002. For today the problem of regulation of the official migration in context of struggle against the hidden economy is rather solved, but still problems with illegal immigration remain.

NUMBER OF SMALL ENTERPRISES

In the 90's the process of creating and operating of small enterprises was complicated by bureaucratic procedures, numerous checks of the local authorities etc., so many enterprises preferred not to legalize the activity at all. Today the law base of operating of small enterprise is formed, the procedure of registration is simplified, and so, the small business began to develop rapidly. The small

entrepreneurs register their activity and pay taxes, but because of the high tax pressure they use some ways to avoid taxation, for example, through underreporting of the part of profits, paying wages in "envelopes", in such a way contributing to the value of the hidden sector in the region. But the point is that today if the number of small enterprises increases the GRP produced by them in the region also increases, but the percent of the hidden economy in GRP is not much influenced. So, the increasing number of small enterprises may not be the cause of the hidden economy in the region.

Let's now address the significant factors in the model: shares of agriculture and industry, unemployment and tax pressure.

AGRICULTURAL VS INDUSTRIAL PRODUCTION

In the latest years before the USSR's collapse the most rapid hidden economy increase was observed in agriculture. In 1989 turnover of the hidden funds in this sphere increased compared to 1965 640 times. The second position was occupied by building, transport, connection, and the third place belonged to industry.[9] Today, as the model has shown small difference between impacts of agricultural and industrial specialization on the hidden economy, agriculture and industry are inclined to the hidden activity to the same extent. This fact could be explained by solving some problems in legislation on agriculture, for example, consolidation of major taxes and social transfers in a single agricultural tax in Ukraine in 1999 and in Russia in 2001. Therefore, the suggestion for policy maker is not to make distinction for agricultural and industrial sectors while elaborating the hidden economy reduction policy.

UNEMPLOYMENT

Today hidden economy is created mostly by officially employed people, who use different ways to avoid taxation. The widespread way of tax avoidance is paying wages in "envelopes", underreporting of the actual income.

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[9] www.niss.gov.ua

TAX PRESSURE

The main message of the given work is that problem of today's hidden economy decrease is the problem of tax system, in particular tax pressure.

In 2005 in Ukraine the hidden economy decreased to 32% according to the Ministry of economy. The results are connected with policy of Timoshenko's government, which closed different hidden schemes. But this is one-time action, and since government changes frequently rational economic agents may expect that next government will not continue the aggressive attack against the ways of the hidden activity. There is a high probability that instead of the closed hidden schemes the new ones will appear. Also, without diminishing the merit of Timoshenko's policy, I wouldn't attribute hidden economy decrease fully to the closeness of the hidden schemes, because recall that since the 1st January 2004 corporate tax has been reduced from 30% to 25% and income tax constitutes 13% for the period 20004 -2006. So taking into account lag between time when law joined into force and economic results showed, mainly decreased tax pressure could serve as main factor for the hidden economy reduction.

In Russia for taking incomes out of the shadow progressive taxation was replaced by the fixed tax rate 13% in 2001. Politicians claimed that the reform decreased the tax pressure and led to the hidden economy reduction, because gathering of income taxes increased by 46.7 % in 2001 and by 39.7% in 2002. But it was a short-run effect, since in 2003 incomes of households increased by 28.2%, and gathering of the income taxes increased only by 27.2%[10]. To decrease the tax pressure as the main cause of the hidden economy the complex of reforms in tax system should be implemented.

Though tax rates are reduced the problem with systematization and straightforward interpretation of tax laws needs solving and the stability of tax law must be ensured. The example of instability of the tax law is that during

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[10] http://www.kp.ru/daily/23593/45422/

1997-2003 the alterations to the Law of Ukraine "About Value Added Tax" were made more than 70 times, to the Law "About Corporate Tax" more than 60 times, to the law concerning taxation of incomes of citizens – more than 10 times.[11] Making tax laws clear and stable will reduce the possibilities for criminal activity in sphere of taxation. There should the policy against reasons of the hidden activity – tax pressure and imperfection of tax laws, not the results – crimes in sphere of taxation.

The fact that regions don't differ much by their hidden sector size may be explained by the fact that regions are parts of one country, therefore, they are affected by the same system of state taxes and regulations. Concerning the local taxes they are quite small to add differentiation by the tax burden among regions. Though in the Russian Federation regions are more autonomous in fiscal policy than regions of unitary Ukraine. Since tax pressure is measured as ration of tax incomes in budget to GRP I should also take into account that there is redistribution through central budget. Probably, if the regions let be more autonomous the deviations of the tax pressure will increase and will lead to more deviations in the hidden economy.

The finding of the MIMIC model that there is no great variability among regions according to their hidden economy size may apply that policy against the hidden activity may be effectively implemented at the country's level, not going deeply into the region's specifics.

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[11] International Centre of Perspective Survey, Analytical report "Legalization of Personal Incomes of Citizens", 2004

CONCLUSIONS

First of all, I would like to conclude on theoretical side of MIMIC model.

The MIMIC model is useful to see how regions within one country or how countries within some global region differ by their hidden economy size given the chosen set of causes and indicators, but the estimation of absolute size of the hidden economy is questionable since it greatly depends on validity of the benchmark.

Since model involves numerous causes and indicators simultaneously the endogeneity problem appears, which undermines the estimation results such that for some factors we may conclude about correlation with hidden economy, not causation.

Today there is no doubt that hidden economy in transition countries is large, it was measured using different techniques, but what takes on special significance is not the absolute value of the hidden economy in region, but the hidden economy determinants and comparison among regions. If Kyiv in 2001 has hidden economy 55.80% of GRP is it high? Does it need extraordinary policy measures? And what if all other regions of the country have the hidden economy percent close to 50%? The western economists would say that 50% of GRP is alarming and regional economy is out of control. But it is not appropriate to apply western standards to evaluate whether the size of the hidden economy is high or normal, because having negative impacts, hidden economy was sort of naturally appeared shock-absorber which played a positive role for millions of unemployed searching for any sources of survival. So, the distribution of the regions matters.

Concerning practical results obtained on the basis of the MIMIC model for regions of Ukraine and Russia in 2001 – 2003 tax pressure as theory suggests has a significant positive effect on the hidden economy. Agricultural and

industrial specializations both have positive effects almost equal in size, which contradicts the belief that agriculture is naturally more inclined to the hidden activity in comparison with industry. Unemployment has unexpected negative impact, which can be explained that today's hidden economy is created by officially employed workers, who use different schemes to overcome taxation. Variables like criminality level, immigration and quantity of small enterprises in the region appeared to be insignificant in major estimations.

In comparison with electricity consumption method of the hidden economy measurement MIMIC model predicts less variability among regions of Russia and Ukraine given the set of chosen causes and indicators of the model. The hidden economy for pooled regions is within interval 19 - 66% of GRP, but the major part of the regions' sample falls into the range (50-60%).

There are given the following policy suggestions:

- Systematization and clarification of the tax system, and providing the stability of laws which bring tax pressure reduction constitute the kernel for today's policy against the hidden economy.

- There should be no distinction between agricultural and industrial spheres while elaborating policies for the hidden economy reduction.

- Struggle against the criminal activity, regulation of legal immigration and number of small enterprises in the region are not the main fields of the policy against the hidden activity today.

- Policy against hidden economy can be effectively carried out at the country's level.

56

Propositions for further research.

I would propose estimating of the MIMIC model for more years, incorporating new indicators (for example, presenting the specialization of the region not only by agriculture and industry, but also trade, building, services etc.; including foreign direct investments as indicator of the institutional development of the region etc.) as soon as official statistics is available.

It will be very interesting to apply MIMIC model to the regions of EU countries and see how regions differ by their hidden economy size. The research will be up-to-date since the EU constantly concerns about the convergence of the countries-members.

BIBLIOGRAPHY

Bajada, C. and F. Schneider (2005), 'The Development and Size of the Shadow Economies in the Asia-Pacific', manuscript Johannes Kepler University of Linz. Forthcoming in pacific Economic Review.

Breusch, T. (2005), 'Estimating the underground economy using MIMIC models', Centre for Social Research, Research School of Social Sciences and School of Economics, The Australian National University, Canberra.

Censis, (1976), 'L'occupazione occulta – caratteristiche della partecipazione al lavoro in Italia', Fondazione Censis, Rome.

Contini, B. (1981), 'Labor Market Segmentation and the Development of the Parallel Economy – the Italian Experience', Oxford Economic Papers, vol.33, nr.4, p. 401-412.

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

Ercolani, G. (2000), 'Inflation Tax and the Hidden economy', Department of Economics, University of Essex, Colchester, United Kingdom.

Feige, E. (1989), 'The Underground Economies: Tax Evasion and Information Distortion, Cambridge: Cambridge University Press.

Frey, B. and W. Pommerehne (1984), 'The Hidden Economy: State and Prospect

for Measurement', Review of Income and Wealth, vol. 30, nr.1, p. 1-23.

Frey, B. S. and H. Weck (1983a), 'Bureaucracy and the Shadow Economy: A Macro-Approach', Anatomy of Government Deficiencies, Berlin, p. 89-109.

Frey, B. S. and H. Weck (1983b), 'Estimating the Shadow Economy: A 'Naive' Approach', Oxford Economic Papers, nr. 35, p. 23-44.

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

Friedman, E., S. Johnson, D. Kaufman and P. Zoido-Lobaton (2000), 'Dodging the Grabbing hand: The Determinants of Unofficial Activity in 69 Countries,'

Journal of Public Economics, nr.76, p.459-493.

Giles, D. and L.M. Tedds (2002), 'Taxes and the Canadian Underground Economy', Canadian Tax Foundation: Toronto.

Giles, D. E. A. (1999), 'Modelling the Hidden Economy and the Tax-Gap in New Zealand', Empirical Economics, nr. 24, p.621—640.

Gutmann, P. (1977), 'The Subterranean Economy', Financial Analysts Journal, vol.34, nr.1, p. 24-27.

Institute of Strategic Analysis and Enterprise Development (1998), 'Informal sector in Russian economy', Moscow.

International Centre of Perspective Survey (2004), 'Legalization of personal incomes of citizens', Analytical report.

Isachsen, A., J. Klovland and S. Strom (1982), 'The Hidden Economy in Norway in: Tanzi Vito (ed.): The underground economy in the United States and Abroad', Heath, Lexington, p.209-231.

Joreskog, K. and A. S. Goldberger (1975), 'Estimation of a Model with Multiple Indicators and Multiple Causes of a Single Latent Variable', Journal of the American Statistical Association, nr.70, p.631—639.

Kaufmann, D. and A. Kaliberda (1996), 'Integrating the Unofficial Economy into the Dynamics of Post Socialist Economies: A Framework of Analyses and Evidence', Policy research working paper 1691, Washington, D.C., The World Bank.

Komarova, T. (2003), 'Hidden economy in Russian Regions, MA Thesis, New Economic School.

Kravchenko T. (2001), "Methods of Measurement and Forecasting of the Hidden Economy', Regional'na Economika, nr.1, p.80-82.

Loayza, N. V. (1997), 'The Economics of the Informal Sector: a Simple Model and Some Empirical Evidence from Latin America', World Bank Policy Research Working Paper, nr.1727.

Maurin, A., S. Sookram and P. K. Watson (2003), 'Measuring the Size of the Hidden Economy in Trinidad&Tobago', International Conference on Policy Modeling (EcoMod 2003), Instanbul.

Mel'ota, I. and P. Gregory (2001), 'New Insights into Ukraine's Shadow Economy: Has it Already Been

Counted?', Institute for Economic Research and Policy Consulting, nr.11.

Nikolayenko, S., Y. Lissovolic and R. MacFarquar (1997), 'Special Report: The Shadow Economy in Russia's Regions, Russian Economic Trends, nr.4.

Petersen, H.-G. (1982), 'Size of the Public Sector, Economic Growth and the Informal Economy: Development Trends in the Federal Republic of Germany', Review of Income and Wealth, vol.28, nr.2, p. 191-215.

Schneider, F. (2002), 'Size and Measurement of the Informal Economy in 110 Countries round the World', Workshop of Australian national Tax Centre, ANU, Canberra, Australia.

Schneider, F. (2004), 'Shadow Economies around the World:

What do We Really Know?', Department of Economics, Johannes Kepler University of Linz, Austria.

Schneider, F. and D. H. Enste (2000), 'Shadow Economy: Size, Causes and Consequences', Journal of Economic Literature, vol. 38, nr.1, p.77—114.

Smith, J.D. (1985), 'Market Motives in the Informal Economy, in Gaertner, W. and Wenig, A. (eds.): The Economics of the Informal Economy, Heidelberg: Springer Publishing Company, p. 161-177.

Tanzi, V. (1983), 'The Underground Economy in the United States: Annual Estimates, 1930-1980', IMF-Staff Papers, vol. 30, nr.2, p. 283-305.

Tedds, L. (1998), 'Measuring the Size of the Hidden Economy in Canada: a Latent

Variable/MIMIC Model Approach', Department of Economics, University of Victoria, Canada.

Westin, P. (2002), 'Emerging from the Shadow: Special Topics in Russian Economy', Aton Capital Group.

Zellner, A. (1970), 'Estimation of Regression Relationships Containing Unobservable Variables', International Economic Review, nr.11, p.441-454.

www.business.kiev.ua/ #25, 23.06.2003

www.intellect.org.ua

www.kfm.ru

www.kp.ru/daily/23593/454 22/

www.kremlin.ru/text/appears /2005/04/87049.shtml)

www.niss.gov.ua

www.rg.ru

www.strana-oz.ru

www.utr.ukrintell.com.ua/ne ws

www.zerkalo-nedeli.com - #6(71), 10-16 February, 1996

MIMIC Model for Estimation of the Size and Determinants of the Hidden Economy in Regions of Ukraine and Russia.

CAUSES   INDICATORS

| RATIO OF TAX INCOME IN GRP |

| UNEMPLOYMENT RATE |

| PERCENT OF AGRICULTURAL/ INDUSTRIAL ADDED VALUES IN THE TOTAL SUM OF AGRICULTURE AND INDUSTRY |

| NUMBER OF SMALL ENTERPRISES |

| IMMIGRATION |

| CRIMINALITY LEVEL |

REGIONAL HIDDEN ECONOMY SIZE

| EMPLOYMENT |

| REAL GROSS REGIONAL PRODUCT PER CAPITA |
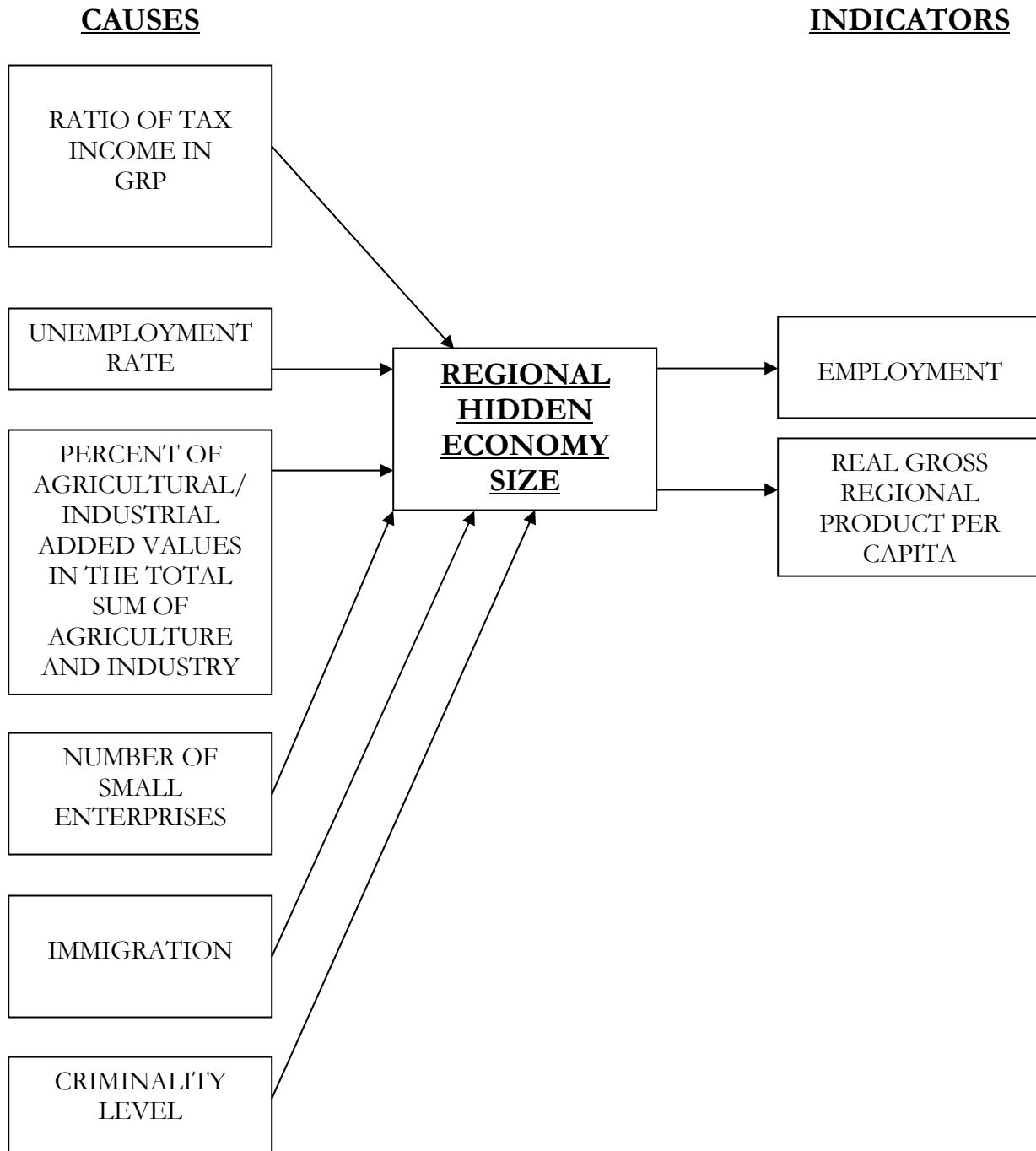
Regions of Russia and Ukraine Used in the Model.

Russia

Region	Full name	Region	Full name
Belgorod	Belgorodskaya oblast	Mordovia	Republic of Mordovia
Bryansk	Bryanskaya oblast	Tatarstan	Republic of Tatarstan
Vladimir	Vladimirskaya oblast	Udmurtia	Republic of Udmurtia
Voronezh	Voronezhskaya oblast	Chuvashia	Republic of Chuvashia
Ivanovo	Ivanovskaya oblast	Kirov	Kirovskaya oblast
Kaluga	Kaluzhskaya oblast	Nizh.Novgorod	Nizhegorodskaya oblast
Kostroma	Kostromskaya oblast	Orenburg	Orenburgskaya oblast
Kursk	Kurskaya oblast	Penza	Penzenskaya oblast
Lipetsk	Lipetskaya oblast	Perm	Permskaya oblast
Moscow	Moskovskaya oblast	Samara	Samarskaya oblast
Orel	Orlovskaya oblast	Saratov	Saratovskaya oblast
Ryazan	Ryazanskaya oblast	Ulyanovsk	Ulyanovskaya oblast
Smolensk	Smolenskaya oblast	Kurgan	Kurganskaya oblast
Tambov	Tambovskaya oblast	Sverdlov	Sverdlovskaya oblast
Tver	Tverskaya oblast	Tyumen	Tyumenskaya oblast
Tula	Tulskaya oblast	Chelyabinsk	Chelyabinskaya oblast
Yaroslavl	Yaroslavskaya oblast	Altai R	Republic of Altai
Moscow-city	City of Moscow	Buryatia	Republic of Buryatia
Karelia	Republic of Karelia	Tyva	Republic of Tyva
Komi	Republic of Komi	Khakassia	Republic of Khakassia
Arkhangelsk	Arkhangelskaya oblast	Altai K	Altaisky krai
Vologda	Vologodskaya oblast	Krasnoyarsk	Krasnoyarsky krai
Kaliningrad	Kaliningradskaya oblast	Irkutsk	Irkutskaya oblast
Leningrad	Leningradskaya oblast	Kemerovo	Kemerovskaya oblast
Murmansk	Murmanskaya oblast	Novosibirsk	Novosibirskaya oblast
Novgorod	Novgorodskaya oblast	Omsk	Omskaya oblast
Pskov	Pskovskaya oblast	Tomsk	Tomskaya oblast
St.Petersburg	City of St.Petersburg	Chita	Chitinskaya oblast
Adygeia	Republic of Adygeia	Sakha	Republic of Sakha (Yakutia)
Dagestan	Republic of Dagestan	Primorsk	Primorsky krai
Ingushetia	Republic of Ingushetia	Khabarovsk	Khabarovsky krai
Kabardino-Balkaria	Republic of Kabardino-Balkaria	Amur	Amurskaya oblast
Kalmykia	Republic of Kalmykia	Kamchatka	Kamchatskaya oblast
Karachaevo-Cherkesia	Republic of Karachaevo-Cherkesia	Magadan	Magadanskaya oblast
S.Osetia-Alania	Republic of Severnaya Osetia (Alania)	Sakhalin	Sakhalinskaya oblast
Krasnodar	Krasnodarsky krai	EAO	Evreiskaya avtonomnaya oblast
Stavropol	Stavropolsky krai	Chukotka	Chukotsky avtonomny okrug
Astrakhan	Astrakhanskaya oblast		
Volgograd	Volgogradskaya oblast		
Rostov	Rostovskaya oblast		
Bashkortostan	Republic of Bashkortostan		
Marij-El	Republic of Marij-El		

Ukraine

Region	Full name	Region	Full name
Cherkasy	Cherkaska oblast	Poltava	Poltavska oblast
Chernihiv	Chernihivska oblast	Rivne	Rivnenska oblast
Chernivtsi	Chernivtska oblast	Sumy	Sumska oblast
Dnipropetrovsk	Dnipropetrovska oblast	Ternopil'	Ternopilska oblast
Donetsk	Donetska oblast	Vinnytsia	Vinnytska oblast
Ivano-Frankivsk	Ivano-Frankivska oblast	Volyn	Volynska oblast
Kharkiv	Kharkivska oblast	Zakarpattia	Zakarpatska oblast
Kherson	Khersonska oblast	Zaporizhzhia	Zaporizka oblast
Khmelnytskyi	Khmelnytska oblast	Zhytomyr	Zhytomyrska oblast
Kirovohrad	Kirovohradska oblast	Crimea	Autonomous Republic Crimea
Kiev Oblast	Kievska oblast	Kyiv	Kyiv
Luhansk	Luhanska oblast		
Lviv	Lvivska oblast		
Mykolaiv	Mykolaivska oblast		
Odessa	Odeska oblast		

APPENDIX 3

Desription of Variables

Variable	Description, units of measurement
SHARE OF TAX INCOME IN GRP	shares
UNEMPLOYMENT RATE	ratio of registered unemployed (according to ILO) to economically active population of 15-70 age, shares
SHARE OF AGRICULTURAL PRODUCTION IN TOTAL SUM OF AGRICULTURAL AND INDUSTRIAL PRODUCTION	shares
SHARE OF INDUSTRIAL PRODUCTION IN TOTAL SUM OF AGRICULTURAL AND INDUSTRIAL PRODUCTION	shares
NUMBER OF SMALL ENTERPRISES	per 100 000 population
IMMIGRATION	share of emigrated from abroad from all arrived at the region
CRIMINALITY LEVEL	number of registered crimes, per 100 000 population
EMPLOYMENT RATE	average annual quantity of employed to total population of 15-70 age, shares
REAL GRP PER CEPITA	real gross regional product per capita, UAH

Note:

For pooled data RUR is converted into UAH according to annual exchange rate set by NBU in 2001 (10 RUR=1.84 UAH), 2002 (10 RUR=1.70 UAH), 2003 (10 RUR=1.74 UAH))

For calculations of real GRP CPI of regions is used.

For Ukraine in calculations of share of agricultural and industrial production I use data on agriculture and industry that is formed according to homogeneous goods that belong to the corresponding kind of economic activity according to the Classificatory of Kinds of Economic Activity (KVED) taking into account data on local entities . Agriculture also includes hunting and forestry. Industry also includes extractive, manufacturing industry, generation and distribution of electricity, gas and water.

Data Summary and Regressions Outputs (2002)

Data Summary

Russia
```
.  sum    tax_grp_s  emp_rate_s  unemp_rate_s  immigrations  ind02nshare  agr02nshare
enter_100000 real_grp_per_cap criminal

    Variable |        Obs        Mean    Std. Dev.        Min         Max
-------------+--------------------------------------------------------------
    tax_grp_s |         79    .1102911    .0264445         .07        .262
   emp_rate_s |         79    .5877089    .0551967        .309        .739
 unemp_rate_s |         79    .0943671    .0535669        .014         .44
 immigrations |         79    .0788354    .0442488        .006        .206
  ind02nshare |         79    .7619076    .1679377        .191           1
-------------+--------------------------------------------------------------
  agr02nshare |         79    .2380924    .1679377           0        .809
 enter_100000 |         79    475.5003     307.439       54.18     1919.04
  real_grp_p~p |         79    8584.393    8332.432     1187.53    58904.23
     criminal |         79    1704.304    486.8282         348        2969
```

Ukraine
```
.  sum    tax_grp_s   emp_rate_s   unemp_rate_s  immigrations  ind02nshare  agr02nshare
enter_100000 real_grp_per_cap criminal

    Variable |        Obs        Mean    Std. Dev.        Min         Max
-------------+--------------------------------------------------------------
    tax_grp_s |         26    .0744615    .0149966        .057        .128
   emp_rate_s |         26        .553    .0508283        .434         .65
 unemp_rate_s |         26    .1087692    .0273149        .056         .16
 immigrations |         26    .1271385    .0750669       .0478       .3519
  ind02nshare |         26    .8384115    .0900904        .672       .9888
-------------+--------------------------------------------------------------
  agr02nshare |         26    .1615885    .0900904       .0112        .328
 enter_100000 |         26    494.6304    227.1221      320.16     1536.76
  real_grp_p~p |         26    3815.675    2048.302     2302.58    12988.42
     criminal |         26    860.6985    258.9459      483.09     1446.13
```

Pooled
```
.  sum     tax_grp_s   emp_rate_s   unemp_rate_s  immigrations  ind02nshare  agr02nshare
enter_100000 real_grp_per_cap criminal

    Variable |        Obs        Mean    Std. Dev.        Min         Max
-------------+--------------------------------------------------------------
    tax_grp_s |        105     .101419    .0286359        .057        .262
   emp_rate_s |        105    .5791143      .05597        .309        .739
 unemp_rate_s |        105    .0979333     .048687        .014         .44
 immigrations |        105    .0907962    .0571131        .006       .3519
  ind02nshare |        105    .7808514     .155577        .191           1
-------------+--------------------------------------------------------------
  agr02nshare |        105    .2191486     .155577           0        .809
 enter_100000 |        105    480.2372    288.7179       54.18     1919.04
  real_grp_p~p |        105    7403.568    7573.508     1187.53    58904.23
     criminal |        105    1495.411    572.4784         348        2969
```

```
.  corr    tax_grp_s   emp_rate_s   unemp_rate_s   immigrations   ind02nshare   agr02nshare
enter_100000 criminal real_grp_per_cap
(obs=105)
             | tax_gr~s emp_ra~s unemp_~s immigr~s ind02n~e agr02n~e e~100000
-------------+-----------------------------------------------------------------
   tax_grp_s |   1.0000
  emp_rate_s |   0.4470   1.0000
unemp_rate_s |  -0.2520  -0.8204   1.0000
immigrations |  -0.0351   0.1092  -0.2413   1.0000
  ind02nshare |   0.0597   0.5281  -0.5193   0.2591   1.0000
  agr02nshare |  -0.0597  -0.5281   0.5193  -0.2591  -1.0000   1.0000
enter_100000 |   0.0925   0.3479  -0.3552   0.1584   0.4096  -0.4096   1.0000
    criminal |   0.4106   0.3847  -0.3096  -0.2358   0.1059  -0.1059   0.0796
  real_grp_p~p |   0.3901   0.2725  -0.1849  -0.1036   0.3209  -0.3209   0.2263

             | criminal real_g~p
-------------+------------------
    criminal |   1.0000
  real_grp_p~p |   0.3954   1.0000
```

Regressions Outputs

Pooled regression
I- normalization on indicator variable - real GRP per capita

```
.  sureg (real_grp_per_cap   tax_grp_s unemp_rate_s enter_100000 criminal    agr02nshare
ind02nshare   immigrations   dummyUkr, nocon) (emp_rate_s   real_grp_per_cap, nocon)

Seemingly unrelated regression
------------------------------------------------------------------------
Equation         Obs  Parms       RMSE    "R-sq"       chi2       P
------------------------------------------------------------------------
real_grp_p~p     105     8      6686.26   0.5995     312.64   0.0000
emp_rate_s       105     1    .4233652    0.4705     219.23   0.0000
------------------------------------------------------------------------


------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
real_grp_p~p |
   tax_grp_s |   43618.15   21039.36     2.07   0.038     2381.754    84854.54
unemp_rate_s |   6523.952    12881.2     0.51   0.613    -18722.74    31770.64
enter_100000 |   1.615331   1.865895     0.87   0.387    -2.041756    5.272418
    criminal |    1.72464   1.181892     1.46   0.145    -.5918251    4.041105
  agr02nshare |  -5947.483   4677.099    -1.27   0.204    -15114.43    3219.462
  ind02nshare |   3721.518   3958.048     0.94   0.347    -4036.114    11479.15
immigrations |  -7284.791   9740.179    -0.75   0.455    -26375.19    11805.61
    dummyUkr |   -358.897   1801.412    -0.20   0.842      -3889.6    3171.806
-------------+----------------------------------------------------------------
emp_rate_s   |
real_grp_p~p |   .0000508    3.43e-06    14.81   0.000     .0000441    .0000575
------------------------------------------------------------------------------
```

5

Pooled regression
II- normalization on indicator variable - employment rate
```
. sureg (real_grp_per_cap    emp_rate_s, nocon) (emp_rate_s      tax_grp_s unemp_rate_s
enter_100000 criminal agr02nshare ind02nshare immigrations dummyUkr, nocon)

Seemingly unrelated regression
-----------------------------------------------------------------------
Equation          Obs  Parms       RMSE     "R-sq"        chi2        P
-----------------------------------------------------------------------
real_grp_p~p      105      1      7374.2     0.5128      111.72   0.0000
emp_rate_s        105      8    .0269429     0.9979    49054.69   0.0000
-----------------------------------------------------------------------

-------------------------------------------------------------------------------
             |      Coef.    Std. Err.       z     P>|z|     [95% Conf. Interval]
-------------+-----------------------------------------------------------------
real_grp_p~p |
  emp_rate_s |     13074.3    1236.924    10.57    0.000     10649.97    15498.62
-------------+-----------------------------------------------------------------
emp_rate_s   |
   tax_grp_s |    .4573942    .1136318     4.03    0.000       .23468    .6801085
unemp_rate_s |   -.7427835    .0698726   -10.63    0.000    -.8797313   -.6058356
enter_100000 |    6.18e-06    .0000101     0.61    0.542    -.0000137     .000026
    criminal |    1.09e-06    6.40e-06     0.17    0.865    -.0000115    .0000136
 agr02nshare |    .5489239    .0251699    21.81    0.000     .4995919    .5982559
 ind02nshare |    .6271183    .0215029    29.16    0.000     .5849733    .6692633
immigrations |   -.0704555    .0528913    -1.33    0.183    -.1741206    .0332095
    dummyUkr |    -.011259    .0097897    -1.15    0.250    -.0304466    .0079285
-------------------------------------------------------------------------------
```
Test whether impacts of agriculture and industry shares on the hidden economy index significantly differ.
```
. test  agr02nshare= ind02nshare

 ( 1)  [emp_rate_s]agr02nshare - [emp_rate_s]ind02nshare = 0
        chi2( 1) =   12.39
      Prob > chi2 =    0.0004
So, the impacts of agriculture and industry differ.
```
What variable to choose for normalization.
```
. reg real_grp_per_cap  tax_grp_s unemp_rate_s enter_100000 criminal   agr02nshare
ind02nshare  immigrations  dummyUkr
      Source |       SS        df        MS              Number of obs =      105
-------------+------------------------------           F(  7,     97) =     6.84
       Model | 1.9708e+09        7   281545426           Prob > F      =   0.0000
    Residual | 3.9944e+09       97  41179557.9           R-squared     =   0.3304
-------------+------------------------------           Adj R-squared =   0.2821
       Total | 5.9652e+09      104  57358029.8           Root MSE      =   6417.1


-------------------------------------------------------------------------------
real_grp_p~p |      Coef.    Std. Err.       t     P>|t|     [95% Conf. Interval]
-------------+-----------------------------------------------------------------
   tax_grp_s |    74363.51    27310.42     2.72    0.008     20159.88    128567.1
unemp_rate_s |    25264.47    16793.04     1.50    0.136    -8065.066       58594
enter_100000 |    2.941447    2.434189     1.21    0.230    -1.889744    7.772639
    criminal |    3.236577    1.538012     2.10    0.038     .1840501    6.289104
 agr02nshare |   (dropped)
 ind02nshare |    16888.86    5339.925     3.16    0.002     6290.588    27487.13
immigrations |   -12523.13    12711.99    -0.99    0.327    -37752.92    12706.65
    dummyUkr |   -481.2018    2352.885    -0.20    0.838    -5151.026    4188.623
       _cons |   -20796.63    6048.943    -3.44    0.001    -32802.11   -8791.153
-------------------------------------------------------------------------------
```
Note: agr02share is dropped, because shares of agricultural and industrial production sum up to 1, which is the same as to include the constant.

```
reg  emp_rate_s tax_grp_s unemp_rate_s enter_100000 criminal   agr02nshare ind02nshare
immigrations  dummyUkr

      Source |       SS       df       MS              Number of obs =     105
-------------+------------------------------           F(  7,    97) =   45.61
       Model |  .249881944      7  .035697421          Prob > F      =  0.0000
    Residual |    .0759127     97  .000782605          R-squared     =  0.7670
-------------+------------------------------           Adj R-squared =  0.7502
       Total |  .325794644    104  .003132641          Root MSE      =  .02798


------------------------------------------------------------------------------
    emp_rate_s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    tax_grp_s |   .4277735   .1190581     3.59   0.001     .1914762    .6640709
 unemp_rate_s |  -.7579335   .0732082   -10.35   0.000    -.9032315   -.6126354
 enter_100000 |   4.94e-06   .0000106     0.47   0.642    -.0000161     .000026
     criminal |  -3.06e-07   6.70e-06    -0.05   0.964    -.0000136     .000013
  agr02nshare |  (dropped)
  ind02nshare |   .0713218   .0232791     3.06   0.003     .0251192    .1175243
 immigrations |  -.0654301   .0554171    -1.18   0.241    -.1754178    .0445576
     dummyUkr |  -.0111144   .0102573    -1.08   0.281    -.0314722    .0092435
        _cons |   .5610408     .02637    21.28   0.000     .5087036    .6133779
------------------------------------------------------------------------------
```

Test for joint significance of agriculture and industry shares.
```
. test  agr02nshare ind02nshare
 ( 1)  agr02nshare = 0
 ( 2)  ind02nshare = 0
       Constraint 1 dropped
       F(  1,    97) =    9.39
            Prob > F =    0.0028
```
So, shares of agriculture and industry are jointly significant.
```
. reg  emp_rate_s tax_grp_s unemp_rate_s enter_100000 criminal   agr02nshare ind02nshare
immigrations  dummyUkr, nocon

      Source |       SS       df       MS              Number of obs =     105
-------------+------------------------------           F(  8,    97) = 5664.43
       Model |  35.4640843      8  4.43301054          Prob > F      =  0.0000
    Residual |   .075912723     97  .000782605         R-squared     =  0.9979
-------------+------------------------------           Adj R-squared =  0.9977
       Total |   35.539997    105  .338476162          Root MSE      =  .02798


------------------------------------------------------------------------------
    emp_rate_s |      Coef.   Std. Err.      t    P>|t|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    tax_grp_s |   .4277736   .1190581     3.59   0.001     .1914762     .664071
 unemp_rate_s |  -.7579334   .0732082   -10.35   0.000    -.9032315   -.6126354
 enter_100000 |   4.94e-06   .0000106     0.47   0.642    -.0000161     .000026
     criminal |  -3.06e-07   6.70e-06    -0.05   0.964    -.0000136     .000013
  agr02nshare |   .5610407     .02637    21.28   0.000     .5087036    .6133779
  ind02nshare |   .6323625   .0225271    28.07   0.000     .5876525    .6770725
 immigrations |  -.0654301   .0554171    -1.18   0.241    -.1754178    .0445576
     dummyUkr |  -.0111143   .0102573    -1.08   0.281    -.0314722    .0092435
------------------------------------------------------------------------------
```

Test for joint significance of agriculture and industry shares.
```
. test  ind02n agr02n
 ( 1)  ind02nshare = 0
 ( 2)  agr02nshare = 0
       F(  2,    97) =  417.19
            Prob > F =    0.0000
```
So, shares of agriculture and industry are jointly significant.

Separate Regressions for Ukrainian and Russian Regions with normalization on employment rate on the basis of cross-section data (2002).

Ukraine 2002

```
. sureg ( real_grp_per_cap  emp_rate_s, nocon) ( emp_rate_s   tax_grp_s unemp_rate_s
enter_100000 criminal   agr02nshare ind02nshare  immigrations, nocon)

Seemingly unrelated regression
------------------------------------------------------------------------
Equation          Obs  Parms        RMSE      "R-sq"        chi2        P
------------------------------------------------------------------------
real_grp_p~p       26     1     1885.527      0.8088      111.33   0.0000
emp_rate_s         26     7    .0307899      0.9969     8802.48   0.0000
------------------------------------------------------------------------
```

```
-----------------------------------------------------------------------------
             |      Coef.   Std. Err.       z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
real_grp_p~p |
  emp_rate_s |   7026.002   665.8818    10.55   0.000     5720.898    8331.106
-------------+---------------------------------------------------------------
emp_rate_s   |
   tax_grp_s |  -.885329    .7294736    -1.21   0.225    -2.315071    .544413
unemp_rate_s |  -1.374488   .2881797    -4.77   0.000    -1.939309   -.8096657
enter_100000 |   .0000859   .0000445     1.93   0.053    -1.28e-06   .0001732
    criminal |   .0000515   .0000323     1.60   0.111    -.0000118   .0001148
 agr02nshare |   .7748703   .088763      8.73   0.000     .600898    .9488427
 ind02nshare |   .6716954   .0646766    10.39   0.000     .5449315   .7984592
immigrations |  -.0552426   .1132366    -0.49   0.626    -.2771822   .166697
-----------------------------------------------------------------------------
```

Russia 2002
```
. sureg ( real_grp_per_cap  emp_rate_s, nocon) ( emp_rate_s   tax_grp_s unemp_rate_s
enter_100000 criminal   agr02nshare ind02nshare  immigrations, nocon)

Seemingly unrelated regression
------------------------------------------------------------------------
Equation          Obs  Parms        RMSE      "R-sq"        chi2        P
------------------------------------------------------------------------
real_grp_p~p       79     1     8146.004      0.5335       91.47   0.0000
emp_rate_s         79     7    .0225838      0.9985    54282.36   0.0000
------------------------------------------------------------------------
```

```
-----------------------------------------------------------------------------
             |      Coef.   Std. Err.       z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
real_grp_p~p |
  emp_rate_s |   14849.58   1552.625     9.56   0.000     11806.49    17892.67
-------------+---------------------------------------------------------------
emp_rate_s   |
   tax_grp_s |   .4437262   .0978615     4.53   0.000     .2519212   .6355312
unemp_rate_s |  -.6690794   .0617563   -10.83   0.000    -.7901195   -.5480393
enter_100000 |   3.33e-06   9.11e-06     0.37   0.715    -.0000145   .0000212
    criminal |  -2.67e-06   5.74e-06    -0.46   0.642    -.0000139   8.59e-06
 agr02nshare |   .5312083   .0228071    23.29   0.000     .4865073   .5759093
 ind02nshare |   .6381047   .0204087    31.27   0.000     .5981045   .6781049
immigrations |  -.0995981   .0635757    -1.57   0.117    -.2242041   .0250079
-----------------------------------------------------------------------------
```

Estimates of the Hidden Economy in Regions of Ukraine and Russia in 2002 on the Basis of Pooled Cross-Section Data (% of GRP)

Rank	Region	% of the hidden economy in GRP	Rank	Region	% of the hidden economy in GRP
1	Chukotka	66.60	56	Poltava	55.17
2	Moscow-city	63.88	57	Tomsk	55.17
3	St.Petersburg	62.96	58	Penza	55.02
4	Yaroslavl	61.21	59	Bryansk	54.82
5	Moscow	60.29	60	Mordovia	54.57
6	Khabarovsk	60.09	61	Zaporizhzhia	54.42
7	Magadan	60.03	62	Voronezh	54.32
8	Tatarstan	59.87	63	Altai R	54.27
9	Lipetsk	59.83	64	Rostov	54.11
10	Tyumen	59.52	65	EAO	54.07
11	Vologda	59.29	66	Astrakhan	54.02
12	Tver	59.18	67	Stavropol	53.99
13	Kyiv	58.90	68	Smolensk	53.87
14	Sakha	58.76	69	Altai K	53.86
15	Krasnoyarsk	58.65	70	Omsk	53.69
16	Komi	58.62	71	Amur	53.54
17	Leningrad	58.48	72	Kharkiv	53.22
18	Samara	58.46	73	Novosibirsk	53.21
19	Tula	58.42	74	Odessa	53.18
20	Khakassia	58.14	75	Donetsk	53.11
21	Ulyanovsk	58.13	76	Cherkasy	53.03
22	Kostroma	58.08	77	Kurgan	52.98
23	Chelyabinsk	57.99	78	Vinnytsia	52.72
24	Udmurtia	57.83	79	Tambov	52.50
25	Novgorod	57.60	80	Mykolaiv	52.47
26	Ivanovo	57.59	81	Volyn	52.45
27	Kaluga	57.58	82	S.Osetia-Alania	52.30
28	Kirov	57.57	83	Adygeia	52.15
29	Saratov	57.56	84	Buryatia	52.06
30	Sverdlov	57.54	85	Kiev Oblast	52.06
31	Karelia	57.48	86	Lviv	51.98
32	Kaliningrad	57.44	87	Zakarpattia	51.68
33	Arkhangelsk	57.32	88	Ivano-Frankivsk	51.48
34	Primorsk	57.22	89	Luhansk	51.46
35	Bashkortostan	57.20	90	Marij-El	51.45
36	Ryazan	56.99	91	Chernihiv	51.32
37	Sakhalin	56.79	92	Kirovohrad	50.56
38	Perm	56.69	93	Rivne	50.44
39	Nizh.Novgorod	56.67	94	Karachaevo-Cherkesia	50.38

40	Volgograd	56.60	95	Zhytomyr	50.35
41	Murmansk	56.56	96	Sumy	49.96
42	Crimea	56.52	97	Kherson	49.64
43	Kemerovo	56.52	98	Khmelnytskyi	49.63
44	Kamchatka	56.18	99	Ternopil'	48.25
45	Pskov	56.04	100	Chernivtsi	48.00
46	Chita	55.81	101	Kalmykia	45.77
47	Orel	55.72	102	Tyva	45.12
48	Belgorod	55.64	103	Kabardino-Balkaria	44.89
49	Krasnodar	55.58	104	Dagestan	40.76
50	Kursk	55.54	105	Ingushetia	28.85
51	Irkutsk	55.50			
52	Orenburg	55.46			
53	Vladimir	55.36			
54	Chuvashia	55.36			
55	Dnipropetrovsk	55.21			

Data Summary and Regressions Outputs (2003)

Data Summary

Russia
```
. sum    r_grp_cap_uah employment_s criminal immigrations enter100000 ind03ns agr03ns
unemployment_s tax_grp_s
```

Variable	Obs	Mean	Std. Dev.	Min	Max
r_grp_cap_~h	79	10566.53	8725.362	1547.46	57049.75
employment_s	79	.5833418	.0644382	.209	.739
criminal	79	1901.19	598.1858	326	3232
immigrations	79	.0532278	.0293148	.003	.128
enter100000	79	477.1009	293.3444	57.65	1944.2
ind03ns	79	.7766177	.166086	.227	1
agr03ns	79	.2233823	.166086	0	.773
unemployme~s	79	.0996709	.0626367	.013	.531
tax_grp_s	79	.1149392	.0306447	.054	.2444

Ukraine
```
. sum    r_grp_cap_uah employment_s criminal immigrations enter100000 ind03ns agr03ns
unemployment_s tax_grp_s
```

Variable	Obs	Mean	Std. Dev.	Min	Max
r_grp_cap_~h	26	4192.8	2461.474	2584.89	15445.88
employment_s	26	.5548462	.0487956	.46	.651
criminal	26	1074.215	342.9151	535.53	1722.5
immigrations	26	.0448846	.0280833	.0143	.1295
enter100000	26	535.6892	244.2051	368.1	1663.85
ind03ns	26	.8661808	.0788004	.6997	.987
agr03ns	26	.1338192	.0788004	.013	.3003
unemployme~s	26	.1028462	.0272994	.051	.143
tax_grp_s	26	.0747923	.0113269	.057	.107

Pooled data
```
. sum    r_grp_cap_UAH employment_s criminal immigrations enter100000 ind03ns agr03ns
unemployment_s tax_grp_s
```

Variable	Obs	Mean	Std. Dev.	Min	Max
r_grp_cap_~H	105	8988.27	8136.133	1547.46	57049.75
employment_s	105	.5762857	.0619621	.209	.739
criminal	105	1696.415	652.1293	326	3232
immigrations	105	.0511619	.0291066	.003	.1295
enter100000	105	491.6085	281.992	57.65	1944.2
ind03ns	105	.7987952	.1539153	.227	1
agr03ns	105	.2012048	.1539153	0	.773
unemployme~s	105	.1004571	.0558888	.013	.531
tax_grp_s	105	.1049981	.0322232	.054	.2444

Pooled regression (normalization on employment rate).

```
. sureg (r_grp_cap_UAH employment_s, nocon) (employment_s tax_grp_s unemployment_s
enter100000 criminal immigrations ind03ns agr03ns  dummyukr, nocon)

Seemingly unrelated regression
---------------------------------------------------------------------------
Equation          Obs  Parms       RMSE     "R-sq"        chi2        P
---------------------------------------------------------------------------
r_grp_cap_~H      105     1    7688.664    0.5961      154.16   0.0000
employment_s      105     8    .0280611    0.9977    44758.95   0.0000
---------------------------------------------------------------------------
```

```
-----------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
r_grp_cap_~H |
employment_s |    16074.2   1294.619   12.42   0.000      13536.8    18611.61
-------------+---------------------------------------------------------------
employment_s |
    tax_grp_s |   .2121549   .1033464    2.05   0.040     .0095998      .41471
unemployme~s |  -.7511395   .0654017  -11.49   0.000    -.8793245   -.6229545
 enter100000 |   5.39e-06    .000011    0.49   0.625    -.0000162     .000027
    criminal |   2.00e-06   5.64e-06    0.36   0.722    -9.04e-06     .000013
 immigrations|  -.1135841   .1097626   -1.03   0.301    -.3287149    .1015467
      ind03ns |   .6559497   .0234844   27.93   0.000     .6099212    .7019782
      agr03ns |   .5541604   .0278874   19.87   0.000      .499502    .6088188
     dummyukr |  -.0249227    .009524   -2.62   0.009    -.0435893   -.0062561
-----------------------------------------------------------------------------
```

Separate Regressions for Ukrainian and Russian Regions with normalization on employment rate on the basis of cross-section data (2003).

Ukraine 2003
```
. sureg ( r_grp_cap_uah employment_s, nocon) (employment_s tax_grp_s unemployment_s
enter100000 criminal immigrations ind03ns agr03ns, nocon)

Seemingly unrelated regression
---------------------------------------------------------------------------
Equation          Obs  Parms       RMSE     "R-sq"        chi2        P
---------------------------------------------------------------------------
r_grp_cap_~h       26     1    2276.634    0.7786       92.36   0.0000
employment_s       26     7    .0389772    0.9951     5373.81   0.0000
---------------------------------------------------------------------------
```

```
-----------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
r_grp_cap_~h |
employment_s |    7704.24   801.6506    9.61   0.000     6133.034    9275.447
-------------+---------------------------------------------------------------
employment_s |
    tax_grp_s |    .228142   .8885247    0.26   0.797    -1.513334    1.969618
unemployme~s |  -.8592492   .3658907   -2.35   0.019    -1.576382   -.1421167
 enter100000 |   .0000797    .0000382    2.09   0.037     4.81e-06    .0001545
    criminal |  -6.04e-07    .0000318   -0.02   0.985    -.0000629    .0000617
 immigrations|  -.2585724   .3866162   -0.67   0.504    -1.016326    .4991814
      ind03ns |   .5953266   .0789048    7.54   0.000     .4406761    .7499771
      agr03ns |   .5969524   .1202111    4.97   0.000      .361343    .8325618
-----------------------------------------------------------------------------
```

Russia 2003 (UAH)

```
. sureg ( r_grp_cap_uah employment_s, nocon) (employment_s tax_grp_s unemployment_s
enter100000 criminal immigrations ind03ns agr03ns, nocon)

Seemingly unrelated regression
-------------------------------------------------------------------------
Equation          Obs  Parms       RMSE     "R-sq"       chi2        P
-------------------------------------------------------------------------
r_grp_cap_~h       79     1     8210.766    0.6391     139.06   0.0000
employment_s       79     7      .022117    0.9986   55739.58   0.0000
-------------------------------------------------------------------------


-----------------------------------------------------------------------------
             |     Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
r_grp_cap_~h |
employment_s |   18562.89   1574.125    11.79   0.000     15477.67    21648.12
-------------+---------------------------------------------------------------
employment_s |
    tax_grp_s |   .2027192    .083833     2.42   0.016     .0384094    .3670289
 unemployme~s |  -.7332884   .0543407   -13.49   0.000    -.8397943   -.6267825
  enter100000 |  -5.51e-06   9.53e-06    -0.58   0.563    -.0000242    .0000132
     criminal |   2.14e-06   4.91e-06     0.43   0.664    -7.49e-06    .0000118
 immigrations |  -.1030225   .1039773    -0.99   0.322    -.3068143    .1007692
      ind03ns |   .6633099   .0215265    30.81   0.000     .6211188     .705501
      agr03ns |    .546693   .0240107    22.77   0.000     .4996328    .5937531
-----------------------------------------------------------------------------
```

13

Estimates of the Hidden Economy in Regions of Ukraine and Russia in 2003 on the Basis of Pooled Cross-Section Data (% of GRP)

Rank	Region	% of the hidden economy in GRP	Rank	Region	% of the hidden economy in GRP
1	Moscow-city	60.52	56	Orel	52.41
2	Chukotka	59.91	57	Voronezh	52.35
3	St.Petersburg	59.43	58	Kursk	52.29
4	Vologda	57.69	59	Zaporizhzhia	51.92
5	Samara	57.39	60	Smolensk	51.81
6	Moscow	57.17	61	Kurgan	51.70
7	Khabarovsk	57.16	62	Penza	51.63
8	Lipetsk	56.59	63	Omsk	51.58
9	Yaroslavl	56.31	64	Donetsk	51.54
10	Chelyabinsk	56.29	65	Volgograd	51.51
11	Perm	56.05	66	Orenburg	51.48
12	Novgorod	55.96	67	Saratov	51.38
13	Udmurtia	55.81	68	Novosibirsk	51.30
14	Tula	55.80	69	Tomsk	50.89
15	Nizh.Novgorod	55.78	70	Cherkasy	50.70
16	Tyumen	55.56	71	Vinnytsia	50.65
17	Mordovia	55.50	72	Luhansk	50.54
18	Sverdlov	55.37	73	Krasnodar	50.50
19	Primorsk	55.18	74	Stavropol	50.47
20	Ivanovo	55.04	75	Volyn	50.40
21	Tatarstan	55.03	76	Kharkiv	50.24
22	Karelia	54.84	77	Mykolaiv	50.21
23	Tver	54.82	78	Marij-El	50.16
24	Kostroma	54.76	79	Tambov	50.14
25	Sakhalin	54.73	80	Rostov	50.11
26	Magadan	54.66	81	S.Osetia-Alania	50.04
27	Kaluga	54.53	82	Kiev Oblast	49.92
28	Kaliningrad	54.45	83	Ivano-Frankivsk	49.54
29	Sakha	54.22	84	Chita	49.49
30	Kemerovo	54.22	85	Lviv	49.45
31	Ulyanovsk	54.15	86	Kirovohrad	49.21
32	Kirov	54.08	87	Altai K	49.01
33	Kyiv	54.01	88	Chernihiv	48.82
34	Arkhangelsk	53.97	89	Altai R	48.56
35	Bashkortostan	53.92	90	Zakarpattia	48.40
36	Leningrad	53.89	91	Buryatia	48.18
37	Murmansk	53.89	92	Sumy	48.11
38	Ryazan	53.59	93	Adygeia	48.07
39	Krasnoyarsk	53.56	94	Rivne	47.93

40	Chuvashia	53.53	95	Zhytomyr	47.82
41	Poltava	53.49	96	Khmelnytskyi	47.53
42	Kamchatka	53.33	97	Kherson	47.41
43	Khakassia	53.28	98	Ternopil'	47.26
44	Pskov	53.27	99	Chernivtsi	46.78
45	Komi	52.96	100	Kalmykia	46.48
46	Crimea	52.90	101	Karachaevo-Cherkesia	43.71
47	Bryansk	52.84	102	Tyva	42.27
48	Dnipropetrovsk	52.77	103	Dagestan	40.04
49	EAO	52.71	104	Kabardino-Balkaria	39.65
50	Irkutsk	52.70	105	Ingushetia	18.54
51	Astrakhan	52.67			
52	Vladimir	52.60			
53	Belgorod	52.60			
54	Amur	52.49			
55	Odessa	52.44			

Data Summary and Regressions Outputs (2001)

Data Summary

Russia
```
. sum   r_grp_cap_uah employment_s criminal immigrations enter100000 ind01ns agr01ns
unemployment_s tax_grp_s

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
 r_grp_cap_~h |        79    6823.459    5357.678    1420.53   38682.95
 employment_s |        79    .5381304    .0624488      .2097      .7535
     criminal |        79    2038.557     572.699        375       3244
 immigrations |        79    .0783038    .0461748       .005       .259
  enter100000 |        79    460.4863    305.4021      21.46    2133.74
-------------+--------------------------------------------------------
       ind01ns |        79    .7491595    .1676261      .2196          1
       agr01ns |        79    .2508405    .1676261          0      .7804
 unemployme~s |        79    .1065949    .0502018       .021       .349
     tax_grp_s |        79     .105438    .0235166      .0591      .2184
```

Ukraine
```
. sum   r_grp_cap_uah employment_s criminal enter100000 ind01ns agr01ns unemployment_s
tax_grp_s

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
 r_grp_cap_~h |        26    3185.733    1762.114    1939.36   11162.62
 employment_s |        26    .5496538    .0450954        .46       .647
     criminal |        26    951.7092    323.2816     476.81    1698.62
  enter100000 |        26    454.1262    190.1777     286.44    1299.74
       ind01ns |        26    .8162192    .1000358   .6491001      .9869
-------------+--------------------------------------------------------
       agr01ns |        26    .1837808    .1000358      .0131      .3509
 unemployme~s |        26    .1181923    .0301702       .061       .184
     tax_grp_s |        26    .0709077    .0254712      .0516      .1739
```

Pooled data
```
. sum   r_grp_cap_uah employment_s criminal enter100000 ind01ns agr01ns unemployment_s
tax_grp_s

    Variable |       Obs        Mean    Std. Dev.       Min        Max
-------------+--------------------------------------------------------
 r_grp_cap_~h |       105    5922.689    4976.346    1420.53   38682.95
 employment_s |       105    .5409838    .0586405      .2097      .7535
     criminal |       105    1769.433    702.3505        375       3244
  enter100000 |       105    458.9114    280.4542      21.46    2133.74
       ind01ns |       105    .7657648    .1559658      .2196          1
-------------+--------------------------------------------------------
       agr01ns |       105    .2342352    .1559658          0      .7804
 unemployme~s |       105    .1094667    .0461982       .021       .349
     tax_grp_s |       105    .0968876    .0281958      .0516      .2184
```

Note: there is no immigration variable for pooled data.

Pooled regression (normalization on employment rate)
```
. sureg   (employment_s tax_grp_s unemployment_s enter100000 criminal ind01ns agr01ns
dummyukr, nocon)(  r_grp_cap_uah employment_s, nocon)
```

Seemingly unrelated regression
```
------------------------------------------------------------------------
Equation          Obs  Parms        RMSE    "R-sq"        chi2       P
------------------------------------------------------------------------
employment_s      105      7    .0435048    0.9936   17374.11  0.0000
r_grp_cap_~h      105      1    4606.915    0.6439     182.21  0.0000
------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+------------------------------------------------------------
employment_s |
   tax_grp_s |  -.1145984    .1777841    -0.64   0.519    -.4630489    .2338521
unemployme~s |  -.6588257    .1048216    -6.29   0.000    -.8642723   -.4533792
  enter100000|   .0000182    .0000153     1.19   0.234    -.0000118    .0000481
    criminal |    .000011    7.72e-06     1.42   0.155    -4.15e-06    .0000261
      ind01ns|   .5919083    .0332391    17.81   0.000      .526761    .6570557
      agr01ns|   .5717587    .0367858    15.54   0.000     .4996598    .6438577
     dummyukr|   .0388229    .0141807     2.74   0.006     .0110292    .0666167
-------------+------------------------------------------------------------
r_grp_cap_~h |
employment_s |   11143.27   825.5127    13.50   0.000     9525.29    12761.24
--------------------------------------------------------------------------
```

Separate Regressions for Ukrainian and Russian Regions with normalization on employment rate on the basis of cross-section data (200).

Ukraine 2001
```
. sureg   (employment_s tax_grp_s unemployment_s enter100000 criminal ind01ns agr01ns,
nocon)(  r_grp_cap_uah employment_s, nocon)
```

Seemingly unrelated regression
```
------------------------------------------------------------------------
Equation          Obs  Parms        RMSE    "R-sq"        chi2       P
------------------------------------------------------------------------
employment_s       26      6     .024482    0.9980   13182.53  0.0000
r_grp_cap_~h       26      1    1617.773    0.8007     104.67  0.0000
------------------------------------------------------------------------
```

```
--------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+------------------------------------------------------------
employment_s |
   tax_grp_s |  -.6600369    .2776343    -2.38   0.017     -1.20419   -.1158837
unemployme~s |  -1.357619    .1999529    -6.79   0.000     -1.74952   -.9657186
  enter100000|   .0000608    .0000359     1.69   0.090    -9.59e-06    .0001312
    criminal |   .0000172    .0000178     0.97   0.335    -.0000177    .0000522
      ind01ns|   .6959039    .0403856    17.23   0.000     .6167497    .7750582
      agr01ns|   .7883541     .061646    12.79   0.000     .6675302    .9091781
-------------+------------------------------------------------------------
r_grp_cap_~h |
employment_s |   5886.403   575.3597    10.23   0.000     4758.719    7014.087
--------------------------------------------------------------------------
```

Russia 2001

```
.  sureg  (employment_s  tax_grp_s  unemployment_s  enter100000    immigrations  criminal
ind01ns  agr01ns, nocon)(  r_grp_cap_uah  employment_s, nocon)

Seemingly unrelated regression
-----------------------------------------------------------------------
Equation          Obs  Parms       RMSE      "R-sq"        chi2        P
-----------------------------------------------------------------------
employment_s       79      7    .0459584     0.9928   11590.07   0.0000
r_grp_cap_~h       79      1    4824.753     0.6892     167.99   0.0000
-----------------------------------------------------------------------


------------------------------------------------------------------------------
             |      Coef.   Std. Err.      z     P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
employment_s |
   tax_grp_s |  -.0575921   .2235775    -0.26   0.797    -.4957959    .3806117
unemployme~s |  -.5994988   .1195207    -5.02   0.000    -.8337551   -.3652424
 enter100000 |   .0000217    .000017     1.27   0.203    -.0000117     .000055
immigrations |  -.0849684   .1147623    -0.74   0.459    -.3098983    .1399615
    criminal |   8.70e-06   9.21e-06     0.94   0.345    -9.35e-06    .0000268
      ind01ns |   .5958191   .0433086    13.76   0.000     .5109358    .6807025
      agr01ns |   .5631932   .0443515    12.70   0.000     .4762658    .6501205
-------------+----------------------------------------------------------------
r_grp_cap_~h |
employment_s |   12972.78   1000.888    12.96   0.000     11011.07    14934.48
------------------------------------------------------------------------------
```

Estimates of the Hidden Economy in Regions of Ukraine and Russia in 2001 on the Basis of Pooled Cross-Section Data (% of GRP)

Rank	Region	% of the hidden economy in GRP	Rank	Region	% of the hidden economy in GRP
1	Moscow-city	56.82	56	Krasnoyarsk	49.84
2	Kyiv	55.80	57	Zhytomyr	49.84
3	St.Petersburg	55.30	58	Sakha	49.80
4	Dnipropetrovsk	54.01	59	Sakhalin	49.79
5	Crimea	53.72	60	Kemerovo	49.65
6	Poltava	53.66	61	Omsk	49.65
7	Donetsk	52.65	62	Vladimir	49.62
8	Samara	52.51	63	Ulyanovsk	49.55
9	Odessa	52.49	64	Volgograd	49.52
10	Zaporizhzhia	52.42	65	Tyumen	49.49
11	Ivanovo	52.34	66	Orel	49.40
12	Kostroma	52.31	67	Altai K	49.37
13	Volyn	52.30	68	Smolensk	49.25
14	Perm	52.22	69	Voronezh	49.20
15	Rivne	52.16	70	Astrakhan	49.19
16	Novgorod	52.05	71	Novosibirsk	49.18
17	Leningrad	52.04	72	Chuvashia	49.10
18	Vinnytsia	51.89	73	Pskov	49.10
19	Kaluga	51.88	74	Chukotka	49.02
20	Kharkiv	51.78	75	Saratov	48.90
21	Tula	51.76	76	Kirovohrad	48.89
22	Sverdlov	51.74	77	Bryansk	48.86
23	Yaroslavl	51.73	78	Stavropol	48.75
24	Mykolaiv	51.64	79	Kursk	48.54
25	Moscow	51.59	80	Mordovia	48.33
26	Primorsk	51.29	81	Sumy	48.32
27	Tatarstan	51.10	82	Altai R	48.25
28	Cherkasy	50.99	83	Kurgan	48.20
29	Chelyabinsk	50.97	84	Bashkortostan	48.02
30	Kiev Oblast	50.91	85	Krasnodar	47.99
31	Luhansk	50.88	86	Amur	47.99
32	Karelia	50.82	87	Ryazan	47.99
33	Kaliningrad	50.81	88	Murmansk	47.68
34	Lviv	50.80	89	Rostov	47.49
35	Vologda	50.78	90	Ternopil'	47.30
36	Chernihiv	50.77	91	Tambov	47.08
37	Nizh.Novgorod	50.76	92	Komi	47.06
38	Ivano-Frankivsk	50.63	93	Kamchatka	47.05
39	Udmurtia	50.60	94	Chernivtsi	46.61
40	Belgorod	50.58	95	Penza	46.16
41	Magadan	50.55	96	Adygeia	45.86

42	Tomsk	50.55	97	Chita	45.23
43	Khabarovsk	50.49	98	Buryatia	45.09
44	Tver	50.46	99	S.Osetia-Alania	44.13
45	Lipetsk	50.43	100	Kabardino-Balkaria	43.59
46	EAO	50.42	101	Karachaevo-Cherkesia	43.34
47	Kherson	50.36	102	Kalmykia	43.21
48	Zakarpattia	50.32	103	Tyva	41.00
49	Kirov	50.29	104	Dagestan	35.83
50	Khmelnytskyi	50.07	105	Ingushetia	31.71
51	Marij-El	50.05			
52	Orenburg	50.03			
53	Arkhangelsk	50.02			
54	Khakassia	49.94			
55	Irkutsk	49.92			

**Regression on the Basis of Pooled Cross-Section Data for 2002, 2003
(disincluding immigration to make estimations for 2001-2003 comparable).**

2002
```
. sureg  (  emp_rate_s    tax_grp_s unemp_rate_s enter_100000 criminal    agr02nshare
ind02nshare  dummyUkr, nocon) (  real_grp_per_cap  emp_rate_s, nocon)
```

Seemingly unrelated regression
```
------------------------------------------------------------------------
Equation         Obs  Parms      RMSE     "R-sq"       chi2       P
------------------------------------------------------------------------
emp_rate_s       105     7    .0271258    0.9978    48357.91    0.0000
real_grp_p~p     105     1    7374.183    0.5128      111.63    0.0000
------------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
emp_rate_s						
tax_grp_s	.4321696	.1132463	**3.82**	0.000	.2102109	.6541284
unemp_rate_s	-.7220478	.0684467	**-10.55**	0.000	-.8562009	-.5878948
enter_100000	5.57e-06	.0000102	0.55	0.585	-.0000144	.0000256
criminal	1.95e-06	6.41e-06	0.31	0.760	-.0000106	.0000145
agr02nshare	.5439114	.0249686	**21.78**	0.000	.494974	.5928489
ind02nshare	.6208898	.0210832	**29.45**	0.000	.5795675	.6622121
dummyUkr	-.0148832	.0094753	-1.57	0.116	-.0334546	.0036881
real_grp_p~p						
emp_rate_s	13068.82	1236.927	**10.57**	0.000	10644.49	15493.15

2003
```
. sureg (   r_grp_cap_UAH employment_s, nocon) (employment_s tax_grp_s unemployment_s
enter100000 criminal ind03ns agr03ns  dummyukr, nocon)
```

Seemingly unrelated regression
```
------------------------------------------------------------------------
Equation         Obs  Parms      RMSE     "R-sq"       chi2       P
------------------------------------------------------------------------
r_grp_cap_~H     105     1    7688.664    0.5961      154.17    0.0000
employment_s     105     7    .0282014    0.9976    44311.38    0.0000
------------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]
r_grp_cap_~H						
employment_s	16074.6	1294.619	12.42	0.000	13537.19	18612
employment_s						
tax_grp_s	.2233478	.1033191	**2.16**	0.031	.020846	.4258496
unemployme~s	-.7286	.0619979	**-11.75**	0.000	-.8501136	-.6070863
enter100000	3.68e-06	.0000109	0.34	0.737	-.0000178	.0000251
criminal	3.69e-06	5.42e-06	0.68	0.496	-6.94e-06	.0000143
ind03ns	.6436248	.0203533	**31.62**	0.000	.6037331	.6835165
agr03ns	.5434198	.0260408	**20.87**	0.000	.4923807	.5944589
dummyukr	-.0219733	.0091305	**-2.41**	0.016	-.0398689	-.0040778

Estimates of the Hidden Economy in Regions of Ukraine and Russia in 2001-2003 on the Basis of Pooled Cross-Section Data Separately for Each Year (% of GRP), (disincluding immigration variable)

Rank	Region	% of the hidden economy in GRP, 2001	Region	% of the hidden economy in GRP, 2002	Region	% of the hidden economy in GRP, 2003
1	Moscow-city	56.82	Chukotka	66.42	Moscow-city	60.47
2	Kyiv	55.80	Moscow-city	63.93	Chukotka	59.87
3	St.Petersburg	55.30	St.Petersburg	62.64	St.Petersburg	58.97
4	Dnipropetrovsk	54.01	Yaroslavl	61.21	Moscow	57.43
5	Crimea	53.72	Moscow	60.36	Vologda	57.41
6	Poltava	53.66	Lipetsk	60.12	Samara	57.40
7	Donetsk	52.65	Magadan	59.89	Lipetsk	57.15
8	Samara	52.51	Khabarovsk	59.71	Khabarovsk	56.97
9	Odessa	52.49	Tatarstan	59.68	Yaroslavl	56.57
10	Zaporizhzhia	52.42	Tyumen	59.61	Chelyabinsk	56.34
11	Ivanovo	52.34	Tver	59.38	Novgorod	56.01
12	Kostroma	52.31	Vologda	59.03	Perm	55.92
13	Volyn	52.30	Samara	58.52	Tula	55.81
14	Perm	52.22	Komi	58.48	Tyumen	55.81
15	Rivne	52.16	Tula	58.46	Nizh.Novgorod	55.64
16	Novgorod	52.05	Kyiv	58.40	Udmurtia	55.43
17	Leningrad	52.04	Sakha	58.39	Mordovia	55.27
18	Vinnytsia	51.89	Leningrad	58.34	Sverdlov	55.23
19	Kaluga	51.88	Krasnoyarsk	58.31	Kaluga	55.17
20	Kharkiv	51.78	Kaliningrad	58.23	Tatarstan	55.08
21	Tula	51.76	Chelyabinsk	58.12	Ivanovo	55.05
22	Sverdlov	51.74	Kaluga	58.07	Kaliningrad	55.04
23	Yaroslavl	51.73	Ulyanovsk	57.88	Tver	54.94
24	Mykolaiv	51.64	Kostroma	57.85	Primorsk	54.85
25	Moscow	51.59	Crimea	57.81	Magadan	54.66
26	Primorsk	51.29	Khakassia	57.71	Karelia	54.64
27	Tatarstan	51.10	Karelia	57.71	Kostroma	54.48
28	Cherkasy	50.99	Saratov	57.69	Sakhalin	54.45
29	Chelyabinsk	50.97	Novgorod	57.66	Kemerovo	54.12
30	Kiev Oblast	50.91	Ivanovo	57.52	Murmansk	54.09
31	Luhansk	50.88	Udmurtia	57.44	Kyiv	54.02
32	Karelia	50.82	Sverdlov	57.34	Bashkortostan	54.01
33	Kaliningrad	50.81	Kirov	57.13	Ulyanovsk	53.95
34	Lviv	50.80	Ryazan	57.10	Sakha	53.92
35	Vologda	50.78	Bashkortostan	57.09	Leningrad	53.77
36	Chernihiv	50.77	Arkhangelsk	57.02	Ryazan	53.75
37	Nizh.Novgorod	50.76	Primorsk	56.87	Crimea	53.71
38	Ivano-Frankivsk	50.63	Volgograd	56.65	Arkhangelsk	53.68
39	Udmurtia	50.60	Murmansk	56.64	Kirov	53.64

40	Belgorod	50.58	Nizh.Novgorod	56.54	Kamchatka	53.33
41	Magadan	50.55	Kemerovo	56.54	Krasnoyarsk	53.32
42	Tomsk	50.55	Sakhalin	56.53	Pskov	53.27
43	Khabarovsk	50.49	Perm	56.47	Poltava	53.22
44	Tver	50.46	Belgorod	56.25	Belgorod	53.16
45	Lipetsk	50.43	Kamchatka	56.06	Komi	53.14
46	EAO	50.42	Pskov	55.94	Khakassia	53.11
47	Kherson	50.36	Orel	55.84	Chuvashia	53.05
48	Zakarpattia	50.32	Orenburg	55.75	Astrakhan	53.01
49	Kirov	50.29	Kursk	55.72	Vladimir	52.90
50	Khmelnytskyi	50.07	Vladimir	55.68	EAO	52.87
51	Marij-El	50.05	Krasnodar	55.57	Odessa	52.82
52	Orenburg	50.03	Chita	55.39	Bryansk	52.75
53	Arkhangelsk	50.02	Irkutsk	55.27	Dnipropetrovsk	52.75
54	Khakassia	49.94	Tomsk	55.16	Irkutsk	52.50
55	Irkutsk	49.92	Dnipropetrovsk	55.14	Voronezh	52.48
56	Krasnoyarsk	49.84	Chuvashia	54.97	Orel	52.39
57	Zhytomyr	49.84	Penza	54.96	Kursk	52.33
58	Sakha	49.80	Poltava	54.84	Zaporizhzhia	52.18
59	Sakhalin	49.79	Zaporizhzhia	54.74	Smolensk	52.16
60	Kemerovo	49.65	Bryansk	54.70	Amur	52.13
61	Omsk	49.65	Astrakhan	54.70	Donetsk	52.12
62	Vladimir	49.62	Voronezh	54.59	Omsk	51.85
63	Ulyanovsk	49.55	Mordovia	54.28	Orenburg	51.80
64	Volgograd	49.52	Smolensk	54.19	Saratov	51.75
65	Tyumen	49.49	Rostov	54.19	Penza	51.67
66	Orel	49.40	Altai K	54.12	Kurgan	51.64
67	Altai K	49.37	Omsk	54.11	Volgograd	51.58
68	Smolensk	49.25	EAO	54.11	Novosibirsk	51.31
69	Voronezh	49.20	Odessa	54.01	Tomsk	50.87
70	Astrakhan	49.19	Stavropol	53.95	Luhansk	50.75
71	Novosibirsk	49.18	Donetsk	53.93	Stavropol	50.64
72	Chuvashia	49.10	Altai R	53.93	Cherkasy	50.59
73	Pskov	49.10	Novosibirsk	53.37	Krasnodar	50.48
74	Chukotka	49.02	Kharkiv	53.19	Vinnytsia	50.45
75	Saratov	48.90	Amur	53.19	Mykolaiv	50.35
76	Kirovohrad	48.89	S.Osetia-Alania	52.99	S.Osetia-Alania	50.32
77	Bryansk	48.86	Kurgan	52.86	Kharkiv	50.31
78	Stavropol	48.75	Cherkasy	52.76	Rostov	50.25
79	Kursk	48.54	Tambov	52.57	Volyn	50.20
80	Mordovia	48.33	Vinnytsia	52.52	Tambov	50.08

81	Sumy	48.32	Mykolaiv	52.48	Marij-El	49.86
82	Altai R	48.25	Volyn	52.40	Kiev Oblast	49.71
83	Kurgan	48.20	Luhansk	52.38	Chita	49.35
84	Bashkortostan	48.02	Adygeia	52.23	Altai K	49.29
85	Krasnodar	47.99	Buryatia	51.84	Ivano-Frankivsk	49.26
86	Amur	47.99	Lviv	51.60	Lviv	49.12
87	Ryazan	47.99	Kiev Oblast	51.54	Kirovohrad	49.09
88	Murmansk	47.68	Zakarpattia	51.51	Chernihiv	48.65
89	Rostov	47.49	Marij-El	51.30	Altai R	48.45
90	Ternopil'	47.30	Ivano-Frankivsk	51.08	Zakarpattia	48.30
91	Tambov	47.08	Chernihiv	51.03	Sumy	48.10
92	Komi	47.06	Kirovohrad	50.43	Adygeia	48.06
93	Kamchatka	47.05	Karachaevo-Cherkesia	50.32	Buryatia	48.00
94	Chernivtsi	46.61	Zhytomyr	50.17	Kherson	47.72
95	Penza	46.16	Rivne	50.07	Zhytomyr	47.70
96	Adygeia	45.86	Sumy	50.06	Rivne	47.65
97	Chita	45.23	Kherson	49.79	Khmelnytskyi	47.41
98	Buryatia	45.09	Khmelnytskyi	49.39	Ternopil'	47.00
99	S.Osetia-Alania	44.13	Chernivtsi	48.12	Chernivtsi	46.83
100	Kabardino-Balkaria	43.59	Ternopil'	47.85	Kalmykia	46.43
101	Karachaevo-Cherkesia	43.34	Kalmykia	45.76	Karachaevo-Cherkesia	43.62
102	Kalmykia	43.21	Kabardino-Balkaria	45.02	Tyva	42.21
103	Tyva	41.00	Tyva	44.99	Dagestan	39.77
104	Dagestan	35.83	Dagestan	40.80	Kabardino-Balkaria	39.60
105	Ingushetia	31.71	Ingushetia	29.05	Ingushetia	18.85

**Regression on the Basis of Panel Data of Ukrainian and Russian Regions
for 2001-2003, (without dummies for regions).**

```
. sureg  ( employ tax_grp unemploy industry agricul enter criminal  dummyukr, nocon)(grp
employ, nocon)
Seemingly unrelated regression
-----------------------------------------------------------------------
Equation          Obs  Parms       RMSE    "R-sq"       chi2        P
-----------------------------------------------------------------------
employ            315      7   .0372545    0.9957   73513.41   0.0000
grp               315      1   6792.179    0.5642     401.91   0.0000
-----------------------------------------------------------------------


------------------------------------------------------------------------
            |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
------------+-----------------------------------------------------------------
employ      |
    tax_grp |    .237952   .0857162     2.78   0.006     .0699514    .4059526
   unemploy |  -.7429436   .0514169   -14.45   0.000    -.8437188   -.6421684
   industry |   .6343287   .0161781    39.21   0.000     .6026203    .6660371
    agricul |   .5649423    .019363    29.18   0.000     .5269915    .6028932
      enter |   8.58e-06   8.19e-06     1.05   0.294    -7.46e-06    .0000246
   criminal |  -2.46e-06   4.22e-06    -0.58   0.560    -.0000107    5.81e-06
   dummyukr |  -.0057933   .0072456    -0.80   0.424    -.0199945    .0084079
------------+-----------------------------------------------------------------
grp         |
     employ |   13488.32   672.8158    20.05   0.000     12169.63    14807.02
------------------------------------------------------------------------
```

Estimates of the Hidden Economy in Regions of Ukraine and Russia in 2001-2003 on the Basis of Panel Data (% of GRP), (without dummies for regions)

Rank	Region	% of the hidden economy in GRP, 2001	Region	% of the hidden economy in GRP, 2002	Region	% of the hidden economy in GRP, 2003
1	Moscow-city	61.63	Moscow-city	62.21	Moscow-city	61.31
2	St.Petersburg	60.41	Chukotka	61.81	Chukotka	60.60
3	Chukotka	58.70	St.Petersburg	61.01	St.Petersburg	60.21
4	Kyiv	58.23	Yaroslavl	58.87	Moscow	58.30
5	Moscow	58.17	Moscow	58.68	Lipetsk	58.01
6	Samara	57.44	Lipetsk	58.12	Samara	57.95
7	Tatarstan	57.31	Kyiv	58.05	Vologda	57.52
8	Tula	57.15	Tatarstan	57.67	Yaroslavl	56.81
9	Lipetsk	56.90	Tver	57.45	Tula	56.72
10	Crimea	56.80	Magadan	57.44	Chelyabinsk	56.65
11	Ivanovo	56.33	Khabarovsk	57.06	Khabarovsk	56.59
12	Kaluga	56.31	Vologda	57.00	Novgorod	56.46
13	Udmurtia	55.96	Crimea	56.84	Kyiv	56.44
14	Yaroslavl	55.86	Tula	56.78	Mordovia	56.40
15	Sakha	55.75	Tyumen	56.76	Crimea	56.17
16	Leningrad	55.74	Samara	56.66	Nizh.Novgorod	56.04
17	Novgorod	55.69	Chelyabinsk	56.59	Udmurtia	55.84
18	Perm	55.63	Sakha	56.46	Kaluga	55.83
19	Sverdlov	55.47	Saratov	56.38	Tatarstan	55.70
20	Kostroma	55.24	Kaluga	56.35	Perm	55.43
21	Primorsk	55.24	Ulyanovsk	56.33	Ivanovo	55.42
22	Belgorod	55.14	Leningrad	56.26	Tver	55.40
23	Karelia	55.14	Kostroma	56.24	Tyumen	55.37
24	Tyumen	54.97	Kaliningrad	56.10	Poltava	55.31
25	Arkhangelsk	54.94	Novgorod	56.02	Kaliningrad	55.26
26	Chelyabinsk	54.83	Krasnoyarsk	56.02	Sverdlov	55.21
27	Vologda	54.76	Karelia	55.90	Kostroma	55.05
28	Tver	54.66	Ivanovo	55.77	Primorsk	55.03
29	Khabarovsk	54.57	Komi	55.73	Odessa	54.95
30	Magadan	54.52	Ryazan	55.59	Magadan	54.85
31	Nizh.Novgorod	54.44	Udmurtia	55.57	Bashkortostan	54.85
32	Kirov	54.35	Kirov	55.45	Ryazan	54.77
33	Kemerovo	54.22	Sverdlov	55.41	Ulyanovsk	54.65
34	Krasnoyarsk	54.22	Khakassia	55.40	Karelia	54.61
35	Dnipropetrovsk	54.15	Arkhangelsk	55.34	Kemerovo	54.48
36	Khakassia	54.10	Nizh.Novgorod	55.27	Dnipropetrovsk	54.48
37	Kaliningrad	54.07	Bashkortostan	55.13	Sakhalin	54.45
38	Orenburg	54.04	Poltava	55.01	Leningrad	54.36
39	Orel	53.94	Primorsk	54.88	Kirov	54.30

40	Poltava	53.93	Kemerovo	54.80	Sakha	54.26
41	Vladimir	53.77	Volgograd	54.74	Murmansk	54.15
42	Tomsk	53.65	Dnipropetrovsk	54.72	Belgorod	54.15
43	Bashkortostan	53.59	Belgorod	54.68	Pskov	53.97
44	Ulyanovsk	53.54	Sakhalin	54.65	Donetsk	53.95
45	Volgograd	53.35	Murmansk	54.61	Arkhangelsk	53.84
46	Astrakhan	53.25	Perm	54.47	Zaporizhzhia	53.82
47	Smolensk	53.09	Kursk	54.33	Chuvashia	53.72
48	Donetsk	53.08	Orel	54.33	Bryansk	53.58
49	Irkutsk	52.98	Zaporizhzhia	54.26	Voronezh	53.48
50	Chuvashia	52.83	Pskov	54.25	Krasnoyarsk	53.38
51	Zaporizhzhia	52.69	Penza	54.17	Kamchatka	53.30
52	Sakhalin	52.67	Krasnodar	54.05	Orel	53.29
53	Odessa	52.62	Odessa	54.02	Vladimir	53.26
54	Murmansk	52.56	Donetsk	53.92	Cherkasy	53.19
55	Saratov	52.52	Vladimir	53.84	EAO	53.16
56	Voronezh	52.51	Orenburg	53.66	Kursk	53.08
57	Rivne	52.47	Kamchatka	53.58	Astrakhan	53.07
58	Marij-El	52.33	Chuvashia	53.46	Vinnytsia	52.99
59	Pskov	52.24	Voronezh	53.42	Khakassia	52.84
60	Ryazan	52.15	Tomsk	53.30	Penza	52.74
61	Volyn	52.13	Bryansk	53.22	Komi	52.70
62	Komi	52.05	Irkutsk	53.04	Amur	52.64
63	Stavropol	51.97	Vinnytsia	52.90	Saratov	52.60
64	Omsk	51.90	Mordovia	52.87	Omsk	52.50
65	Kursk	51.77	Chita	52.87	Mykolaiv	52.46
66	Bryansk	51.66	Kharkiv	52.87	Volyn	52.42
67	Kharkiv	51.55	Altai K	52.83	Smolensk	52.30
68	Mordovia	51.52	Astrakhan	52.79	Orenburg	52.29
69	Lviv	51.41	Volyn	52.75	Luhansk	52.24
70	Altai K	51.37	Omsk	52.71	Irkutsk	52.21
71	Vinnytsia	51.23	Cherkasy	52.69	Volgograd	52.21
72	Krasnodar	51.21	Smolensk	52.53	Kharkiv	52.14
73	Kamchatka	51.16	Rostov	52.46	Kiev Oblast	52.10
74	Mykolaiv	51.13	Stavropol	52.44	Krasnodar	51.92
75	Ivano-Frankivsk	51.03	Mykolaiv	52.32	Novosibirsk	51.84
76	EAO	50.94	Luhansk	52.09	Kurgan	51.79
77	Altai R	50.93	EAO	51.98	Stavropol	51.76
78	Rostov	50.83	Novosibirsk	51.83	Kirovohrad	51.71
79	Luhansk	50.80	Zakarpattia	51.76	S.Osetia-Alania	51.48

80	Zakarpattia	50.63	Kiev Oblast	51.74	Tambov	51.38
81	Cherkasy	50.62	Amur	51.63	Ivano-Frankivsk	51.33
82	Novosibirsk	50.60	Lviv	51.60	Lviv	51.19
83	Kiev Oblast	50.56	Tambov	51.56	Rostov	51.03
84	Chernihiv	50.54	Ivano-Frankivsk	51.42	Tomsk	50.81
85	Amur	50.03	Kurgan	51.27	Chernihiv	50.79
86	Khmelnytskyi	49.71	S.Osetia-Alania	51.26	Marij-El	50.53
87	Penza	49.58	Chernihiv	51.12	Zakarpattia	50.53
88	Tambov	49.37	Altai R	50.71	Altai R	50.22
89	Adygeia	49.36	Kirovohrad	50.61	Sumy	50.20
90	Kherson	49.11	Adygeia	50.32	Zhytomyr	49.87
91	Zhytomyr	49.08	Rivne	50.30	Altai K	49.84
92	Kurgan	49.07	Zhytomyr	50.27	Kherson	49.78
93	S.Osetia-Alania	48.66	Sumy	50.04	Rivne	49.76
94	Sumy	47.60	Kherson	49.86	Khmelnytskyi	49.72
95	Chita	47.46	Marij-El	49.85	Chita	49.57
96	Kirovohrad	47.39	Khmelnytskyi	49.61	Ternopil'	49.49
97	Buryatia	47.11	Buryatia	49.55	Adygeia	49.47
98	Ternopil'	46.43	Karachaevo-Cherkesia	49.55	Chernivtsi	49.15
99	Kabardino-Balkaria	46.31	Chernivtsi	48.23	Buryatia	47.96
100	Chernivtsi	46.27	Ternopil'	48.18	Kalmykia	47.79
101	Karachaevo-Cherkesia	45.29	Kalmykia	44.76	Karachaevo-Cherkesia	44.59
102	Kalmykia	43.97	Kabardino-Balkaria	44.38	Tyva	42.52
103	Tyva	39.81	Tyva	43.25	Dagestan	41.73
104	Dagestan	36.39	Dagestan	40.15	Kabardino-Balkaria	41.08
105	Ingushetia	33.28	Ingushetia	27.42	Ingushetia	19.81

Regression on the Basis of Panel Data of Ukrainian and Russian Regions Separately for 2001-2003.

Ukrainian Regions

```
. sureg(employ tax_grp unemploy industry agricul enter criminal, nocon)(grp employ,
nocon)

Seemingly unrelated regression
-----------------------------------------------------------------------
Equation         Obs  Parms       RMSE      "R-sq"      chi2        P
-----------------------------------------------------------------------
employ            78      6    .0336702     0.9963   21376.08   0.0000
grp               78      1     1987.65     0.7850     287.16   0.0000
-----------------------------------------------------------------------


-----------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
employ       |
     tax_grp |  -.4678858   .2590787   -1.81   0.071    -.9756706     .039899
    unemploy |  -1.128642   .1634283   -6.91   0.000    -1.448956   -.8083289
    industry |    .657218   .0353865   18.57   0.000     .5878618    .7265742
     agricul |   .7245186   .0502821   14.41   0.000     .6259675    .8230696
       enter |   .0000636   .0000217    2.93   0.003      .000021    .0001062
    criminal |   .0000118   .0000144    0.82   0.414    -.0000165      .00004
-------------+---------------------------------------------------------------
grp          |
      employ |   6877.047   405.8278   16.95   0.000     6081.639    7672.455
-----------------------------------------------------------------------------
```

Russian Regions

```
. sureg  ( employ tax_grp unemploy industry agricul enter criminal   immigration,
nocon)(grp employ, nocon)

Seemingly unrelated regression
-----------------------------------------------------------------------
Equation         Obs  Parms       RMSE      "R-sq"      chi2        P
-----------------------------------------------------------------------
employ           237      7     .036359     0.9960   58965.36   0.0000
grp              237      1     7348.81     0.5989     349.32   0.0000
-----------------------------------------------------------------------


-----------------------------------------------------------------------------
             |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+---------------------------------------------------------------
employ       |
     tax_grp |   .2636524   .0896277    2.94   0.003     .0879852    .4393195
    unemploy |  -.7390667   .0547807  -13.49   0.000    -.8464349   -.6316985
    industry |   .6606756   .0191721   34.46   0.000     .6230989    .6982523
     agricul |    .568544   .0214826   26.47   0.000     .5264388    .6106492
       enter |   8.78e-06   8.69e-06    1.01   0.312    -8.25e-06    .0000258
    criminal |  -7.67e-06   4.57e-06   -1.68   0.093    -.0000166    1.28e-06
 immigration |    -.19459   .0618597   -3.15   0.002    -.3158328   -.0733472
-------------+---------------------------------------------------------------
grp          |
      employ |   15559.44   832.5019   18.69   0.000     13927.77    17191.12
-----------------------------------------------------------------------------
```

Regression on the Basis of Panel Data of Pooled Ukrainian and Russian Regions for 2001-2003, (with dummies for regions) .

```
. xi: sureg ( grp employ, nocon) (employ  tax_grp unemploy industry agricul enter
criminal i.region, nocon)


Seemingly unrelated regression
------------------------------------------------------------------------
Equation          Obs  Parms       RMSE     "R-sq"       chi2        P
------------------------------------------------------------------------
grp               315      1    6791.939    0.5642      407.67    0.0000
employ            315    110    .0243723    0.9982   171232.57    0.0000
------------------------------------------------------------------------
```

	Coef.	Std. Err.	z	P>|z|	[95% Conf. Interval]	
grp						
employ	13585.21	672.8399	20.19	0.000	12266.47	14903.96
employ						
tax_grp	.1545463	.1083216	1.43	0.154	-.05776	.3668527
unemploy	-.5788479	.1033255	-5.60	0.000	-.7813623	-.3763336
industry	.6893133	.0439043	15.70	0.000	.6032625	.7753641
agricul	.4700595	.0489728	9.60	0.000	.3740746	.5660444
enter	.0000464	.0000254	1.83	0.068	-3.39e-06	.0000962
criminal	-.0000631	8.06e-06	-7.83	0.000	-.0000789	-.0000473
_Iregion_2	.1098056	.023021	4.77	0.000	.0646853	.154926
_Iregion_3	.1806617	.034474	5.24	0.000	.1130938	.2482295
_Iregion_4	.1163529	.0231425	5.03	0.000	.0709945	.1617113
_Iregion_5	.0481369	.0331038	1.45	0.146	-.0167452	.1130191
_Iregion_6	.0787435	.030404	2.59	0.010	.0191527	.1383343
_Iregion_7	.0296161	.0261977	1.13	0.258	-.0217303	.0809626
_Iregion_8	.023489	.024827	0.95	0.344	-.025171	.072149
_Iregion_9	.0735755	.0235263	3.13	0.002	.0274648	.1196862
_Iregion_10	.1015166	.0288241	3.52	0.000	.0450224	.1580108
_Iregion_11	.0260559	.0328541	0.79	0.428	-.0383371	.0904488
_Iregion_12	.0016516	.0247691	0.07	0.947	-.0468949	.0501982
_Iregion_13	.0289969	.0300565	0.96	0.335	-.0299129	.0879066
_Iregion_14	-.0837708	.0293295	-2.86	0.004	-.1412555	-.026286
_Iregion_15	.1187966	.0250337	4.75	0.000	.0697315	.1678616
_Iregion_16	.0778942	.0350322	2.22	0.026	.0092325	.146556
_Iregion_17	.0810781	.0255267	3.18	0.001	.0310467	.1311096
_Iregion_18	.0085586	.0255259	0.34	0.737	-.0414712	.0585884
_Iregion_19	.1054532	.0283648	3.72	0.000	.0498593	.1610471
_Iregion_20	.0234671	.0351834	0.67	0.505	-.0454912	.0924254
_Iregion_21	-.0267077	.03606	-0.74	0.459	-.0973839	.0439685
_Iregion_22	.1807236	.0275286	6.56	0.000	.1267686	.2346786
_Iregion_23	-.055724	.0384866	-1.45	0.148	-.1311563	.0197084
_Iregion_24	.1042285	.0327928	3.18	0.001	.0399558	.1685013
_Iregion_25	-.0999951	.03656	-2.74	0.006	-.1716513	-.0283388
_Iregion_26	.046424	.0280134	1.66	0.097	-.0084813	.1013292
_Iregion_27	.0582447	.0231003	2.52	0.012	.012969	.1035205
_Iregion_28	.0806115	.0293668	2.74	0.006	.0230536	.1381695
_Iregion_29	.1261578	.0220544	5.72	0.000	.0829319	.1693838
_Iregion_30	.0482244	.0271169	1.78	0.075	-.0049237	.1013725
_Iregion_31	.12335	.0329028	3.75	0.000	.0588618	.1878383
_Iregion_32	.0392419	.0215894	1.82	0.069	-.0030725	.0815564
_Iregion_33	.0659352	.0342681	1.92	0.054	-.0012291	.1330995
_Iregion_34	.015498	.0328566	0.47	0.637	-.0488999	.0798958

```
_Iregion_35 |    .1289142    .0353278     3.65   0.000     .0596729    .1981554
_Iregion_36 |     .078323    .0299123     2.62   0.009     .0196959    .1369501
_Iregion_37 |     .042502    .0311157     1.37   0.172    -.0184837    .1034876
_Iregion_38 |    .0134345    .0250347     0.54   0.592    -.0356326    .0625016
_Iregion_39 |   -.0003292    .0273888    -0.01   0.990    -.0540102    .0533518
_Iregion_40 |   -.0080455    .0282175    -0.29   0.776    -.0633508    .0472599
_Iregion_41 |    .1084276    .0252321     4.30   0.000     .0589736    .1578816
_Iregion_42 |    .0299631    .0235894     1.27   0.204    -.0162712    .0761974
_Iregion_43 |    .0912954    .0355639     2.57   0.010     .0215914    .1609995
_Iregion_44 |    .0943772    .0257497     3.67   0.000     .0439088    .1448456
_Iregion_45 |    .0434731    .0209699     2.07   0.038     .0023729    .0845733
_Iregion_46 |     .087013     .032411     2.68   0.007     .0234886    .1505375
_Iregion_47 |    .1524729    .0261817     5.82   0.000     .1011577     .203788
_Iregion_48 |    .0866526    .0247523     3.50   0.000      .038139    .1351661
_Iregion_49 |   -.0378756    .0404037    -0.94   0.349    -.1170653    .0413141
_Iregion_50 |     .052307    .0279266     1.87   0.061    -.0024282    .1070422
_Iregion_51 |    .0129388    .0290068     0.45   0.656    -.0439136    .0697912
_Iregion_52 |   -.0402604    .0363455    -1.11   0.268    -.1114963    .0309756
_Iregion_53 |   -.0322487    .0351079    -0.92   0.358    -.1010588    .0365615
_Iregion_54 |     .089835    .0375537     2.39   0.017      .016231    .1634389
_Iregion_55 |    .1070714     .022529     4.75   0.000     .0629154    .1512273
_Iregion_56 |    .0543896    .0225534     2.41   0.016     .0101857    .0985935
_Iregion_57 |   -.0193865    .0294585    -0.66   0.510    -.0771241    .0383511
_Iregion_58 |     .012279    .0482071     0.25   0.799    -.0822052    .1067632
_Iregion_59 |    .0653233    .0368905     1.77   0.077    -.0069808    .1376274
_Iregion_60 |    -.005689    .0283754    -0.20   0.841    -.0613037    .0499258
_Iregion_61 |    .0477286    .0318735     1.50   0.134    -.0147424    .1101996
_Iregion_62 |    .0726385    .0296442     2.45   0.014     .0145369    .1307401
_Iregion_63 |    .0883075    .0263896     3.35   0.001     .0365848    .1400301
_Iregion_64 |   -.0085209    .0293038    -0.29   0.771    -.0659552    .0489135
_Iregion_65 |    .1041909    .0234292     4.45   0.000     .0582705    .1501114
_Iregion_66 |    .1175492    .0226387     5.19   0.000      .073178    .1619203
_Iregion_67 |    .0605222      .02648     2.29   0.022     .0086224     .112422
_Iregion_68 |    .0302163     .023604     1.28   0.200    -.0160468    .0764794
_Iregion_69 |     .130718     .035193     3.71   0.000      .061741     .199695
_Iregion_70 |   -.0347644    .0317117    -1.10   0.273    -.0969181    .0273893
_Iregion_71 |    .0829982    .0308373     2.69   0.007     .0225583    .1434382
_Iregion_72 |    .0670229    .0237217     2.83   0.005     .0205292    .1135167
_Iregion_73 |   -.0665993    .0321773    -2.07   0.038    -.1296656   -.0035329
_Iregion_74 |    .0435585    .0231574     1.88   0.060    -.0018292    .0889463
_Iregion_75 |   -.0062014    .0258467    -0.24   0.810    -.0568601    .0444572
_Iregion_76 |    .0344533    .0221743     1.55   0.120    -.0090076    .0779141
_Iregion_77 |    .0909605    .0333199     2.73   0.006     .0256547    .1562663
_Iregion_78 |    .0947295     .034198     2.77   0.006     .0277026    .1617564
_Iregion_79 |    .0088069    .0328819     0.27   0.789    -.0556405    .0732543
_Iregion_80 |    .0581002    .0242099     2.40   0.016     .0106497    .1055508
_Iregion_81 |    .0771292    .0302458     2.55   0.011     .0178485    .1364098
_Iregion_82 |   -.0295987    .0460824    -0.64   0.521    -.1199184    .0607211
_Iregion_83 |    .0431737    .0218908     1.97   0.049     .0002685    .0860788
_Iregion_84 |    .0138866     .029657     0.47   0.640     -.04424    .0720133
_Iregion_85 |    .0751726    .0334534     2.25   0.025     .0096052      .14074
_Iregion_86 |    .0684548     .022278     3.07   0.002     .0247907    .1121189
_Iregion_87 |    .0447489    .0286912     1.56   0.119    -.0114848    .1009826
_Iregion_88 |   -.0743476    .0279021    -2.66   0.008    -.1290347   -.0196604
_Iregion_89 |    .0595128     .031016     1.92   0.055    -.0012774    .1203029
_Iregion_90 |    -.004375    .0285588    -0.15   0.878    -.0603492    .0515992
_Iregion_91 |    .0520894    .0273113     1.91   0.056    -.0014397    .1056186
_Iregion_92 |     .116756    .0370809     3.15   0.002     .0440787    .1894333
_Iregion_93 |    .1952022    .0259069     7.53   0.000     .1444257    .2459787
_Iregion_94 |    .0842268    .0278024     3.03   0.002     .0297351    .1387186
_Iregion_95 |    .0261579    .0276232     0.95   0.344    -.0279827    .0802984
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_Iregion_96  |    .080335   .0260201    3.09   0.002    .0293365   .1313334
_Iregion_97  |    .071446   .0287879    2.48   0.013    .0150227   .1278693
_Iregion_98  |   .0642333   .0254751    2.52   0.012    .0143031   .1141635
_Iregion_99  |   .0945066   .0323307    2.92   0.003    .0311397   .1578736
_Iregion_100 |   .0558406   .0303608    1.84   0.066   -.0036655   .1153468
_Iregion_101 |   .0473945   .0230505    2.06   0.040    .0022164   .0925726
_Iregion_102 |   .0905034   .0310491    2.91   0.004    .0296482   .1513586
_Iregion_103 |  -.0474789   .0333788   -1.42   0.155   -.1129002   .0179424
_Iregion_104 |  -.0019943   .0340553   -0.06   0.953   -.0687415    .064753
_Iregion_105 |  -.0330374   .0281877   -1.17   0.241   -.0882844   .0222096
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Estimates of the Hidden economy in regions of Ukraine and Russia in 2001-2003 on the Basis of Panel Data (% of GRP), (with dummies for regions)

Rank	Region	% of the hidden economy in GRP, 2001	Region	% of the hidden economy in GRP, 2002	Region	% of the hidden economy in GRP, 2003
1	Moscow-city	67.41	Chukotka	65.63	Chukotka	62.34
2	Chukotka	62.90	Moscow-city	63.18	Moscow-city	60.15
3	Sakha	60.77	Magadan	63.16	St.Petersburg	59.71
4	Kyiv	59.79	Sakha	61.46	Vinnytsia	58.26
5	Volyn	58.97	St.Petersburg	60.54	Sakha	57.50
6	Vinnytsia	58.25	Kyiv	60.40	Volyn	57.27
7	Udmurtia	58.19	Kirov	60.18	Magadan	57.25
8	Tyumen	58.06	Kamchatka	60.17	Vologda	56.25
9	St.Petersburg	57.94	Tyumen	60.09	Kamchatka	55.97
10	Kamchatka	57.32	Volyn	59.71	Kyiv	55.94
11	Magadan	57.21	Vinnytsia	59.66	Yaroslavl	55.53
12	Orel	57.20	Udmurtia	59.41	Murmansk	55.48
13	Yaroslavl	57.05	Yaroslavl	59.32	Kirov	55.11
14	Perm	56.32	Vologda	58.96	Tyumen	55.09
15	Kirov	56.00	Khabarovsk	58.93	Udmurtia	55.03
16	Khabarovsk	55.91	Krasnoyarsk	58.17	Novgorod	55.01
17	Murmansk	55.67	Karelia	58.17	Lipetsk	54.95
18	Primorsk	55.64	Murmansk	57.72	Khabarovsk	54.90
19	Sakhalin	55.61	Perm	57.68	Sakhalin	54.61
20	Tatarstan	55.60	Komi	57.67	Nizh.Novgorod	54.40
21	Vologda	55.45	Tatarstan	57.50	Tatarstan	54.14
22	Moscow	55.25	Saratov	57.40	Chuvashia	53.84
23	Kharkiv	55.24	Sverdlov	57.05	Amur	53.77
24	Komi	55.04	Sakhalin	56.98	Samara	53.74
25	Kaluga	54.96	Kaluga	56.88	Primorsk	53.62
26	Samara	54.92	Nizh.Novgorod	56.84	Krasnoyarsk	53.59
27	Krasnoyarsk	54.67	Chuvashia	56.82	Perm	53.54
28	Dnipropetrovsk	54.56	Kostroma	56.44	Dnipropetrovsk	53.43
29	Lipetsk	54.52	Vladimir	56.35	Leningrad	53.43
30	Arkhangelsk	54.51	Kharkiv	56.34	Sverdlov	53.35
31	Crimea	54.51	Primorsk	56.29	Kaluga	53.22
32	Vladimir	54.48	Arkhangelsk	56.22	Orel	53.21
33	Chuvashia	54.21	Lipetsk	56.14	Crimea	53.12
34	Astrakhan	53.99	Kaliningrad	56.12	Kaliningrad	53.06
35	Sverdlov	53.91	Novgorod	55.99	Kursk	52.94
36	Novgorod	53.89	Tver	55.88	Karelia	52.85
37	Chernihiv	53.88	Crimea	55.83	Moscow	52.82
38	Karelia	53.81	Dnipropetrovsk	55.71	Kharkiv	52.74
39	Khakassia	53.70	Moscow	55.66	Arkhangelsk	52.68
40	Irkutsk	53.58	Orel	55.55	Kostroma	52.68

41	Smolensk	53.44	Kursk	55.52	Tula	52.61
42	Kaliningrad	53.34	Khakassia	55.40	Vladimir	52.55
43	Nizh.Novgorod	53.19	Leningrad	55.02	Mordovia	52.48
44	Tver	53.17	Ulyanovsk	55.01	Saratov	52.33
45	Bashkortostan	53.08	Chelyabinsk	54.99	Chelyabinsk	52.27
46	Donetsk	53.05	Amur	54.86	Chernihiv	52.18
47	Lviv	52.79	Ryazan	54.86	Tver	52.08
48	Belgorod	52.71	Samara	54.82	Ryazan	51.92
49	Kursk	52.44	Penza	54.82	Odessa	51.92
50	Volgograd	52.44	Chernihiv	54.43	Ulyanovsk	51.80
51	Odessa	52.25	Omsk	54.42	Belgorod	51.74
52	Tomsk	52.21	Volgograd	54.37	Bashkortostan	51.74
53	Kostroma	52.19	Bashkortostan	53.82	Kemerovo	51.58
54	Zaporizhzhia	52.09	Orenburg	53.77	Volgograd	51.23
55	Marij-El	52.04	Marij-El	53.76	Omsk	51.13
56	Orenburg	51.91	Smolensk	53.73	Marij-El	51.02
57	Ivanovo	51.88	Tula	53.71	Kirovohrad	51.00
58	Saratov	51.84	Zaporizhzhia	53.69	Orenburg	50.87
59	Tula	51.82	Tomsk	53.69	Irkutsk	50.78
60	Altai K	51.69	Kurgan	53.63	Pskov	50.68
61	Chelyabinsk	51.56	Pskov	53.62	Smolensk	50.66
62	Altai R	51.35	Ivanovo	53.58	Komi	50.61
63	Poltava	51.34	Donetsk	53.57	Penza	50.60
64	Kemerovo	51.33	Belgorod	53.31	Donetsk	50.55
65	Khmelnytskyi	51.30	Irkutsk	53.27	Astrakhan	50.55
66	Omsk	51.07	Kemerovo	53.18	Lviv	50.55
67	Amur	51.05	Voronezh	53.17	Voronezh	50.52
68	Ulyanovsk	50.98	Odessa	53.04	Cherkasy	50.49
69	Kiev Oblast	50.87	Astrakhan	53.00	Kurgan	50.40
70	Zakarpattia	50.79	Altai K	52.88	Kiev Oblast	50.26
71	Leningrad	50.57	Chita	52.79	Krasnodar	50.25
72	Voronezh	50.50	Novosibirsk	52.62	Bryansk	50.23
73	Mordovia	50.31	Bryansk	52.61	EAO	50.20
74	Mykolaiv	50.30	Lviv	52.54	Mykolaiv	50.15
75	EAO	50.09	Altai R	52.38	Novosibirsk	50.10
76	Penza	50.05	Mordovia	52.33	Sumy	50.05
77	Sumy	49.92	Sumy	52.16	Poltava	50.01
78	Cherkasy	49.82	Rostov	52.15	Zaporizhzhia	50.01
79	S.Osetia-Alania	49.50	Mykolaiv	52.14	Ivanovo	49.72
80	Bryansk	49.49	Kiev Oblast	52.12	S.Osetia-Alania	49.59

81	Novosibirsk	49.40	Poltava	52.09	Tambov	49.26
82	Rostov	49.28	Kirovohrad	51.98	Zakarpattia	49.20
83	Ryazan	49.25	Krasnodar	51.84	Rostov	49.09
84	Rivne	49.20	Cherkasy	51.79	Khmelnytskyi	48.91
85	Kirovohrad	49.10	EAO	51.68	Tomsk	48.39
86	Kherson	48.84	Zakarpattia	51.43	Altai R	48.20
87	Kalmykia	48.28	Tambov	51.00	Stavropol	48.06
88	Pskov	48.19	Khmelnytskyi	50.68	Buryatia	47.69
89	Tambov	48.18	S.Osetia-Alania	50.64	Kherson	47.57
90	Krasnodar	47.92	Kherson	50.39	Chita	47.53
91	Kurgan	47.89	Buryatia	49.80	Altai K	47.52
92	Stavropol	47.58	Stavropol	49.18	Kalmykia	47.08
93	Ivano-Frankivsk	46.97	Zhytomyr	48.77	Khakassia	46.82
94	Luhansk	46.97	Luhansk	48.75	Zhytomyr	45.61
95	Zhytomyr	46.39	Kalmykia	48.20	Dagestan	45.42
96	Chita	46.39	Tyva	48.05	Ivano-Frankivsk	45.21
97	Kabardino-Balkaria	46.04	Rivne	46.85	Luhansk	45.18
98	Buryatia	44.36	Karachaevo-Cherkesia	46.76	Rivne	44.62
99	Karachaevo-Cherkesia	43.83	Ivano-Frankivsk	46.66	Adygeia	43.68
100	Adygeia	43.44	Dagestan	45.58	Ternopil'	43.36
101	Dagestan	43.04	Adygeia	45.31	Tyva	42.94
102	Tyva	42.39	Kabardino-Balkaria	44.92	Chernivtsi	42.43
103	Chernivtsi	42.27	Ternopil'	43.29	Karachaevo-Cherkesia	42.21
104	Ternopil'	41.74	Chernivtsi	43.18	Kabardino-Balkaria	41.29
105	Ingushetia	28.59	Ingushetia	22.86	Ingushetia	16.21