SHADOW ECONOMY OF UKRAINE: THE CASE OF FINANCIAL CONSTRAINTS

by

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Abstract

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In this thesis we investigate the behaviour of the shadow economy and its impact on the total economic performance at the country. The study is new in considering the financial constraints as the main costs faced to hidden enterprises due to semi-formal character of their shadow activity. For the purpose of research, the model with possibility of unofficial business and financial constraint was developed in the context of neoclassical growth framework. Solving this model analytically and examining its implications, we have found that it adequately reflects the main empirical findings on the topic available up to now. Besides, the model provides us with finding that under certain conditions shadow sector does not depress the total performance at the country but even stimulate economic growth. On the evidence of Ukraine we have shown that such conditions are associated with the period of transition from command type of the economy to the market one.

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Chapter 1

INTRODUCTION

The existence and expansion of shadow economic activity is the wide known fact now. In many countries around the world underground economy plays crucial role in all spheres of life. Thus, the phenomenon of shadow activity is studied not only in economic science but also in psychology, sociology and other disciplines (Lassen, 2003).

From economic point of view, informal sector is actual functioning part of all economies. Its size fluctuates on average from 12% of GDP for developed countries to 39% for developing ones. Also, the level of shadow economies for most countries has been growing during the last decade (Schneider and Enste, 2000). Moreover, the problem of underground activity is even more critical for economies of Eastern Europe and the former Soviet Union, with Ukraine among them, where transition "from communism to capitalism" has been accompanied impetuous growth of the size of shadow sector (Johnston, Kaufmann and Shleifer, 1997).

How damaging is the impact of underground activity? Does it really slow down the economic performance of the country and prevent significant growth? The analysis of the effects of shadow sector is rather complicated and comprehensive evidence is not available due to hidden nature of such business. Nevertheless, the data of 76 countries shows that low rate of GDP per capita are usually combined with high value of underground economy (Schneider and Enste, 2000). The presence of shadow sector has such negative consequences as tax evasion with following budget deficit, decrease in supply of public goods and services, inefficient decisions in economic policy and others. At the same time,

underground activity reduces the unemployment and increases competitiveness at labor market, encourages accumulation of capital and provides sufficient part of recourses for official sector. Thus, the sum effect of shadow economy on total performance at the country remains unclear and needs more research to provide additional knowledge about its penalties and gains (Fleming, Roman and Farell, 2000).

In this light, the case of transition countries seems to be most favorable and beneficial. Economies under transition have attractive pace: changes and consequences here could be observed more easily then in economies close to stable state. In the course of our study we would like to develop theoretical macroeconomic model of transition economy with informal sector; on this base, investigate the relationship between the size of the shadow sector at the country and its total economic performance. We expect to find such situations, where the presence of underground activity does not pressure the economic growth. Finally, we will analyze the model implications to the Ukrainian data and try to formulate corresponding policy suggestions.

Our research differs from the earlier studies by the character of relationship examined since we would like to concentrate on the impact of underground activity on the economic performance taking into consideration the financial constraints that shadow enterprises face. We will use the results in evaluation of the size and causes of underground economy received by previous researchers to make our conclusions more comprehensive.

The rest of the thesis is organized as follows. Chapter 2 deals with theoretical and empirical issues concerning causes and effects of shadow economy around the world. In Chapter 3 the description of the model is given. Chapter 4 provides with analytical solution to the model developed. In Chapter 5 we analyze the model predictions and make them more specific for Ukraine in Chapter 6. Finally, Chapter 7 contains conclusions.

Chapter 2

LITERATURE REVIEW

The increase of the size of shadow economy in many countries around the world stimulates attention of the economists to such kind of activity. To this moment, a lot of theoretical papers investigating the shadow economy, with support of empirical tests, were developed. Since our research interest lies in narrow field of underground sector impact on the official activity, we would like to start from definition of shadow economy, refer to the methods of estimation of its size and continue with the main approaches used for examining the influence of underground activity in order to meet their findings and build on the best from all.

Shadow activity can take various forms according to intensity of informality. Some types will never become formal like drugs trading or criminal "protection". Fortunately, most part of shadow business could be legalized under favorable conditions; more precisely, when cost of informality will be greater than its benefits. This fraction of shadow activity is the point of our interest.

We will define shadow economy (underground activity, hidden sector, etc.) according to the commonly used formulation of Schneider and Enste (p.5, 2000): "all economic activities which contribute to the officially calculated (or observed) Gross National Product, but currently unregistered". Since this definition presumes all activities which would be taxable if were reported to the tax collectors, it is the most appropriate for our research purposes.

The techniques for estimation of the size of unofficial sector provide the basis for further study of the consequences of underground activity. Wide-cited survey by

Schneider and Enste (2000) present the fundamental analysis of the methods developed for estimation. Among them, the currency demand approach and electricity method have appeared to be most relevant in the case of transition economies (Dzvinka, 2002).

The relationship between official and shadow sectors has dual nature: on the one hand, underground activity has certain (positive or negative) impact on "official" business, on the other hand, causes and reasons for development of such phenomenon undoubtedly lay in official economy. Most of researchers argue that the high taxes and social payments, complexity of tax code, administrative and bureaucratic burden, corruption and high unemployment are main roots of unofficial economy. However, the direction of its influence is not obvious. Empirical investigations provide rather ambiguous results.

Schneider and Enste (2000) have revealed that the enlargement of the shadow sector in OECD countries is best explained by the high level of direct taxation and social payments with increasing state regulatory activities. Lemieux, Fortin and Frechette (1994) also have found, using micro data, the positive relation between the size of social transfers and participation in shadow economy. Surprisingly, greater complexity of tax system may even reduce the underground sector (Schneider and Neck, 1993). Also, higher tax rates might actually be associated with less shadow activity (Friedman, Johnston, Kaufmann and Zoido-Lobaton, 2000). According to research of Johnston, Kaufmann and Shlieifer (1997) based on transition counties' data, politization and weak institutions stimulates the growth of unofficial sector and hence institutional reforms could significantly improve the situation. At the same time, institutional quality affects the size of underground economy through influence on the magnitude of corruption. In addition to direct effect, perfection of the institutions reduces the level of corruption that, in turn, increases the incentives to switch to the official economy (Friedman, Johnston, Kaufmann and Zoido-Lobaton, 2000).

Nevertheless, the direction of corruption impact is still the open question. The influence of bureaucratic burden and rent-seeking officials depends on the level of entry costs in official economy: when these costs are low, advanced bureaucracy does not influence the size of shadow sector, but in case of high entry costs the impact is substantial and positive (Sarte,1999).

Besides, the most recent studies show that ethnic fragmentation (Lassen, 2003) and income inequality (Rosser, Rosser, Ahmed, 2003) are the significant factors of changes in the underground activity. Countries with high differentiation in ethnic groups and large deviation of income distribution suffer from huge size of shadow economy.

Thus, empirical papers investigating the direct relation – the impact of official sector on shadow economy size - came up with quite different results. Probably, the conclusions received by the researchers depend on assumptions and hypotheses made which could be confirmed by the evidence of the country or region of the researchers' interest. For example, Loyaza (1996) has built his model using Latin America experience where character of shadow activity is quite specific and could hardly be compared with other parts of the world. Due to such ambiguity, one should be very careful in applying the outcome of these empirical findings to others countries and regions, especially the transition ones with their distinctive conditions and environment.

At this stage we have enough information to answer the question: Why firms participate in shadow economy? Obviously, they believe that benefits of doing so exceed costs of operating informally. Let us analyze this point in more detail.

The major benefit of shadow activity is tax evasion and escaping bureaucracy and excessive regulation. First, firms save money due to not paying fees and bribes. Second, they save the time spent on various bureaucratic procedures. The level of such "amount saved" is rather diverse for different transition countries. Clearly, the amount of money saved directly depends on the rates of taxes, fees, number

of permitting payments, etc. at the country. According to World Bank snapshot (2005), only tax pressure varies from 20% to 63% across transition countries, with 39.5% for Ukraine (VAT, corporate income tax, social payments, etc.). Also, Djankov et al (2002) tried to estimate time saved using as example business registration process. It costs form 22 days in Kyrgyz Republic to 133 days in Romania (or from 7 procedures in Latvia to 20 in Belarus) to register an enterprise. Nevertheless, most of firms operating in shadow sector prefer to register and do certain fraction of their business officially in order to have some protection of their assets and access to public goods and services – doing so called semi-formal activity (Kaufmann and Kaliberda, 1996). But besides registration, there are a lot of other regulation aspects which also take huge time costs like licenses for certain types of activity, permissions for export or environmental issues.

Considering the costs of operating at informal sector, the greatest problem participants face is the possibility of being caught. As Djankov et al (2002) state firms have to stay sufficiently small in order not to draw attention of tax inspectors. On the other hand, the crucial difference between shadow activity at FSU countries and other parts of the world is the size of business since at FSU countries even medium and large firms keep part of their activity hidden (Kaufmann and Kaliberda, 1996). Here the problem of uncertainty arises: when informal activity was discovered it is unknown to what extent the firm will be punished. The greatest penalty is the claim to be closed but, taking into account previously mentioned high level of bureaucracy and corruption, the firm could offer satisfactory amount of bribe with purpose of minimizing the punishment. However, if the law and justice function well at the country, enterprises lose a lot by operating unofficially.

Other important aspect of the costs of informality is the lack of access to formal credit channels and various forms of assistance programs for private firms. Most

of literature that research small business in transition countries considers inability of getting finance to be the main problem for development a new enterprise. As Vavryshchyk (2003) reports for Ukraine, "on average one of five businesses attempted to receive a credit or loan during six month prior to the survey. Half of those succeeded in obtaining a credit".

Nevertheless, shadow firms could use informal sources of financing like personal savings or moneylenders. But the costs of borrowing from such sources can be very high making the borrowing unreasonable. For example, in transition countries informal interest rates of borrowing from moneylenders vary from 5% to 10% a month (Djankov et al, 2002).

Summarizing, due to semi-formal type of shadow activity and high level of corruption, the main problem that shadow business run into is the lack of financing. Despite the numerous articles analyzing shadow economy, none of them focuses on impact of financial constraints on the informal business. On the other hand, capital investment or inventory models do incorporate financial constraints like Carlstrom and Fuerst (1998) or Kolev (2004). Thus, it is important to model these two processes together because they are closely related in case of transition countries.

What effect should we expect? Does the shadow economy influence official sector positively of negatively? Logic suggests, and research papers confirm, that answer to this question is not straightforward. Theoretic frameworks provide strong base for possibility of both positive and negative effects of underground economy (Eilat and Zinnes, 2000). Consequently, its impact on development and economic growth is also confusing and need more detailed examination.

The negative consequences of underground activity could be presented from micro-economic, macroeconomic or social standpoints.

The micro models usually refer to the efficiency with which economy work. The problems arise since the existence of shadow economy creates distortions in allocation of resources since shadow business attracts more labor and less capital into the production process than official enterprises and hence cause allocative efficiency effect (Tanzi, 1982). Besides, due to evasion the tax payments shadow firms could offer lower price and affect the market structure and conduct. Also, the behavioral effects of shadow sector and leisure-labor choice of workers should be considered here. This suggestion appeared in response to toughening of labor market regulation in many countries around the world. Restrictions on work hours and establishment of minimal wages forced firms and workers to develop the "shadow" labor market where the enterprises hire additional employees for higher wage (since they do not pay social transfers) and workers get the opportunity to increase their earnings according with their leisure-labor preferences. The different modifications of this scheme were applied to number of countries (for instance, Portes and Saseen-Koob, 1987) and generally shown the positive impact of shadow activity due increase of competitiveness, redistribution of labor and decrease of unemployment.

Macroeconomic problems concern, generally, the provision of public goods and efficiency of decisions in economic policy. Public finance frameworks suggest that due to tax evasion underground business hurts provision of public goods and services. Considering that official firms benefit from public goods more than unofficial one, the fall in its provision pushes business to shadow sector. On this base, Loayaza (1996) presented macroeconomic endogenous growth model where production depends on public services among other inputs. He investigated the economies with excessive taxes and regulations using the data for countries of Latin America. Loayaza's model showed that in economies where (i) the statutory tax is higher than the optimal tax and (ii) enforcement of compliance is rather weak, the raise of shadow sector causes the depreciation of

economic growth. Nevertheless, this negative conclusion is not broadly accepted and main assumptions of this model have been criticized (Asea, 1996).

Macroeconomic policy decisions are usually less effective with the presence of shadow economy. First, incompleteness of information about real macroeconomic figures causes inaccurate and even wrong conclusions. Second, monetary policy could be impaired because underground firms weakly use banking system and capital markets. Moreover, fiscal policy decisions about tax changes have weak effect since shadow firms do not pay taxes. As a result, it is harder to achieve and sustain macroeconomic stability in the country (Eilat and Zinnes, 2000).

Social negative effects of shadow activity and basically connected with disintegration of social norms (Schneider and Enste, 2000). Here the problem of two-way causality appears since it remains unclear whether shadow economy is a cause or consequence of bad moral.

Positive influences of underground economy also should be considered. On the micro level, Kaufmann and Kaliberda (1996) have found that shadow activity provides market and entrepreneurial experience to firms. On the macro level, its most significant benefit is that when official business reduces due to high level of corruption and rent-seeking, shadow economy carries economic activity in the country. It increases competition to official sector and enforces boundaries on governmental activities. Also, empirical findings of Schneider (1998) clearly show that greatest part of income received in shadow sector is immediately spent in official one. These additional expenditures positively influence the economic growth and indirect tax revenues. The results are similar to one obtained by Adam and Ginsburg (1985) in their study for Belgium. Also, Bhattacharyya (1999) has shown the strong positive relation between the size of underground economy and consumer expenditures of goods and services for United Kingdom.

Particularly, the effect for durable goods appeared to be even stronger than for non-durable.

Therefore, some researchers argue for the existence of multiple unofficial economy equilibria with two stable states (Johnston, Kaufmann and Shlieifer, 1997). "Good" one represents low tax, regulatory and corruption burdens with highly effective and transparent government supported by valuable tax revenues and providing high-quality public goods. This state corresponds with rather small size of shadow activity. In the "bad" equilibrium, taxes and regulations are prohibitive, provision of public goods in the official economy is poor since public finance are precarious. As a result, most firms switch to underground sector. If firms are more productive in official sector (due to exercise of public goods, for example) than in unofficial one, this equilibrium is associated with worse aggregate economic performance than the "good" state. Economies of transition countries seem to go in direction of the "bad" equilibrium. In the next section we develop the macroeconomic model to look for the results with presence of financial constraint..

Chapter 3

DESCRIPTION OD THE MODEL

In this section we would like to develop the theoretical model, which allow us to examine the behavior of economy with presence of shadow sector. With this purpose in hand, the real business cycle framework is the most convenient approach since it allows to introduce the parameters of our interest in the basic setup which could be solved analytically and tested numerically. Besides, it has been proven that such kind of models is roughly in accordance with real data. Direct statistical tests of these models are mildly supportive and do not reject the models' ability to explain observed economic patterns.

Precisely, we will bring the possibility of informal activity and financial constraints in a simple neoclassical growth model. Defining the representative form and parameters of the model, we will use the current information about business and state conditions of Ukraine. In order to keep the model as simple as possible, we will ignore some aspects of informal activity such as labor-leisure choice and corruption.

Thus, in the next chapters we will follow the standard procedure: start from description of our model, analyze it qualitatively and examine how the model explains the real data.

3.1. General assumptions

In order to formulate the model, we have to make the assumptions about characteristics of our artificial economy and behavior of its agents.

First, we assume that the same firms operate in both official and unofficial sectors; in other words, firms produce some amount of goods, but only certain

portion of this quantity is declared officially. This statement is consistent with evidence of transition countries (Eliat and Zinnes, 2000) in contrast to countries of Latin America where all great enterprises are official but most of small private firms are in shadow (Loayza, 1996).

Second, we will consider that agents choose to participate in underground activity as a result of optimization of their behavior. Since the tax rates on firms' profit are very high (Johnston, Kaufmann and Zoido-Lobaton, 1998), it is natural to try to reduce the huge payments. The choice firms make is based on information about tax rates and rates of return on capital. Entering the shadow activity, the agent has additional profit due to tax evasion and additional costs of impossibility of getting loan from a bank in the amount required for production purposes. In reality of Ukraine and other transition countries, banks take into consideration the borrower's value of assets and profitability indexes of her activity when decide about crediting. The firm which operates in underground sector will have low values of the former (when it produces unofficial output using unofficial assets) or the latter (producing unofficial output with official assets) and get only small or even no credit from banks. Thus, such agents face the restrictions on the borrowing from banks. Besides, this assumption is in line with one made by Calstrom and Fuerst in their research on impact of net worth of a firm on its activity.

As has been already noted, we will not take into consideration the level of corruption and bureaucracy. It affects the size of underground economy significantly and this relation is positive. Sarte (1999), Jonhson, Kaufmann and Zoido-Lobaton (1998) have shown that the high level of corruption and bureaucracy lead to large shadow sector. Thus, we will treat this intensity at some constant level and ignore effects of its possible change so as not to repeat the already proven results of mentioned positive correlation and to distinguish other impacts we are looking for.

Next, we need to define the possibility of punishment for participation in the underground activity. Actually, government has various punitive means, from different kinds of fines to criminal proceedings. Taking into consideration the high level of corruption in transition countries (again, shown by Jonhson, Kaufmann and Zoido-Lobaton (1998)), we can assume that firms pay certain lump-sum fine in case of detection of their unofficial operations. Also, Yakovlev (2001) in his research of black market in Russia has come to the same conclusion and plausibility of mentioned assumption.

As the typical real business cycle model, our artificial economy consists of infinitely lived households (consumption sector) and firms (production sector). There is no financial sector in the economy; and if firms need additional capital, they can borrow it form local people and from abroad. International financial institutions are able to supply unlimited amount of capital at a constant world interest rate. However, they require the guarantee for their loans and use the information about firms' official net worth for this purpose. Thus, firms can borrow at international market only at the fraction proportional to their official size. On the other hand, they can borrow form local people any amount they want but the local interest rate is much higher than the world one because local people do not require the collateral and compensate their risk by setting high interest rates (Djankov et al, 2002).

The model has infinite number of time periods. Each period agents use the information available at this period, optimize their behavior and make forecast on the future periods.

3.2. Consumer problem

There is a fixed number N of identical households in the economy. Households own shares of firms and consume the final good produced by them. Besides, households accumulate the capital in the economy and lend it directly to the producers at the interest rate r_t. Also, they supply labor to firms for real wage w_t.

Households are endowed with one unit of time and supply all this time to the market. Agents do not care whether they work in officially or unofficially since their wage does not depend on the status of the job.

Since households are identical, we can use representative agent's formulation. The stand-in household makes her choice by maximizing the expected discounted value of her intertemporal utility function U (with respect to consumption in the current period) subject to certain budget constraint. For this purpose, she selects aggregate consumption C_t and amount of capital K_{t+1} in period t.

$$\max_{\{C_t, K'_t\}} \quad E\left[\sum_{t=1}^{\infty} \beta^t U(C_t) \right] \quad \text{subject to} \tag{1}$$

$$C_t + K'_{t+1} = (r_t + 1 - d) K'_t + \Pi_t + w_t N_t \tag{2}$$

where β is discount factor ($\beta \in (0;1)$), C_t is consumption at period t , K'_{t+1} and K'_t is the capital owned by household at period t+1 and t respectively, Π_t is the profit of production firms, N_t is aggregate labor supply and d means rate of depreciation.

Let us assume that households' utility does not depend on the value of the leisure. Thus, we can choose certain utility function that has necessary properties (differentiable, strictly increasing and strictly quasi-concave), for instance, CRRA utility function of the following form:

$$U(C_t) = \frac{C_t^{1-\varphi} - 1}{1 - \varphi} \tag{3}$$

Besides, we can express the maximization problem in per capita terms since aggregate labor supply equals to the number of households in the economy, $N = N_t$.

In this case, maximization problem becomes:

$$\max \{c_{t,\,kt}\} \quad E[\ \sum_{t=1}^{\infty} \beta^t \ \frac{c_t^{\,1-\varphi}-1}{1-\varphi}\ ] \quad \text{subject to} \tag{4}$$

$$c_t + k'_{t+1} = (r_t + 1 - d)\, k'_t + \pi_t + w_t \tag{5}$$

where $c_t = C_t/N$, $k_t = K_t/N$, $k'_{t+1} = K'_{t+1}/N$, $\pi_t = \Pi_t/N$ are per capita values of consumption, capital and firms' profit correspondingly.

3.3. Firm problem

Production sector consists of infinitely many firms that create homogeneous consumption goods, using capital and labor as input. They can operate in official and unofficial way and choose the shadow fraction γ_t of output by themselves. At the beginning of each period, firms hire labor and rent capital to finance their activity, which they return at the end of the current period.

Firms operate under constant return to scale technology and have the following production function for both official and unofficial production:

$$y_t^i = \theta_t^i\ y\ (k_t^i,\ l_t^i)\ ,$$

where at each period t y_t^i is output produced by i-firm, k_t^i and l_t^i are the amounts of capital and labor used, and θ^i is the technology shock.

Due to CRS technology, number of producing firms at the economy is irrelevant for solution and we can assume one firm for convenience with Cobb-Douglas production function

$$Y_t = \theta_t K_t^a N_t^{\,1-a} \tag{6}$$

that in per capita terms will be

$$\frac{Y_t}{N} = \theta_t \frac{K_t^{\alpha} N_t^{1-\alpha}}{N} = \theta_t \frac{K_t^{\alpha}}{N_t^{\alpha}} \frac{N_t}{N_t} = \theta_t \left(\frac{K_t}{N}\right)^{\alpha} = \theta_t k_t^{\alpha} = y_t \tag{7}$$

Firm pays taxes only on official output and does not pay anything for hidden part but does incur the possibility of punishment for shadow activity. Besides,

producer can borrow the capital she needs for production from local households by interest rate r_t (any amount) and from international institutions by interest rate R_t (at the amount proportional to the official size of a firm). Interest rate r_t is much higher than the world one R_t because local people do not require the collateral, contract or reports and compensate their risk by setting high interest rates.

All together, each period the firm chooses amount of borrowed capital K_t, hired labor N_t and share of official output γ_t such that it maximizes the net return from production:

$$\max_{\gamma, y} \quad E \quad [\Pi_t(Y_t) = (\Pi_t^o(Y_t^o) + \Pi_t^s(Y_t^s))] \tag{8}$$

$$\text{subject to} \quad Y_t^s = (1-\gamma_t)Y_t \text{ and } Y_t^o = \gamma_t Y_t \tag{9}$$

$$K_t > 0, \text{ given.}$$

where Π_t is the net return from production at the period t, Y_t is the output in the period t, and subscripts s and o mark shadow and official activity correspondingly.

Generally speaking, net return from production is defined as

$$\Pi_t(Y_t) = Y_t - w_t N_t - r_t K_t \tag{10}$$

where first term is the revenue from production, second term means costs of labor hiring and last one shows the costs of capital renting.

In our case, the return from official production has the following form:

$$\begin{aligned} &\Pi_t^o(Y_t^o) = (1-T)Y_t^o - w_t N_t^o - R\tilde{K}_t(\gamma_t) = \\ &= (1-T)\gamma_t Y_t - w_t \gamma_t N_t - R\tilde{K}_t(\gamma_t) \end{aligned} \tag{11}$$

where T is the tax rate paid by a firm from official output and R is the constant world interest rate. The first term shows the expected official output of the

producer net of tax at period *t* which depends on realization of technology shock. Next term shows costs for officially hired labor. Third term is the payment for capital $\tilde{K}_t$ that firm borrows at the beginning of the period. Producer rents as much capital as possible from the international institutions due to $R<r_t$. Since the firm is allowed to borrow at the international market only at official size, this amount $\tilde{K}_t$ is the function of official share γ_t.

The formula for shadow part of producer activity is quite different. The dissimilarity is the following:

- producer does not pay taxes,
- she creates the unofficial output accounting for possibility of punishment *p*M*, where *p* is the probability of being caught which depends on the intensity of shadow activity (thus, p is the function of γ_t) and *M* is amount of penalty,
- producer borrows the capital she needs for unofficial production from local people at the interest rate r_t.

$$\begin{aligned} &\Pi_t^s(Y_t^s) = Y_t^s - w_t N_t^s - r_t K^s{}_t - p(\gamma_t) * M = \\ &= (1-\gamma_t)Y_t - w_t(1-\gamma_t)N_t - r_t(K_t - \tilde{K}_t(\gamma_t)) - p(\gamma_t) * M \end{aligned} \tag{12}$$

Now we are able to rewrite the firm's optimization problem (9):

$$\max_{\gamma_t, K_t, N_t} \begin{bmatrix} \Pi_t(Y_t) = (1-T)\gamma_t Y_t - w_t\gamma_t N_t - R\tilde{K}_t(\gamma_t) \\ +(1-\gamma_t)Y_t - w_t(1-\gamma_t)N_t - r_t(K_t - \tilde{K}_t(\gamma_t)) - p(\gamma_t) * M \end{bmatrix}$$

subject to $K_t>0$, given.

This problem could be presented in more compact form as

$$\begin{aligned} \max_{K,N,\gamma} \quad & \Pi_t(Y_t) = Y_t(1-T\gamma_t) - r_t(K_t - \tilde{K}_t(\gamma_t)) - \\ & - R\tilde{K}_t(\gamma_t) - w_t N_t - p(\gamma_t) * M \end{aligned} \tag{13}$$

subject to $K_t>0$, given.

C h a p t e r 4

ANALYTICAL SOLUTION

In order to solve the model we need to find equilibrium state according to the following definition:

Definition. Competitive equilibrium of the economy is a sequence of prices $\{r_t,w_t\}^{\infty}_{t=0}$, the household's allocation $\{c_t, k'_{t+1}\}^{\infty}_{t=0}$ and the firm's allocation $\{K_t,N_t\}^{\infty}_{t=0}$ such that, given prices,

(a) $\{c_t, k'_{t+1}\}^{\infty}_{t=0}$ solves (4)-(5);

(b) $\{K_t, N_t\}^{\infty}_{t=0}$ solves (13);

(c) all markets clear:

capital market $K_t = \sum_{n=1}^{N} k'^{n}_{t}$ (14)

labor market $N_t = \sum_{n=1}^{N} 1^{n}_{t} = N$ (15)

goods market $C_t + K_{t+1} - K_t(1-d) = Y_t$. (16)

Next, we will use usual technique for solving business cycle models: taking first-order conditions for household utility maximization problem and firm profit maximization problem.

Building Lagrangian and taking FOCs for household problem (4) - (5) we get standard form of Euler equation that relates consumption of current and next periods:

Lagrangian for consumer maximization problem:

$$L = \sum_{t=1}^{\infty} \beta^t U(c_t) + \sum_{t=1}^{\infty} \lambda_t ((r_t + 1 - d)k'_t + \pi_t + w_t n_t - c_t - k'_{t+1})$$

FOCs:

$$\frac{\partial L}{\partial c_t} = \beta^t U'(c_t) + \lambda_t(-1) = 0 \quad (17)$$

$$\frac{\partial L}{\partial k'_{t+1}} = \lambda_t(-1) + \lambda_{t+1}(r_{t+1} + 1 - d) = 0 \quad (18)$$

From (17) and (18) we derive Euler equation:

$$U'(c_t) = \beta E[U'(c_{t+1})(r_{t+1} + 1 - d)] \quad (19)$$

This equation represents the intertemporal efficiency condition where left-hand side shows the marginal costs of investing in more capital in terms of utility and right-hand side means the expected marginal utility gain.

In order to solve firm optimization problem for optimal values of wage, local interest rate and share of official output we plug production function (6) in (13). From first order condition with respect to capital we derive the expression for local interest rate:

$$r_t = \alpha\theta_t K_t^{\alpha-1} N_t^{1-\alpha} (1 - T\gamma_t) \quad (20)$$

In the same way, from FOC with respect to labor we have:

$$w_t = (1-\alpha)\theta_t K_t^{\alpha} N_t^{-\alpha} (1 - T\gamma_t) \quad (21)$$

We see that local interest rate and wage are marginal products of capital and labor respectively adjusted on taxes paid on official output.

First order condition with respect to share of official activity gives:

$$T\theta_t K_t^{\alpha} N_t^{1-\alpha} = (r_t - R)\frac{\partial \tilde{K}_t(\gamma_t)}{\partial \gamma_t} - M * \frac{\partial p_t(\gamma_t)}{\partial \gamma_t} \quad (22)$$

Here we have to examine the behavior of $\tilde{K}_t(\gamma_t)$ - the fracrion of capital that the firm can borrow at world interest rate which depends on officially declared firm

size. Thus, this function should satisfy $\tilde{K}_t(0) = 0$, $\tilde{K}_t(1) = K_t$ and $\partial \tilde{K}_t(\gamma_t)/\partial \gamma_t > 0$. When $\tilde{K}_t(\gamma_t) = 0$, the firm borrows all capital at local interest rate and makes zero profit. If $\tilde{K}_t(\gamma_t) > 0$, the firm have positive profit due to difference $r_t - R$. For simplicity, let us suppose such possible form of $\tilde{K}_t(\gamma_t)$:

$$\tilde{K}_t(\gamma_t) = K_t \gamma_t \ , \tag{23}$$

which means that the firm can lend from international institutions exactly the same share of capital as size of output declared.

Besides, the function of probability to be caught should be determined. Logically, *p(1)* should be equal to zero, *p(0)* should tend to one and function have to be decreasing in γ_t. Again, we assume the simplest form of such a function:

$$p(\gamma_t) = 1 - \xi \gamma_t \tag{24}$$

where ξ could be treated as the parameter which reflects severity of persecution for shadow activity. More precisely, ξ is the value that inverse to the level of enforcement. Thus, with more enforcement probability to be caught increases.

Now we can plug (20), (23) and (24) in (22):

$$T\theta_t K_t^{\alpha} N_t^{1-\alpha} = (\alpha \theta_t K_t^{\alpha-1} N_t^{1-\alpha}(1 - T\gamma_t) - R)K_t - M * (-\xi)$$

And rewrite this expression in per capita terms:

$$T\theta_t k_t^{\alpha} = (\alpha \theta_t k_t^{\alpha-1}(1 - T\gamma_t) - R)k_t - m * (-\xi)$$

where $m = M/N_t$.

This equation implies:

$$\gamma_t = \frac{\alpha - T}{\alpha T} - \frac{Rk_t - m\xi}{T\alpha\theta_t k_t^{\alpha}} \tag{25}$$

We have got the share of official output as the function of tax, world interest rate, amount of penalty, capital, technology level and the share of capital in production function.

Rewrite the expressions for local interest rate and wage in per capita terms and substitute them in firm profit function:

$$r_t = \alpha\theta_t k_t^{\alpha-1}(1-T\gamma_t) \tag{26}$$

$$w_t = (1-\alpha)\theta_t k_t^{\alpha}(1-T\gamma_t) \tag{27}$$

$$\begin{aligned}\pi_t &= \theta_t k_t^{\alpha}(1-T\gamma_t) - r_t k_t(1-\gamma_t) - Rk_t\gamma_t - w_t - m(1-\xi\gamma_t) = \\ &= \gamma_t\alpha\theta_t k_t^{\alpha}(1-T\gamma_t) - Rk_t\gamma_t - m(1-\xi\gamma_t)\end{aligned} \tag{28}$$

Also, we can plug the expression for γ_t:

$$\begin{aligned}\pi_t &= (\frac{\alpha-T}{\alpha T} - \frac{Rk_t - m\xi}{T\alpha\theta_t k_t^{\alpha}})\alpha\theta_t k_t^{\alpha}(1-T(\frac{\alpha-T}{\alpha T} - \frac{Rk_t - m\xi}{T\alpha\theta_t k_t^{\alpha}})) - \\ &- Rk_t(\frac{\alpha-T}{\alpha T} - \frac{Rk_t - m\xi}{T\alpha\theta_t k_t^{\alpha}}) - m(1-\xi(\frac{\alpha-T}{\alpha T} - \frac{Rk_t - m\xi}{T\alpha\theta_t k_t^{\alpha}})) = \\ &= \frac{\alpha-T}{\alpha\theta_t k_t^{\alpha}} - \frac{Rk_t - m\xi}{\alpha}\end{aligned} \tag{29}$$

With the derived formulas for r_t, w_t and π_t we turn to consumer utility maximization problem.

In equilibrium, the values of consumption and capital are stable. Thus, we can consider $c_t = c_{t+1} = c$, $k_t = k_{t+1} = k$ and $r_t = r_{t+1} = r$. From Euler equation (19) we have:

$$c = \beta c(r + 1 - d)$$

Eliminating c and plugging derived expression for r_t, we have this equation in the following form:

$$\frac{1}{\beta} - 1 - d = \alpha\theta k^{\alpha-1}(1 - T\gamma) \quad \text{or} \tag{30}$$

$$\frac{1}{\beta} - R - 1 - d = T\theta k^{\alpha-1} - \frac{m\xi}{k} \tag{31}$$

The only unknown here is amount of capital. Unfortunately, no analytical solution is possible but we can evaluate it numerically after calibration of β, R, d, α, ξ, θ and m. Also, we can still derive the differential equations for comparative static purposes.

Let us do the same procedure for consumer budget constraint (5). Let us define capital k'_t that the consumer rents and accumulates as the share $k_t(1-\gamma_t)$. Then, consumer constraint becomes:

$c_t + k_{t+1}(1-\gamma_{t+1}) = (r_t + 1 - d)\, k_t(1-\gamma_t) + \pi_t + w_t$

In equilibrium we have:

$c = (r - d)\, k(1-\gamma) + \pi + w$ or

$$\begin{aligned} c &= (\alpha\theta k^{\alpha-1}(1 - T\gamma) - d)(1-\gamma)k + (1-\alpha)\theta k^{\alpha}(1 - T\gamma) + \\ &+ \gamma\alpha\theta k^{\alpha}(1 - T\gamma) - Rk\gamma - m(1 - \xi\gamma) = \\ &= \frac{T\theta k^{\alpha}}{\alpha} - \frac{(Rk - m\xi)^2}{T\alpha\theta k^{\alpha}} - \frac{Rk - m\xi}{T} - dk\left(1 - \frac{\alpha - T}{T\alpha} + \frac{Rk - m\xi}{T\alpha\theta k^{\alpha}}\right) - m \end{aligned} \tag{32}$$

With (25), (31), (32) we have the system of three equations with three unknown values. Thus, we are able to find numerical solution $\{c^{ss}, k^{ss}, \gamma^{ss}\}$ for steady-state in case we need them.

Chapter 5

DISCUSSION OF RESULTS

In this chapter we will establish a correspondence between the real world links and what our model states. With this purpose, we can analyze how steady-state capital, consumption and share of official output change in response to change in taxes, world interest rate, technological level and other parameters. Since we are not interested how fast economy moves from one equilibrium to another, we need only the direction and size of relationship between our variables and parameters; thus, we will apply comparative static issue to (25), (31), (32).

It is essentially important to mention that only one input we have in our production function is capital. Thus, the direction of change in output will be the same as the one of capital. Since the economic growth is associated with growth in output, we state that, in line of our model, the factors of increase in capital stimulate the economic growth too.

To start with, let us look for the character of relationship between our exogenous variables - consumption, share of official output and capital.

$$\frac{\partial \gamma}{\partial k} = (\alpha - 1)\frac{R}{T\ \alpha\theta k^{\alpha}} - \alpha\frac{m\xi}{T\ \alpha\theta k^{\alpha+1}} = \frac{1}{T\ \alpha\theta k^{\alpha+1}}((1-\alpha)Rk + am\xi) > 0 \qquad (33)$$

$$\frac{\partial c}{\partial k} = T\theta k^{\alpha-1} + (2-\alpha)\frac{dR}{T\alpha\theta k^{\alpha-1}} + \frac{(Rk - m\xi)^2}{T\alpha\theta k^{\alpha+1}} + \frac{\alpha m\xi}{T\alpha\theta k^{\alpha+1}} > 0 \qquad (34)$$

These equations show that with greater amount of capital the share of official output and total consumption increase. On rational point of view, when agents have their wealth risen they prefer more legal protection of the assets to more income from shadow activity. With higher capital people risk to lose more in case

of detection and, thus, the benefits of having capital officially exceed costs for them. As a result, share of official sector in total activity increases. Knowing that share of capital in GDP does not vary significantly across time but across countries, we can come to the similar conclusion as Kaufmann and Kaliberda (1996) did. In their empirical research on evidence of transition countries they have found that a 10 percent decline in GDP stimulates 4 percent increase in shadow activity.

The positive relation between capital and consumption is the standard implication of in temporal utility maximization models Numerous empirical and theoretical papers have proved this fact (see, for example, Van der Berg (2001)).

With these results in hand, we consider the influence of the parameters. Let us start on the change in tax rate. The behavior of the variables in response to tax change is the most interesting since it could be easily checked with logic and empirical findings. Thus, in the context of our model we have:

- for share of official production

$$\frac{\partial \gamma}{\partial T} = -\frac{1}{T^2} + \frac{Rk - m\xi}{T^2 \alpha \theta k^{\alpha}} = \frac{1}{T^2}\left(\frac{Rk - m\xi}{\alpha \theta k^{\alpha}} - 1\right) < 0 \tag{35}$$

- for capital

$$\frac{\partial k}{\partial T} = \frac{\theta k^{\alpha-1}}{T(1-\alpha)\theta k^{\alpha-2} - \frac{m\xi}{k^2}} = \frac{\theta k^{\alpha+1}}{T(1-\alpha)\theta k^{\alpha} - m\xi} \tag{36}$$

- for consumption

$$\frac{\partial c}{\partial T} = \frac{\theta k^{\alpha}}{\alpha} + \frac{Rk - m\xi - dk}{T^2} + \frac{dk(Rk - m\xi)}{T^2 \alpha \theta k^{\alpha}} + \frac{(Rk - m\xi)^2}{T^2 \alpha \theta k^{\alpha}} \tag{37}$$

We clearly see that the relationship between size of official output and tax rate is negative. When taxes are high enterprises prefer to hide greater part of their activity despite increasing probability to be caught. Consequently, with high tax

rates share of shadow sector at the economy is large. This finding is in line with the one that Schneider and Enste (2000) have obtained in their empirical research (see literature review). Nevertheless, the response of total capital and consumption is not straightforward. Here the direction of change depends on the relative size of penalty which the firm pays in case of detection of their shadow activity. Using the fact that around the world penalties contribute to GDP less than 1% on average (Sarte,1999), the size of penalty is small comparing to amount paid for renting capital or taxes on official output. Thus, we can conclude that the model predicts positive relationship between total consumption and capital on one hand, and tax rate on the other hand. When tax rate is high, feasible official output become smaller and consumption and capital have to fall due to market clearing conditions. But with presence of hidden sector agents may shift to shadow their capital and consumption providing in such a way utility maximization and accumulation of capital. Assuming that in absence of tax burden the return on capital at shadow economy is greater than at official one, the total capital and consumption increase with higher tax rates. This result goes in line with conclusion of Asea (1996).

Let us analyze now the impact of the world interest rate considering the following derivatives:

$$\frac{\partial \gamma}{\partial R} = -\frac{k}{T\ \alpha\theta k^{\alpha}} = -\frac{1}{T * MPK} < 0 \tag{38}$$

$$\frac{\partial k}{\partial R} = \frac{k^2}{T(1-\alpha)\theta k^{\alpha} - m\xi} \tag{39}$$

$$\frac{\partial c}{\partial R} = -\frac{2(Rk - m\xi)}{T\alpha\theta k^{\alpha-1}} - \frac{k}{T} - \frac{d}{T\alpha\theta k^{\alpha+2}} < 0 \tag{40}$$

Since the world interest rate defines the costs of capital for official production, it is obvious that increase in these costs leads to fall in benefits of operating

officially. Thus, agents would like to shorten the fraction of official output in their activity (as the expression (38) shows).

The response of capital to change in world interest rate is not lucid since the sign of derivative depends on the relative size of tax revenue adjusted on share of capital income in output and amount of penalty. We believe that both situations are possible. At economies with high tax rates and weak institutions (like transition countries) the relationship between total capital and world interest rate is positive. Since in such economies shadow sector is large and more profitable than official one, greater world interest rate leads to reallocation of capital accumulation to shadow sector with higher return and, consequently, to more total capital at the economy. On the other hand, at economies with low tax rates and strong regulation increase in the world interest rate stimulates fall in amount of capital because dominating share of business is hold in official sector with capital rent at world interest rate.

Also, world interest rate negatively corresponds to consumption at economy because it directly affects the costs of official business. High world interest rate and high costs of official production implies low or even zero official profit for the firm and, thus, smaller income for households. Consequently, households have to reduce consumption according to lower income. Together with the empirical results of Eilat and Zinnes (2000) showing the negative relation between international transactions, capital market and the share of shadow economy, it means that total consumption at the economy will decrease if the world interest rate rises.

The size of penalty is the next parameter should be considered.

$$\frac{\partial \gamma}{\partial m} = \frac{\xi}{T\ \alpha\theta k^{\alpha}} > 0 \tag{41}$$

$$\frac{\partial k}{\partial m} = -\frac{\xi k}{T(1-\alpha)\theta k^{\alpha} - m\xi} \tag{42}$$

$$\frac{\partial c}{\partial m} = \frac{2\xi(Rk - m\xi)}{T\alpha\theta k^{\alpha}} + \frac{\xi}{T} + \frac{d\xi}{T\alpha\theta k^{\alpha-1}} - 1 \qquad (43)$$

The derivative of the share of official output with respect to size of penalty shows the direct impact. This result is consistent with logic since greater penalty implies higher costs of operating unofficially that force firms to switch to official sector. Besides, derived relation correlates with empirical conclusions of Cebula (1997). On the data of United States, he has shown that increased audit and penalties reduce the size of shadow economy.

The second equation does not give obvious answer about effect of penalty on capital. But here we can apply the same logic as to the impact of world interest rate on capital (39). When tax rates are high, increased size of penalty means the greater costs of business in shadow sector. The firms have two alternatives – stay at unofficial sector or switch to official one. In both cases they run at additional costs and have the total profit reduced. Consequently, the future capital will decrease (negative sign of derivative). Nevertheless, if taxes are low but penalty rises firms will prefer to operate officially with higher return due to official borrowing at low world interest rate and small tax payments. In this case, the total capital at the economy will grow (positive sign of derivative).

The impact of penalty on total consumption is also unclear. Again, it depends on tax rates at economy. Higher (lower) tax rates imply negative (positive) response of consumption on the change in size of penalty. Considering that consumption and capital have one source of supply, the argumentation of the previous case is applicable here too.

Concerning the effect of ξ (the parameter inverse to the level of enforcement), we have the same correlation with share of official economy, total capital and consumption as for amount of penalty impact. Consequently, with strict enforcement share of official production decreases while total capital and consumption tends to increase. Here we have a strong support of numerical

empirical papers which have proven such kind of relationship (Johnston, Kaufmann and Zoido-Lobaton (1998), Kaufmann and Shleifer (1997), etc.)

We will not consider the effect of the share of capital income in output since it is the same as for standard growth models. Besides, the share of capital income in output almost does not vary across time and can not be changed eventually.

The effect of change in technological level could be seen from following derivatives:

$$\frac{\partial \gamma}{\partial \theta} = -\frac{Rk - m\xi}{T\ \alpha\theta^2 k^\alpha} \tag{44}$$

$$\frac{\partial k}{\partial \theta} = \frac{Tk^{\alpha+1}}{T(1-\alpha)\theta k^\alpha - m\xi} \tag{45}$$

$$\frac{\partial c}{\partial \theta} = \frac{(Rk - m\xi)^2}{T\alpha\theta^2 k^\alpha} + \frac{Tk^\alpha}{\alpha} + \frac{d}{T\alpha\theta^2 k^\alpha} > 0 \tag{46}$$

The negative effect of technological level on share of official output seems to be strange but could be explained. With higher level of technology firms need less capital to produce the same amount of output. Thus, they care less about low world interest rate and have incentives to go to shadow sector with purpose of getting greater profit due to tax evasion.

The impact of technological level, again, depends on the type of an economy as in (39) and (42). Considering the reasoning of previous relationship (44), we are able to state that at the economy with low taxes and great penalties total amount of capital decreases with higher technological level (because (i) firms need less capital to keep the same level of output and (ii) firms operate mostly at official sector and part of profit goes to international institutions in this case). With huge taxes and small penalty firms keep larger part of their business in shadow and in case of technology increase they just continue to accumulate capital.

The positive response of total consumption to change in technology in our model is in line with conclusions of theoretical and empirical papers on economic growth that show exclusive importance of technology development for long-run increase in consumption (see Solow (1960) for the simplest case).

Thus, we can infer that our model conclusions are roughly in accord with what we observe in the world. The model suggests relationships between consumption, capital, share of official sector and other parameters that can be verified for different (not only transition one) economies and time periods.

Besides, the model shows that situations where great shadow sector does support economic prosperity are possible, at least theoretically. Let us mention a couple of such possibilities that could be clearly seen:

- with high bank interest rates, the share of official economy headily shortens while the total amount of capital at the country increases stimulating overall development;
- when tax rates are large, the opportunity of going to shadow sector becomes more attractive and agents prefer to accumulate capital inofficially, in such a way increasing total capital at the economy but not the official one.

Chapter 6

IMPLICATIONS FOR UKRAINE

In this chapter we will provide some kind of calibration of the parameters using Ukrainian data. With defined values of these parameters we will be able to specify for Ukraine the relationships that are ambiguous at general form. Mostly, the response of capital on change in different factors is unclear.

We will follow standard calibration methods and use annual data of Ukrainian economy for 1996-2003. Data on GDP is available from site of National Bank of Ukraine; data on investment, consumption and population is given by Government Statistics Committee of Ukraine. Data on share of shadow economy in percent of GDP is calculated by Hryshko (2001) till 2001 and World Bank snapshot for 2001-2003. We also will use data on fiscal revenue at percent of GDP and interest rates from www.ier.com.ua.

We need to value the following parameters: a ,d, β, R, T, ξ and m.

The formula for capital share α follows from CRC property of production function:

$$\alpha = \frac{\partial y(k,l)/\partial k}{y(k,l)} k = \frac{rk}{y} = 0.46 \qquad \text{where } k/y = 3.17 \text{ and } r = 0.145 \tag{47}$$

Depreciation rate d is chosen to be equal to the ratio of long-run investment to capital (using assumption that we are in steady state and $k_t = k_{t+1} = k$ as long as c and y):

$$d = \frac{i}{k} = \frac{i/y}{k/y} = 0.085 \quad \text{per year} \tag{48}$$

since $i/y = 1-c/y = 1 - 0.73 = 0.27$

For defining discount factor β we can use Euler equation (19), again, evaluated in steady state:

$$c^{-\gamma} = \beta c^{-\gamma}(r + 1 - d)$$

or $1 = \beta(r + 1 - d)$

and $$\beta = \frac{1}{r + 1 - d} = 0.94 \tag{49}$$

Also, using form (30) of Euler equation we can find T:

$$\frac{1}{\beta} - 1 + d = \alpha\theta k^{\alpha-1}(1 - T\gamma)$$

$$T = \frac{1}{\gamma} - \frac{k}{\alpha\beta y\gamma} + \frac{(1-d)k}{\alpha y\gamma} = 0.41 \text{ since } \gamma = 0.575 \tag{50}$$

From equation (25) and consumer budget constraint (5) we are able to derive the formula for penalty *m*:

$$\frac{m}{k} = \frac{y}{k}(1 - \alpha\gamma + \alpha\gamma^2 T) - \frac{c}{k} - d(1-\gamma) = 0.01 \tag{51}$$

In order to find the parameter ξ, we are able to use the function defined for probability to be caught (24): $p(\gamma_i) = 1 - \xi\gamma_i$. We already have the value γ of official sector estimated and need some proxy for the probability. Using the data from Tax Administration of Ukraine, we will treat as the stated probability the ratio of the number of legal prosecutions (opened by tax administration) to the number of firms that participate in shadow economy. The latter can be roughly calculated as the number of firms registered multiplied by the size of shadow economy (in per cent of GDP). Calculated *p* is equal to 0.015. Thus,

$$\xi = \frac{1-p}{\gamma} = 1.71 \tag{52}$$

World interest rate can be expressed form (25) as:

$$R = \frac{y}{k}(\alpha - T) - \frac{y}{k}\alpha T\gamma + \frac{m}{k}\xi = 0.004 \tag{53}$$

Now, we have all parameters calculated with Ukrainian data and are able to identify the direction of relationship with sure.

$$\frac{\partial k}{\partial T} = \frac{\theta k^{\alpha+1}}{T(1-\alpha)\theta k^{\alpha} - m\xi} = \frac{y}{T(1-\alpha)\frac{y}{k} - \frac{m}{k}\xi} = \frac{y}{0.07 - 0.02} > 0 \tag{54}$$

From (37): $\frac{\partial c}{\partial T} > 0$ (55)

$$\frac{\partial k}{\partial R} = \frac{k^2}{T(1-\alpha)\theta k^{\alpha} - m\xi} = \frac{k}{T(1-\alpha)\frac{y}{k} - \frac{m}{k}\xi} = \frac{k}{0.07 - 0.02} > 0 \tag{56}$$

$$\frac{\partial k}{\partial m} = -\frac{\xi k}{T(1-\alpha)\theta k^{\alpha} - m\xi} = -\frac{1.71}{0.07 - 0.02} < 0 \tag{57}$$

$$\begin{aligned} \frac{\partial c}{\partial m} &= \frac{2\xi(Rk - m\xi)}{T\alpha\theta k^{\alpha}} + \frac{\xi}{T} + \frac{d\xi}{T\alpha\theta k^{\alpha-1}} - 1 = \\ &= \frac{3.42(0.004 - 0.02)}{0.41 * 0.46 * 3.17} + \frac{1.71}{0.41} + \frac{0.145}{0.41 * 0.46 * 3.17} - 1 = 3.3 > 0 \end{aligned} \tag{58}$$

$$\frac{\partial k}{\partial \alpha} = \frac{\ln(k)T\theta k^{\alpha+1}}{T(1-\alpha)\theta k^{\alpha} - m\xi} = \frac{\ln(k)Ty}{0.07 - 0.02} > 0 \tag{59}$$

$$\frac{\partial k}{\partial \theta} = \frac{Tk^{\alpha+1}}{T(1-\alpha)\theta k^{\alpha} - m\xi} = \frac{0.41k}{0.07 - 0.02} > 0 \tag{60}$$

For convenience, we have summarized the results for Ukraine in the following table.

Table 1.The correlations between the variables and the parameters: the case of Ukraine

with respect to	Derivative of		
	share of official output	total capital (total output)	total consumption
tax rate	negative	positive	positive
world interest rate	negative	positive	negative
penalty	positive	negative	positive
technology level	positive	positive	positive

All the defined linkages could be explained in line described in Chapter 5. Nevertheless, the additional comments should be done. Also, we can illustrate some of links derived before with IMF Country Report for Ukraine (2005).

First, while the impact of tax rate on the size of official sector is clear, the behavior of total capital (and, thus, total output) should be explained. If there was no shadow sector, the total capital at the economy would fall with higher tax rates. But in our case enterprises shift the production to hidden economy supporting accumulation of shadow capital. As a result, a total amount of capital and output grows. Moreover, analyzing the data for 1996-2004 IMF experts have concluded that lower tax rates would not stimulate further economic growth in Ukraine. Since in our model economic growth is associated with growth of capital, we also have come to the conclusion that smaller tax rates correlate with lower total capital.

Second, because the world interest rate directly affects the costs of doing business officially, it negatively correlates with the share of official sector. In this case, the total capital at the economy follows the same path as with increase of tax rate. Since in official sector enterprises pay rent for capital to the international

institutions, the certain part of capital goes abroad every period. Thus, with higher world interest rate more capital leaves the country and, consequently, total consumption decreases. The economic situation in Ukraine at the beginning of transition period rather sufficiently demonstrate the described influence of interest rates (local and world as well) as our model predicts. With high bank rates and huge shadow sector (about 80% by estimation of Schneider and Enste (2000)) at early 90th the official level of capital accumulation was poor. In fact, larger fraction of capital was located at unofficial business and total capital increased rapidly. Now, when interest rates become lower, the credit boom happens but growth of total capital slowed down.

Besides, after running in stability and regaining access to international market in 2003 Ukraine has considerably increased the total amount of capital at the economy. It has strong positive effect on the share of official sector (which enlarged by 4-5% by World Bank estimations) and consumption (by 6-8% according to IMF calculations). It is the closely the case that our model forecasts.

Chapter 7

CONCLUSIONS

Our study was devoted to the issue of shadow economy impact on total economic performance of a country and, particularly, its consequences for the countries in transition. The challenge of our work was to provide theoretical background to numerous empirical papers that came to rather interesting and ambiguous results. With this purpose, the model of an economy with shadow sector was built on the base of neoclassical growth theory. The model developed has allowed us to derive analytical solution and qualitatively examine its soundness for real world evidence.

Relying on the literature review, we have singled out the characteristics which distinguish shadow economy of transition countries from the other one. Since the most part of unofficial activity in transition is semi-formal, it appeared that the main cost of "going shadow" for transition enterprises is inaccessibility of financial resources instead of the public services restrictions as was stated earlier. Thus, in order to get the plausible pattern we have introduced the financial constraint in the context of our model.

The results of our research are as follows. To start with, we have solved our model for equilibrium and shown its existence. Then, we have examined the derived equations for main economic indicators (value of consumption, capital, etc.) and convinced that they reflect logical argumentation supported with main findings of empirical papers on the topic. Here our model offers some essential discoveries. Precisely, we have shown the possibility of situation where large shadow sector does not hurt economic growth but even could accelerate it. When interest rates and taxes are sufficiently high, capital accumulation happens at the

shadow sector alimenting the official part. In reality, such kind of conditions is associated with the period of transition from command type of economy to the market one that was experienced by transition countries at the beginning of 90th.

Besides, after calibration of the parameters using Ukrainian data, we have concluded that our model adequately describes the major economic coherences of Ukrainian development. On this base, our study opens the wide opportunities for further research of the impact of different policies on Ukrainian economy. Nevertheless, one policy idea could be already suggested: shadow economy should not be treated only as destructive, under appropriate favorable conditions capital accumulated at the underground sector will be the significant source of future economic growth and prosperity.

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