WP/99/130

INTERNATIONAL MONETARY FUND

African Department and Middle Eastern Department

Skill Acquisition and Firm Creation in Transition Economies[1]

Prepared by Zuzana Brixiova, Wenli Li and Tarik Yousef

Authorized for distribution by Paulo Neuhaus and Howard Handy

September 1999

IMF WORKING PAPER

INTERNATIONAL MONETARY FUND

IMF Working Paper

WP/99/130

INTERNATIONAL MONETARY FUND

African Department and Middle Eastern Department

Skill Acquisition and Firm Creation in Transition Economies[1]

Prepared by Zuzana Brixiova, Wenli Li and Tarik Yousef

Authorized for distribution by Paulo Neuhaus and Howard Handy

September 1999

Abstract

The transition from plan to market has hinged on the development of a dynamic private sector that would serve as the engine of growth and employment creation. This paper examines the link between the availability of skilled workers and the creation of new private firms. Using a dynamic search model, it shows how the lack of skilled workers inhibits entrepreneurship and depresses the rate of firm creation, slowing the recovery of aggregate output and labor productivity during the transition. The paper also shows how policies designed to encourage skill acquisition by workers have a positive impact on the economy.

JEL Classification Numbers: J4, J31, P21

Keywords: Skill acquisition, firm creation, transition

Authors' E-Mail Addresses: zbrixiova@imf.org, wenli.li@rich.frb.org, tyousef@imf.org

---

[1]International Monetary Fund, Federal Reserve Bank of Richmond, and International Monetary Fund, respectively. We thank David T. Coe, Pietro Garibaldi, Emine Gürgen, Ernesto Hernández-Catá, Richard Jackman, Nobuhiro Kiyotaki, Hartmut Lehmann, Piroska M. Nagy, Paulo Neuhaus, Stefania Scandizzo, Thomas Walter, and seminar participants at the IMF, the 54th Annual Congress of the International Institute for Public Finance in Cordoba, Argentina, the World Bank Conference on Labor Market Adjustment in Transition Economies in Sinaia, Romania, and the 4th Annual Conference on Transition Economics in Beijing, China for helpful comments. The usual disclaimer applies.

Contents

I. INTRODUCTION

In Central and Eastern Europe, the Baltic states, Russia, and other countries in the former Soviet Union, the transition from plan to market has hinged on the development of a dynamic private sector which would serve as the engine of growth and job creation. In these economies, the private sector is emerging through the privatization of public sector enterprises ("top-down" strategy) and through the creation of new firms ("bottom-up" strategy). By and large, academics and policy makers have focused on the top-down strategy in spite of the accumulating evidence highlighting the dismal economic performance of privatized enterprises. In particular, the economic restructuring of public enterprises has been associated more with job destruction and slow growth in productivity and output (Bilsen and Konings, 1998; and Faggio and Konings, 1998). However, the growth of *de novo* small and medium private firms has been one of the most positive developments in transition economies. With an ability to adapt to the new economic realities and exploit the opportunities offered by the transition, emerging private enterprises have become the driving force behind the recent recovery in output and employment (Johnson and Loveman, 1995; and Konings, Lehmann, and Schaffer, 1996).[2]

Given the importance of new firms to the success of economic transition, it is crucial that researchers identify the conditions that govern their creation and facilitate their contribution to job creation and output growth. Three factors have received wide attention in the literature: the availability of capital, progress on privatization, and the institutional and regulatory environment (Green, 1993; Borish and Noel, 1996; Buckberg, 1997; and Pissarides, 1998). Although widely cited in recent discussions and documented in various surveys, the constraints imposed by the availability of human capital have not received adequate attention in the theoretical literature on transition.[3] This is surprising in light of the prominent role assigned historically to human capital in development economics and, more recently, in the new growth literature (Barro, 1992).

This paper examines the role of human capital and, specifically, the availability of skilled labor, in facilitating firm creation in transition economies. It employs a dynamic search model that draws on two streams of theoretical literature: first, industry evolution and

---

[2]Studies on Poland by Johnson and Loveman (1995) and Konings, Lehmann and Schaffer (1996) find that new private firms account for the majority of job creation and their labor productivity is much higher than in state-owned or privatized enterprises. Richter and Schaffer (1996) find similar evidence for firms in Russian manufacturing.

[3]The exceptions are Chadha, Coricelli and Krajnyak (1993) and Fan and Spagat (1994). Chadha, Coricelli, and Krajnyak (1993) recognize that human capital needed in the private sector differs significantly from that in the state sector. They argue that the rate of growth and the shifting of the production toward the private sector depend critically on the human capital in the private sector. Fan and Spagat (1994) argue that individual decisions to withdraw from, or not to enter, the skilled labor force could have irreversible negative consequences for long-run growth in Russia.

entrepreneurship (Jovanovic, 1982; Hopenhayn and Rogerson, 1993; and Li, 1997); and second, labor relocation from the state to the private sector in transition economies (Aghion and Blanchard, 1994; Atkeson and Kehoe, 1995; Brixiova and Kiyotaki, 1997). In examining the relationship between the availability of skilled workers and the creation of firms, we build on Snower's 1996 work on OECD economies.

We show how the lack of skilled workers discourages entrepreneurs from searching for business opportunities; in consequence, workers are pushed into the informal sector, output growth is lower, and the transition is slowed down. Furthermore, we examine government policies designed to subsidize skill acquisition by workers, such as expenditures on retraining the unemployed workers and wage subsidies to private enterprises, showing their positive impact on firm creation. The paper is organized as follows: Section II motivates the analysis of human capital in transition economies; Sections III-IV present the model, along with numerical solutions and policy analysis; and Section V concludes.

II. Human Capital in Transition Economies

While credit constraints and legal problems have typically dominated the discussion of obstacles facing firms in transition economies, evidence has accumulated in support of the existence of human capital constraints. Surveys of entrepreneurs and managers of enterprises in transition economies have regularly cited the lack of skilled workers as the most serious labor-related problem in starting new enterprises and raising productivity and output in existing firms.[4] For example, in surveys of small and medium-sized manufacturing enterprises in Estonia, Latvia, Lithuania, and Poland in the mid 1990s, between 50-70 percent of firms in each industry indicated that the most common labor-related constraint to business development was skill shortage (Smallbone, Venesaar, and Piasecki, 1996).[5] The lack of skills affected product quality, and the ability to meet production schedules and expand output. In contrast to unskilled labor, the 1994 St. Petersburg survey of service firms found that more than 50 percent of entrepreneurs reported having problems recruiting skilled professionals (De Melo and Ofer 1994). Over 40 percent of owners of small enterprises in the

---

[4]Examples of such surveys include Wyznikiewicz, Pinto and Grabowski (1993), Bilsen and Konings (1996), and Central Statistical Bureau of Latvia (1997). However, since these surveys have examined constraints facing only enterprises already in existence, we assume in our model that enterprises that do not come into existence face similar constraints. A study examining constraints that entrepreneurs face in creating enterprises including those that do not come into existence would be relevant since the focus on firm creation ex ante could potentially help identify additional conditions governing the success of *de novo* firms and, hence, the determinants of the transition to market.

[5] Like the surveys cited above, we distinguish between skill-related labor problems and those dealing with character, attitude, and work ethic, which are also widely reported in these surveys. Our focus here is exclusively on skills.

same survey complained that workers were not sufficiently skilled, with the level of dissatisfaction highest in trade and finance sectors.

The suggestion that a "shortage of skills" exists runs counter to historical perceptions of the transition countries which on the eve or restructuring were considered to be well endowed with high levels of human capital.[6] Under central planning, the countries of Central and Eastern Europe rapidly increased basic, technical, and vocational education and achieved high levels of literacy, basic knowledge, and technical expertise. Indeed, these perceptions may partly account for the lack of attention devoted by theoretical researchers to the role of human capital in transition. However, several years of transition and a more thorough examination of the human capital stock in transition economies have exposed serious deficiencies in the education system of transition economies under central planning. Weaknesses of the Soviet-style education system included excessive specialization and emphasis on vocational training at the expense of flexible academic programs and balanced curricula (Sandi, 1992; World Bank, 1992; Boeri, Burda, and Köllo, 1998).[7] As Table 1 documents, while the labor force shares of workers with more than just basic education in countries of Central and Eastern Europe were in 1992 only slightly below those of the OECD countries represented in the table, much larger portions of secondary students in Central and Eastern Europe attended vocational schools than in Western Europe. This emphasis has naturally affected the quality of education received.

---

[6] As Lehmann and Walsh (1999) have noted, the early literature on transition has implicitly assumed that workers have effective human capital at the start of the transition. For example, no direct or indirect reference is made to the role of human capital in any of the chapters in Brezinski and Fritsch (1996) which was devoted to examining the role of and the constraints facing new firms in postsocialist countries. The same is true of the chapters contained in Woo, Parker, and Sachs (1997) that contrasted the transition experiences of Asia and Eastern Europe. However, more recently, Stiglitz (1999) lists the lack of skills among entrepreneurs as one of the bottlenecks of the transition.

[7]Students in transition economies did poorer than those in market economies in tests that emphasized the application of knowledge to new problems (World Bank, 1996) .

Table 1. Selected OECD and Central and Eastern European Countries: Indicators of Secondary and Vocational Educational Attainment in 1989 and 1990.
(In percent of the total labor force)

	Bulgaria	Czecho slovakia	Hungary	Poland	Austria	Italy	Netherlands
Secondary	18.2	29.9	12.0	13.0	45.8	39.3	34.1
Vocational	27.6	34.9	38.0	44.4	18.3	26.9	27.2
Total	45.8	64.8	50.0	57.4	64.1	66.2	61.3

Source: Boeri and Keese 1992.

The large share of vocational training lead to an excessive specialization at an early age, and lifetime learning was almost nonexistent, since the wage scale was very flat (reducing the reward for updating skills after obtaining a job). Moreover, the socialist systems guaranteed job security, and workers lacked the incentives to acquire skills to cope with unexpected events, such as loss of employment.

Furthermore, the education acquired under central planning may have become less relevant in the new, market economy, as the education system was biased toward the hard sciences and engineering, neglecting the social sciences, law, business, and public policy (Kovacs and Virag, 1995; and Laporte and Schweitzer, 1994). With the launching of reforms in ownership, technology, and trade, and with the exposure to outside competition, demands for certain skills increased, rendering other types of training obsolete. The same observation has been made with regard to the inherited stock of physical capital in transition economies (Hernández-Catá, 1997). Thus, it is not surprising that the shift in employment patterns away from manufacturing and agriculture toward trade, financial services, and real estate in the early 1990s (Table 2) was accompanied by a significant mismatch between the skills demanded in the new enterprises (law, marketing, accounting, and foreign language skills) and those available in the existing workforce.

Table 2. Selected Central and Eastern European Countries: Employment Shifts, 1991 - 1995.
(Percentage change)

	Czech Republic	Hungary 1/	Poland 1/	Slovak Republic
Agriculture	-5.5	-3.5	-7.9	-4.2
Manufacturing	-6.0	-2.5	-1.2	-8.1
Trade and catering	7.8	1.1	6.7	5.1
Fin. services, real estate	1.2	2.4	2.3	0.3
Public administration	3.3	2.5	--	3.7

Source: Allison and Ringold 1996.
1/ 1992 - 1995.

In response, training of the workforce has become standard practice for enterprises in transition economies: according to the surveys mentioned above, 65 percent of enterprises in the Baltic states, 59 percent in Poland, and 70 percent in St. Petersburg have adopted retraining programs for their workforces. Similarly, state-sponsored training programs have been put in place in Poland and the Baltic economies, and more are being organized in other transition economies.[8] Most of the training has focused on supplying missing market-related skills, such as accounting, law, business administration, languages, computers, and new technologies.

To what extent has the lack of skills embodied in the inherited stock of human capital conditioned the pace of private firm creation in transition economies? The next sections provide a theoretical model linking the incentives of entrepreneurs to develop new business opportunities during the transition with the availability of skilled labor.

[8]See Kluve, Lehmann, and Schmidt's 1999 work on active labor market policies in Poland.

III. The Two-Period Model

In our model, the population is normalized to one. There are two types of agents, entrepreneurs and workers, with population sizes μ and $1-\mu$.[9] Each agent lives for two periods and has the same risk-neutral preferences, $c_1+E(c_2)$, where c_i is consumption of a single good in period i and E denotes the expectation formed at period 1 about income in period 2. Both entrepreneurs and workers are endowed with one unit of time every period. During period 1, all agents are employed in the state sector and receive the wage w_s. At the same time, entrepreneurs search for business opportunities to open private firms in period 2, and workers acquire skills applicable in these firms. In period 2, the state sector is dissolved.

In period 1, entrepreneurs determine their search effort for business opportunities, x. This effort costs them $d(x)=x^2/2\gamma$ units of consumption good (where $\gamma>0$ is a parameter of efficiency of entrepreneurial search) and results in the probability x of finding a business opportunity. The business opportunity the entrepreneur finds allows him to produce output y using n amount of labor according to

$$y=\frac{1}{1-\alpha}z^{\alpha}n^{1-\alpha} \tag{1}$$

where z denotes business capital and α, $0<\alpha<1$, is the share of capital in output. The entrepreneur pays each hired worker a wage w and also pays a payroll tax τw per worker to the state; the profit the entrepreneur receives is $\Pi=y-(1+\tau)wn$.[10] Since in period 2 the entrepreneurs are either running a business or are unemployed, their populations $(m_h,\ m_u)$ satisfy

$$\mu=m_h+m_u\ . \tag{2}$$

In the beginning of period 1, all workers are unskilled and employed in the state sector, and they decide how much effort to put into acquiring skills. When acquiring skills, workers incur costs according to the function $k(q)=(c-c_g)q$ (where $c>0$ is the total cost per unit and c_g is the cost paid by the government); this effort results in the probability q of obtaining

---

[9]Benacek (1993) illustrates that, at the beginning of transition, entrepreneurs were either former black market operators or managers of public companies; only very few entrepreneurs had been workers under the previous regime. We use his finding in justifying our assumption of fixing the supply of entrepreneurs at level μ.

[10] With an excess wage tax, profit would be given by $\Pi=y-wn-\tau(w-\bar{w})n$. Unless the payroll tax payment imposed on a worker is directly linked to the benefit each worker receives, the qualitative impact of the payroll and the excess wage tax is the same. In what follows, we therefore focus on the impact of the payroll tax only.

skills.[11] Workers with skills always find employment in the formal private sector at wage w, determined through labor market clearing. Workers who do not acquire skills work in the informal sector, which can be thought of as either household production or underground economic activities, determined by the following production function:[12]

$$Y_u = \frac{1}{1-\alpha} Z_u^{\alpha} N_u^{1-\alpha} \tag{3}$$

where N_u is total labor in the informal sector, which includes labor of the unemployed workers, and Z_u is the aggregate business capital of the informal sector, which is assumed to be constant.[13] Since workers are either employed in the formal private sector or in the informal sector, their respective populations (n_h, N_u) satisfy

$$N_0 + 1 - \mu = n_h + N_u \ , \tag{4}$$

where N_0 is hours endowment of workers besides the standard labor hours, which we assume to be constant.

The **competitive equilibrium** of this economy is defined as an allocation of workers and entrepreneurs and setting of a wage rate such that (i) each entrepreneur chooses how much effort to put into searching for a business opportunity and how many workers to hire, (ii) each worker chooses how much effort to put into acquiring skills, and (iii) product and labor markets clear.

---

[11] We restrict parameters so that x and q are between 0 and 1. We assume that workers do not obtain the skills needed in the private sector with certainty because they either do not know which skills are appropriate or simply fail to obtain them despite their effort.

[12] Recent empirical work has found that the size of the underground sector in transition economies ranges from 20 percent in Eastern Europe to 50 percent in Russia (Johnson and Kaufman, 1999). Since the distribution of underground economic activities coincides well with the observed levels of unemployment in these countries, the designation of workers as being in the informal sector in this paper is probably interchangeable with them being unemployed.

[13] A worker moving from the formal into the informal sector would thus receive a payoff equivalent to the marginal product, $Z_u^{\alpha} N_u^{-\alpha}$.

By maximizing the expected discounted utility of workers and entrepreneurs, and substituting from the labor market clearing condition $n_h = m_h n$, we obtain the following equilibrium conditions:[14]

$$c - c_g = w - Z_u^{\alpha} N_u^{-\alpha} = \frac{1}{1+\tau}\left(\frac{\mu x z}{(1-\mu)q}\right)^{\alpha} - Z_u^{\alpha}\left(N_0 + (1-q)(1-\mu)\right)^{-\alpha} \tag{5}$$

$$\frac{x}{\gamma} = \Pi = \frac{\alpha}{1-\alpha} z \left(\frac{(1-\mu)q}{\mu x z}\right)^{1-\alpha} . \tag{6}$$

Equation (5) states that the marginal cost of acquiring skills equals the marginal benefit (wage in the formal sector less the income in the informal sector); the worker's decision to acquire skills depends directly on the cost to a worker of acquiring skills, $c - c_g$, and on the payroll tax rate, τ. Similarly, equation (6) states that the marginal cost of the entrepreneur's search for business opportunities equals the marginal benefit (the profit from running a business).[15]

Together, (5) and (6) show how the effort that unskilled workers put into acquiring skills influences the effort that entrepreneurs put into searching for business opportunities. A lower number of skilled workers leads to a higher equilibrium wage which, in turn, makes the opening of private firms less profitable; entrepreneurs consequently reduce their search effort for business opportunities. Moreover, equations (5) and (6) show that the equilibrium effort level of both entrepreneurs and workers is lower with a higher payroll tax and with a higher cost of acquiring skills. This is illustrated in Figure 1, where the learning curve represents the learning effort of workers in the case of a decline in the payroll tax rate or an increase in the

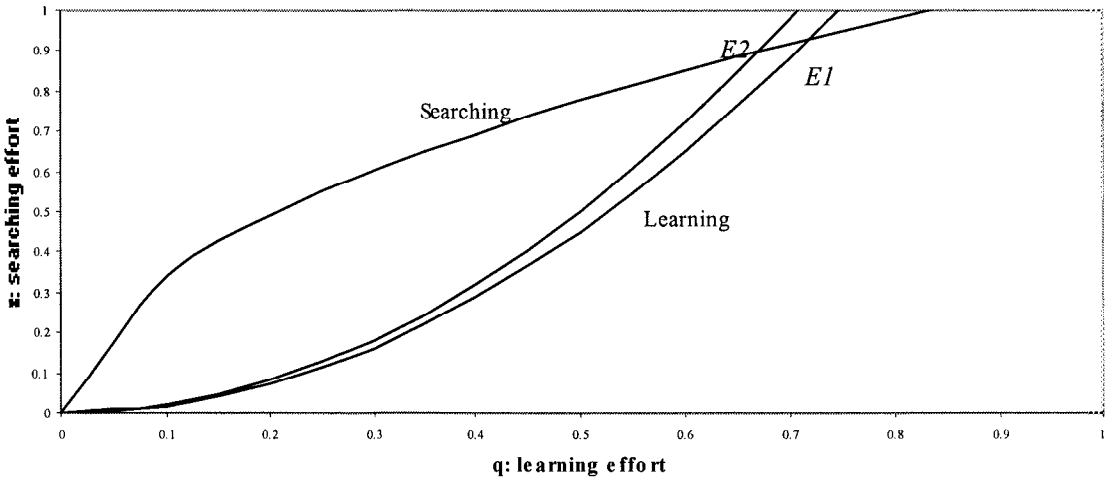
---

[14]It is straightforward to show that there exists a unique equilibrium where entrepreneurs search for business opportunities and workers acquire skills, i.e. $x>0$ and $q>0$. In this version of the model we do not explicitly model government's budget constraint; we leave that for the infinite horizon model.

[15] Since the entrepreneurs hire workers in the perfectly competitive labor market, they are able to shift the entire tax burden onto the workers, and, hence, the payroll tax rate, τ, does not directly affect the entrepreneur's decision. If each worker that pays the payroll tax would receive a payment from the government at the end of period 2 in the amount τw, the payroll tax rate does not have any impact on the worker's decision to acquire skills. See Stiglitz (1998) for a detailed discussion of the impact of the payroll tax on the allocation of labor and unemployment. With a sales tax, the burden would be shared by both workers and entrepreneurs, and in the case of a profit tax, the burden would influence only the entrepreneur.

cost of acquiring skills, and the learning curve shows the shift in this effort under a higher tax rate and/or cost of acquiring skills. Even though the search effort by entrepreneurs is independent of the tax rate and the cost of acquiring skills – the searching curve does not shift – the equilibrium level (point *E2*) of both q and x is lower under a higher tax and/or higher cost of skill acquisition.

Figure 1: Learning and Searching Curves



It is straightforward to examine the impact of wage subsidies on skill acquisition and firm creation in the present framework. In Appendix II, we show that retraining expenditures are more effective than wage subsidies in encouraging skill acquisition by workers. Our result is consistent with the empirical work of Kluve, Lehmann, and Schmidt (1999) who examine the effectiveness of the active labor market policies in Poland, and find the retraining programs to be more effective than wage subsidies in increasing job-finding rates of the unemployed workers.[16]

[16]The same conclusion is found in Puhani (1999). However, contrary to these finding, the share of retraining expenditures (as part of active labor market policies) in GDP is low relative to the share of expenditures on direct job creation/wage subsidies. For example, while in 1995 the average GDP share of expenditures on retraining for the Czech Republic, Hungary, Poland, and the Slovak Republic was only 0.07 percent, it was 0.23 percent for direct job creation/wage subsidies (Godfrey and Richards, 19997).

IV. THE INFINITE HORIZON MODEL

The extension of the two-period model into the infinite horizon allows us to trace the time paths of the relevant variables and to examine how these are influenced by changes in policies—in this case, by subsidies to skill acquisition. We also illustrate how these subsides affect the time path of the government budget.

A. The Framework

We modify the model from the previous section by letting at every time t a new population of agents of measure δ to be born and the same measure of agents to die.[17] Since we assume that portion μ of new born agents are entrepreneurs, at every instant the economy's population is still normalized to one; some agents are entrepreneurs while others are workers, with population shares μ and $1-\mu$. A representative agent has the same risk-neutral preferences in consumption, discounted at rate r, and receives an endowment of one unit of labor at every t. The size of the state sector, s_t, is given exogenously at every period. More specifically, we assume that, at the beginning, all agents are working in the state sector, $s(0)=1$, and, during the transition, the government reduces the state sector at the exogenously given rate λ.

One difference from the previous section is that entrepreneurs cannot simultaneously work in the state sector while searching for opportunities to open private firms. We assume that during the transition, as the size of the state sector decreases, agents that are released can only go to the private sector. Once in the private sector, entrepreneurs either search for business opportunities or run firms. Searching for a business opportunity is costly but results in the formation of business opportunities at a rate x_t. After finding a business opportunity, the entrepreneur hires n workers and produces output y according to

$$y_t = \frac{1}{1-\alpha} z^{\alpha} n_t^{1-\alpha} . \tag{7}$$

Let $\mu(1-s_t)$ be the number of entrepreneurs moved out of the state sector. Since the entrepreneurs either search for a business opportunity or run a business, the following condition must hold:

$$(1-s_t)\mu = m_{ut} + m_t, \tag{8}$$

where m_{ut} is the number of searching entrepreneurs, consisting of entrepreneurs previously working in the state sector (m_{ut}^{o}) and newly born entrepreneurs (m_{ut}^{n}), that is, $m_{ut} = m_{ut}^{o} + m_{ut}^{n}$.

---

[17]This modification allows us to determine the time at which the transition economy is transformed to a situation such that, instead of retraining workers with obsolete skills from the previous regime, young people with no skills are being trained.

The number of searching entrepreneurs previously employed in the state sector and the number of newly born searching entrepreneurs evolve according to

$$\dot{m}_{ut}^{o}=\mu\lambda s_t-x_t m_{ut}^{o}-\delta m_{ut}^{o};\quad m_{u0}^{o}=0 \tag{9}$$

$$\dot{m}_{ut}^{n}=\mu\delta-x_t m_{ut}^{n}-\delta m_{ut}^{n};\quad m_{u0}^{n}=0. \tag{10}$$

Similarly, m_t is the number of entrepreneurs running private businesses, consisting of entrepreneurs previously working in the state sector (m_t^{o}) and newly born entrepreneurs (m_t^{n}). Their populations evolve according to

$$\dot{m}_t=x_t\left((1-s_t)\mu-m_t\right)-\delta m_t;\quad m_0=0, \tag{11}$$

$$\dot{m}_t^{n}=x_t m_t^{n}-\delta m_t^{n};\quad m_o^{n}=0, \tag{12}$$

$$\dot{m}_t^{o}=x_t m_{ut}^{o}-\delta m_t^{o};\quad m_0^{o}=0. \tag{13}$$

As in the previous section, there are two types of workers, skilled and unskilled. Skilled workers work in the formal private sector (and receive wage w_t), while unskilled workers go to the informal sector and decide whether to acquire skills. The effort to obtain skills results in the arrival rate, q_t, of obtaining skills. Since workers in the private sector are either unskilled and working in the informal sector or skilled and working in the formal sector, their populations (n_{ut}, n_{ht}) satisfy

$$(1-\mu)(1-s_t)=n_{ut}+n_{ht} \tag{14}$$

where $1-\mu$ denotes the size of the population of workers in the economy. The number of workers working in the formal private sector depends on the average size of the private firm, n_t, and the number of private firms, m_t:

$$n_{ht}=m_t\, n_t;\quad n_{h0}=0\ , \tag{15}$$

The **competitive equilibrium** of this economy is again defined by the allocation of entrepreneurs and workers and setting of a wage rate such that (i) entrepreneurs decide how much effort to put into searching for business opportunities and how much labor to hire to produce output in order to maximize the expected discounted utility of consumption; (ii) unskilled workers choose how much effort to invest into obtaining skills (hence, the allocation of labor between formal and informal sectors) to maximize the expected discounted utility of consumption; (iii) the government chooses bond holdings so that its budget constraint is satisfied, and (iv) labor and product markets clear.[18]

To characterize the optimization of the entrepreneurs and the workers, we define the value functions from the dynamic programming approach. Suppressing the time subscript, let J_h and J_u be the values for the entrepreneur operating a private firm and searching for a business opportunity, respectively. Accordingly, the returns are given by

$$rJ_h = \max_n \left(\frac{1}{1-\alpha} z_h^{\alpha} n^{1-\alpha} - (1+\tau) wn \right) - \delta J_h + \dot{J}_h \tag{16}$$

$$rJ_u = \max_x \left(-\frac{x^2}{2\gamma} + x(J_h - J_u) \right) - \delta J_u + \dot{J}_u \ , \tag{17}$$

where $\dot{J}_i$ is the change of the value J_i over time. Equation (16) implies that the return on running a business equals the operating profits plus the change of the value of running a firm over time. Equation (17) implies that the return from searching for a business opportunity equals the expected return from obtaining a random business opportunity minus the cost of search, plus the change of the value of searching over time. The entrepreneur chooses the search intensity so that the marginal cost of search is equal to the expected marginal gain of search:

$$d'(x) = \frac{x}{\gamma} = J_h - J_u \ . \tag{18}$$

The "profit" from searching for the entrepreneur then becomes:

$$\Pi_u = \frac{\gamma (J_h - J_u)^2}{2} \ . \tag{19}$$

---

[18]In the steady state equilibrium, variables do not change over time. It is straightforward to show that there exists a unique steady state equilibrium.

From (16), the profit maximizing choice of labor implies $n=z[w(1+\tau)]^{\frac{-1}{\alpha}}$ and the profit for the entrepreneur from operating a business becomes

$$\Pi=\frac{\alpha}{1-\alpha}z[w(1+\tau)]^{-(1-\alpha)/\alpha} . \tag{20}$$

Let V_h and V_u be the values of the worker of being skilled and employed in the formal private sector, and being unskilled and investing in obtaining skills, respectively. The corresponding value function can be written as

$$rV_h=w-\delta V_h+\dot{V}_h \tag{21}$$

$$rV_u=Z_u^{\alpha}N_u^{-\alpha}+\max_q\left(-(c-c_g)q+q(V_h-V_u)\right)-\delta V_u+\dot{V}_u , \tag{22}$$

where $\dot{V}_i$ is a change in V_i over time. Equation (21) states that the return on working for a private firm equals the wage plus the change in the value of working over time. Equation (22) implies that the return on acquiring skills equals the expected return from acquiring skills minus the cost of learning plus the change in the value of acquiring skills over time. The worker chooses the training intensity so that the marginal cost equals the marginal benefit, i.e., $c-c_g=(V_h-V_u)$. Using this together with (21) and (22) yields the following equilibrium wage rate:

$$w=(r+\delta)(c-c_g)+Z_u^{\alpha}N_u^{1-\alpha} . \tag{23}$$

Equation (23) basically says that the difference between workers employed in private firms and workers involved in household production equals the discounted marginal cost of acquiring skills. Finally, in order to compare the differences in costs associated with various retraining programs, we need to introduce the government budget constraint, which must hold at every period *t*:

$$\dot{b}=c_g n_u+rb-T-\tau wnm , \tag{24}$$

where b is the amount of bonds the government holds and T is the amount of lump sum tax collected. Equation (24) states that the change in government bonds is equal to the expenditures (on education plus interest payments) minus revenues from lump-sum taxes and payroll taxes. The possibility of a Ponzi scheme is excluded, that is $\lim_{t\Rightarrow\infty}e^{-rdt}b=0$.

B. Numerical Solutions

This subsection provides numerical solutions of the model which are meant to be illustrative (see Appendix I for details of the solution method). Table 3 presents the baseline parameter values used in all the illustrative numerical solutions of the model. Some of these parameters were drawn directly from the transition literature, others from the available data—in particular, the payroll tax rate, the share of entrepreneurs in the labor force, the speed of the state sector closure, and the entry (exit) of workers into (from) the labor force. Hours outside the formal labor force and the aggregate productivity coefficients in the informal sector were chosen so that, in the steady state, the employment in the private sector (firms) is about 50 percent of the total labor force, and the wage in the private sector is about 80 percent of that at the beginning of the transition.[19] The cost of searching for business opportunities and the cost of acquiring skills are set to 1. The other parameters were chosen to roughly match the statistics of a representative OECD country. More specifically, the real interest rate is set at 4 percent annually, and the share of the business capital in output is 40 percent.

Table 3. Parameter Values Used in Numerical Solutions

Variable	Notation	Value
Real interest rate	r	0.04
Share of entrepreneurs in the population	μ	0.3
Hours outside the formal labor force	N_0	0.3
Aggregate business capital in the informal sector	Z_u	0.3
Marginal product of labor in the state sector	z_s	1
Cost of searching for business opportunity	γ	1
Business capital in the private sector	z_h	1.3
Cost of acquiring education	c	1
Rate of entry (exit) into (from) labor force	δ	0.03
Lump-sum tax collected	T	0.12
Share of business capital in output	α	0.4

[19]These numbers correspond to the average private sector's share in total employment in transition economies in 1996, and the average of the real wage indices in 1996, compared with the 1989 level.

Table 4 shows how steady state variables (w = wage of workers employed in the private firm, n = average employment in the private firm, n_u = unskilled self-employed workers, y = aggregate output) of the model are affected by changes in the cost of acquiring skills financed by the government, c_g. We consider two cases of the cost financed by government: c_g=0.1, and c_g=0.7. The first corresponds to the situation where it is more costly for workers to acquire skills; this higher cost has two opposite effects on workers' incentives to learn. Since it is now more expensive to acquire skills, workers reduce their learning effort. However, since the premium on acquiring skills is now higher, the wages (and the payoff on learning) for skilled workers are higher. If the first effect is sufficiently strong, we would observe fewer workers acquiring skills despite the higher wages, according to the result presented in Table 4. In the exercise, the larger share of the education cost financed by the government also results in larger firm size, smaller informal sector employment, and higher aggregate output in the formal sector, y_f.

Table 4. Steady State Values of the Model

	w	n_h	n	n_u	y_f
I. c_g=0.1	0.819	0.40	1.36	0.30	0.64
II. c_g=0.7	0.794	0.43	1.46	0.27	0.68

To illustrate the transition paths of the relevant variables, Figures 2a-2b show the evolution of real private sector wages and the number of skilled workers under different cost of acquiring skills financed by the government. As Figure 2b shows, when the cost of acquiring skills for a worker is high, fewer workers choose to acquire skills, even though the premium on acquiring skills (and hence the wage) is high (Figure 2a). Figures 3a and 3b show transition paths of profits and outputs in the formal sector. In our model, higher costs financed by the government lead to higher profits, more private firms being created, and higher formal sector output. Figures 4a and 4b show the path of informal sector employment and primary surplus under the two policies. The informal sector employment is lower under c_g=0.7 (since there are more skilled workers), but this is accompanied by a higher primary surplus deficit, mainly because more education expenditures are financed by the government. As indicated in Figures 5a-5b, the speed of state sector closure changes the number of searching entrepreneurs during the transition. With the faster rate of state sector closure, there are more searching entrepreneurs at the beginning of the transition, but they also exit the pool of searching entrepreneurs faster. This is because, under a higher rate of state sector closure, more workers are learning new skills and firm creation is faster. As shown in our two-period model, with more available skilled workers, entrepreneurs are likely to search more intensively, and vice versa. However, since both learning and searching take time, initially more people will engage in activities in the informal sector, and productivity will be lower at the beginning of the transition with faster state sector closure (Figures 6a-6b). Both informal sector employment and the government primary deficit levels are higher under the higher rate of state sector closure (Figures 7a-7b).

V. CONCLUSIONS

This paper has examined the role of human capital in facilitating firm creation in transition economies. Specifically, it had focused on the link between workers' skill acquisition and entrepreneurial incentives to develop new business opportunities. We have shown how the lack of skilled workers during the transition lowers the rate of firm creation, leading to a larger share of the labor force in the informal sector. Although most of the demonstrated results are not surprising, our contribution lies in providing a new theoretical link that sheds light on the slow recovery of employment, productivity, and output in the early stages of transition. Furthermore, we have shown how the recently formulated active labor market policies, which are designed to subsidize skill acquisition, can be effective along with a fundamental restructuring of educational systems.

NUMERICAL METHOD[20]

The problem described by equations (10)–(25) in Section III can be reduced to the following:

$$\dot{d} = \frac{\gamma}{2} d^2 + (r+\delta)d - \frac{\alpha}{1-\alpha} z\left(w(1+\tau) - \tau\bar{w}\right)^{\frac{\alpha-1}{\alpha}}, \tag{25}$$

$$\dot{m} = \left((1-s)\mu - m\right)\gamma d - \delta m, \tag{26}$$

$$w = (r+\delta)(c-c_g) + Z_u^{\alpha}\left(N_0 + (1-s)(1-\mu) - mz[w(1+\tau) - \tau\bar{w}]^{\frac{-1}{\alpha}}\right)^{-\alpha}. \tag{27}$$

where m_0 is given and d in equations (25) and (26) is the defined as $d = J_h - J_u$. Equations (25)– (27) constitute a boundary value system of differential equations. The standard approach to solve a boundary value problem is to use the "shooting method". This numerical procedure consists of guessing the initial value of the control variable (in our case this is defined as $d = J_h - J_u$) and solving the transition paths according to (25)–(27). The implied steady state values are then compared to the steady state values of the unique nontrivial competitive equilibrium. If these are not sufficiently close, the initial guess is adjusted and the procedure repeated.

---

[20]In Figures 2–7, one unit on the horizontal axis corresponds to one year.

IMPACT OF WAGE SUBSIDIES

In this appendix, we compare the impact of wage subsidies with that of retraining (educational) subsidies on skill acquisition and firm creation. In order to do that, we allow entrepreneurs to decide whether they want to operate their firms in the formal or informal sector. If they operate in the formal sector, they have to pay profit taxes at rate τ, but at the same time they receive wage subsidies per worker, w_s. If they operate in the informal sector, they do not pay taxes, but do not receive wage subsidies. In this framework, educational subsidies are more effective because workers receive them regardless of whether firms operate in the formal or informal sector.

Under the option of operating in the informal sector, the entrepreneur's problem changes to

$$\max_{c_1,c_2} \; c_1 + E(c_2) \tag{28}$$

$$s.t. \quad c_1 + \frac{x^2}{2\gamma} \leq \bar{w}$$

$$c_2 \leq x(p(1-\tau)\Pi^F(w_f) + (1-p)[(1-\phi)\Pi^I(w_I) + \phi(1-\beta)\Pi^I(w_I)])$$

where w_f denotes the wage a worker receives in the formal sector and w_I denotes the wage in the informal sector. The probability of operating in the formal sector is 0 if (and only if), after tax/subsidy profits in the formal sector are not larger than the expected profit in the informal sector, that is,

$$p = 0 \Leftrightarrow (1-\tau)\Pi^F(w_f) \leq (1-\phi)\Pi^I(w_I) + \phi(1-\beta)\Pi^I(w_I) \;, \tag{29}$$

where the profit in the formal sector is $\Pi^F = (1-\tau)\left(\frac{1}{1-\alpha} z^{\alpha} n^{1-\alpha} - (w_f - w_s)n\right)$. In equation (29), ϕ denotes the probability that the firm will be detected when operating in the informal sector, and β is the penalty imposed on the firm when caught operating in the informal sector. Similarly, the worker's problem changes to

$$\max_{c_1,c_2} \; c_1 + E(c_2) \tag{30}$$

$$s.t. \quad c_1 + cq \leq \bar{w}$$

$$c_2 \leq q\left(pw_f+(1-p)w_I\right)+(1-q)w_u \ ,$$

where w_u denotes income of unskilled workers. In equation (30), workers take the probability of working for a firm in the formal sector conditional on having skills, p, as given. The corresponding equilibrium conditions for the case when firms are operating in the formal sector are:

$$c=w_f-Z^{\alpha}N_u^{-\alpha}=w_s+\left(\frac{\mu xz}{(1-\mu)q}\right)^{\alpha}-Z_u^{\alpha}(N_0+(1-q)(1-\mu))^{-\alpha} \tag{31}$$

$$\frac{x}{\gamma}=\Pi=\frac{\alpha z(1-\tau)}{1-\alpha}\left(\frac{(1-\alpha)q}{\mu xz}\right)^{1-\alpha} . \tag{32}$$

If firms operate in the informal sector, (31) and (32) change to:

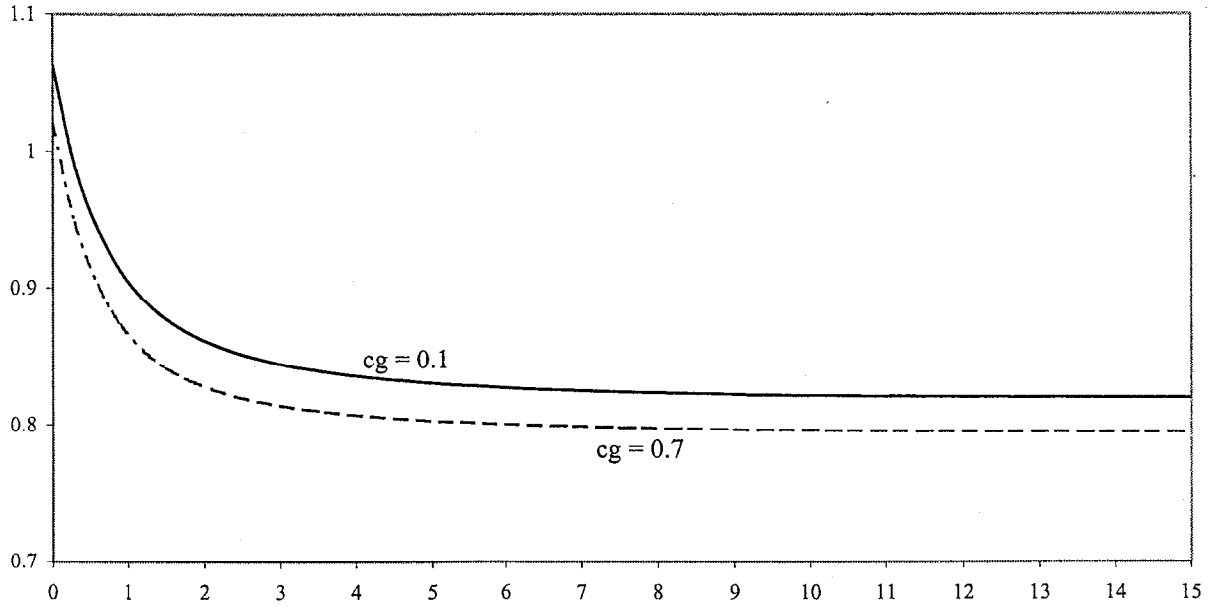
$$c=w_I-Z^{\alpha}N_u^{-\alpha}=\left(\frac{\mu xz}{(1-\mu)q}\right)^{\alpha}-Z_u^{\alpha}(N_0+(1-q)(1-\mu))^{-\alpha} \tag{33}$$

$$\frac{x}{\gamma}=\Pi=\frac{\alpha z(1-\phi\beta)}{1-\alpha}\left(\frac{(1-\alpha)q}{\mu xz}\right)^{1-\alpha} . \tag{34}$$

If $\phi\beta=\tau$, then (32) and (34) are equivalent (and search effort curves for the formal and informal sectors are identical). However, since the firm in the informal sector does not receive subsidy, the equilibrium levels of the search and learning efforts are lower than when workers directly receive an education subsidy. However, if they receive education subsidy in the amount w_s, equations (31) and (33) would be equivalent as well.

Figure 2. Wages in the Private Sector and Share of Skilled Workers

2a. Wages in the Private Sector



2b. Share of Skilled Workers in the Labor Force

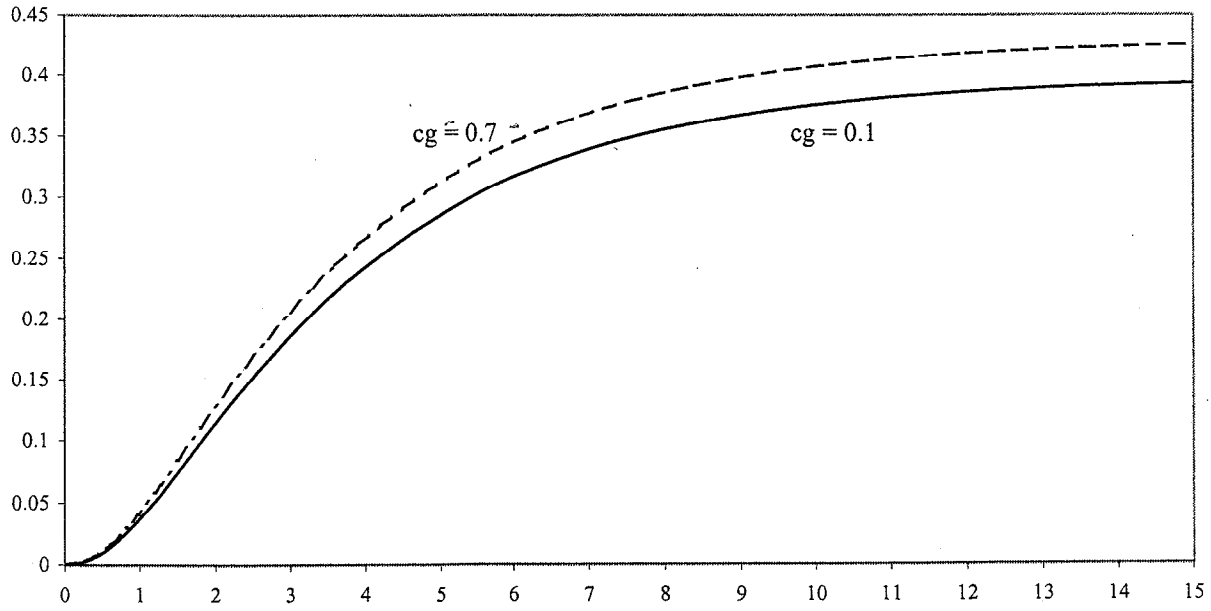
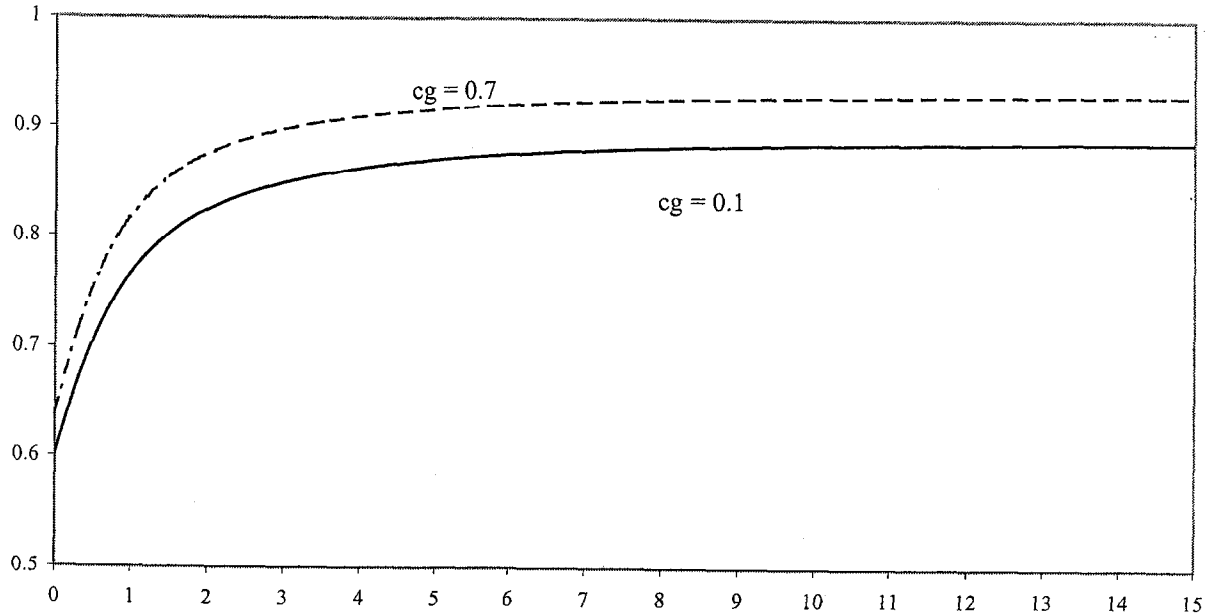


Figure 3. Profits in the Private Sector and the Official Output

3a. Profits in the Private Sector



3b. Official Output

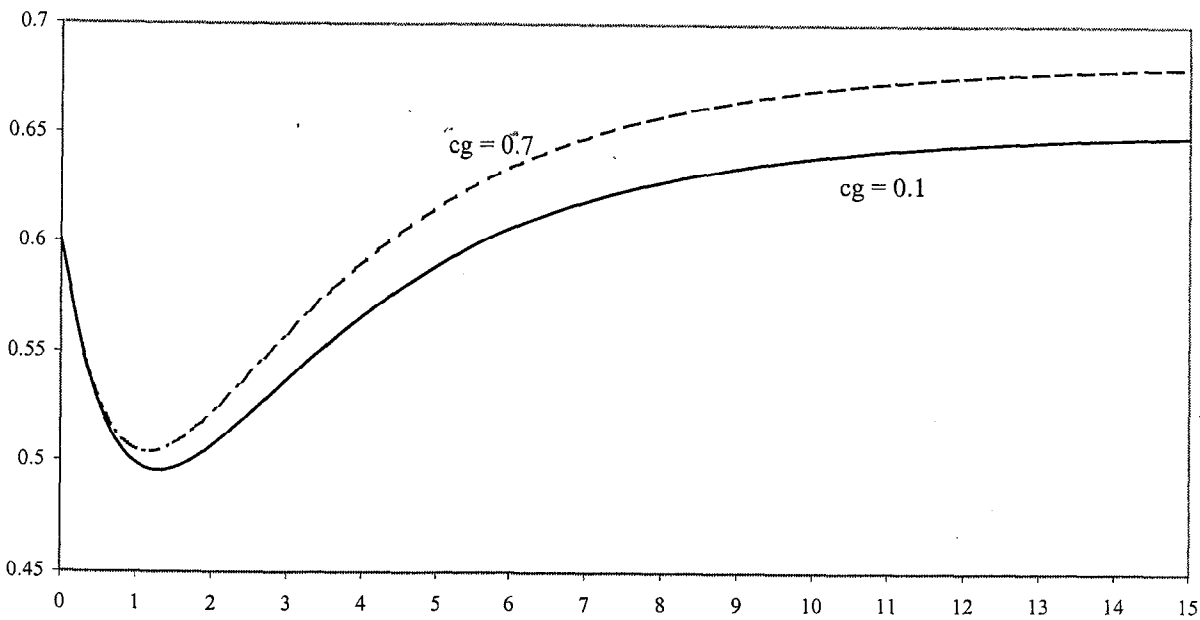
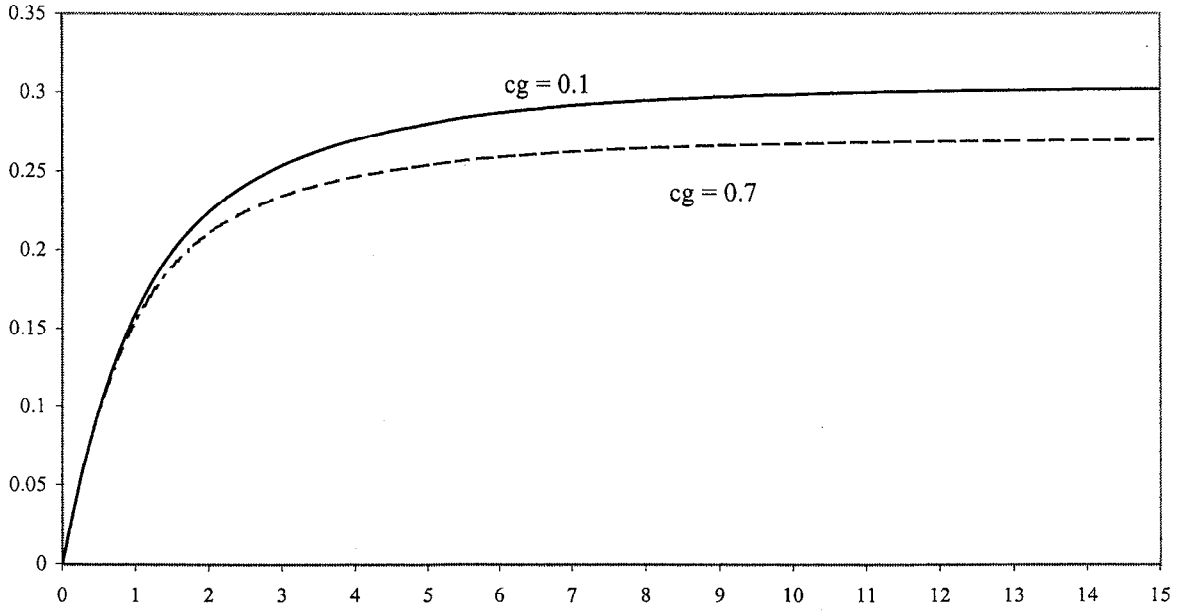


Figure 4. Informal Sector Employment and Government Budget Deficits

4a. Informal Sector Employment



4b. Government Budget Deficits

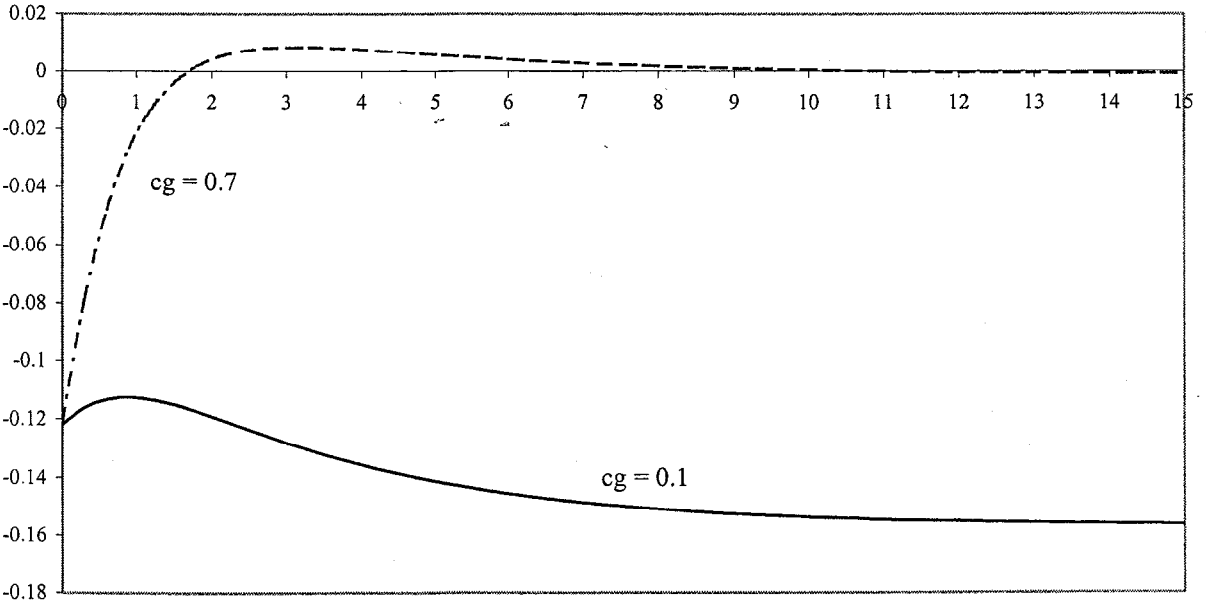
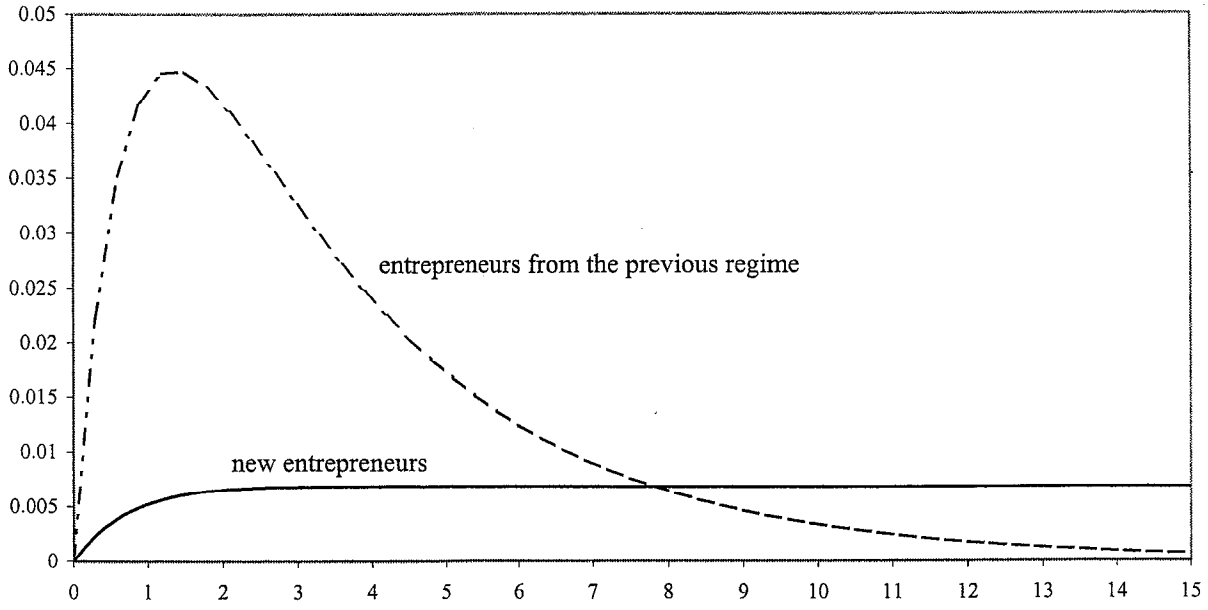


Figure 5. Searching Entrepreneurs under Different Rates of State Sector Closure

5a. Searching Entrepreneurs when the Rate of State Sector Closure = 0.3



5b. Searching Entrepreneurs when the Rate of State Sector Closure = 0.5

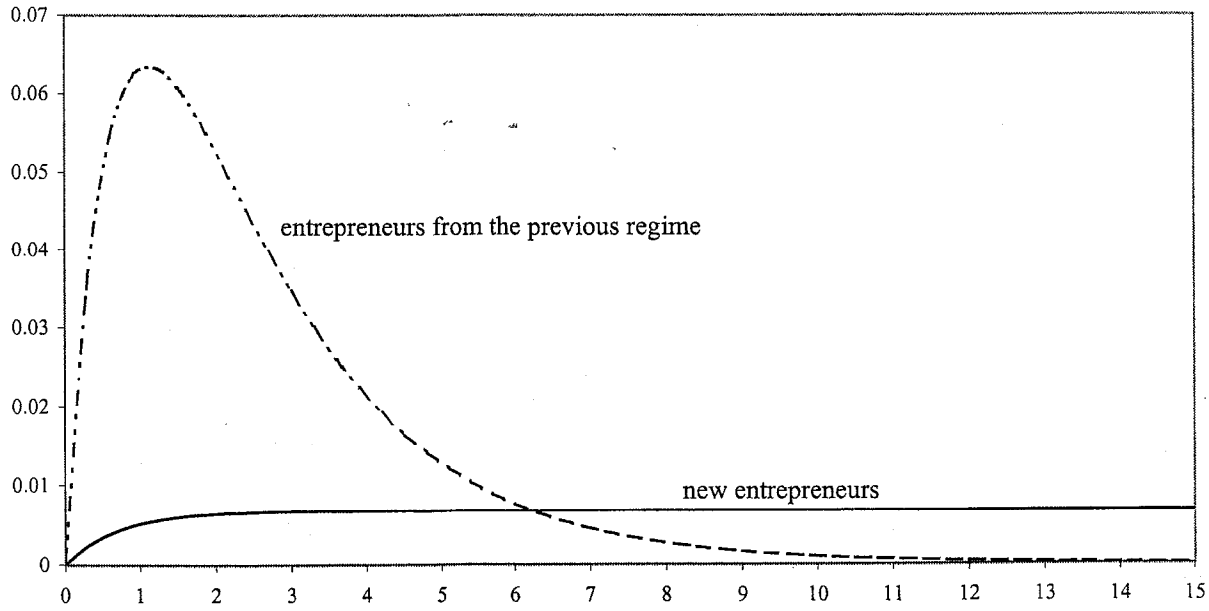
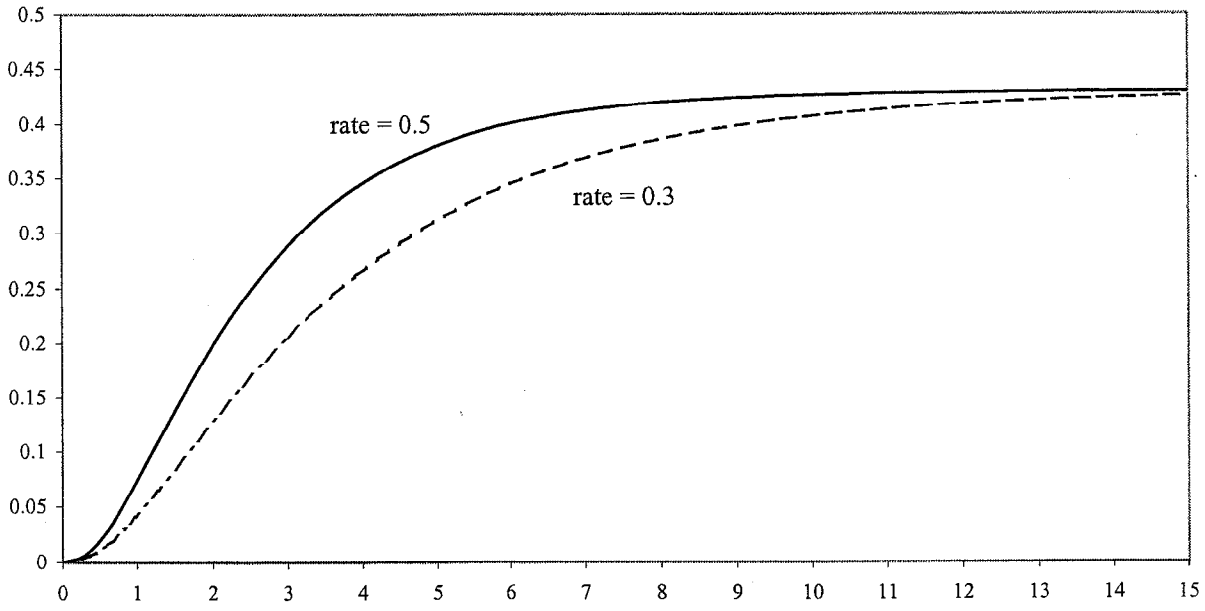


Figure 6. Share of Skilled Workers in the Labor Force and Labor Productivity under Different Rates of State Sector Closure

6a. Skilled Workers



6b. Labor Productivity in the Formal Sector

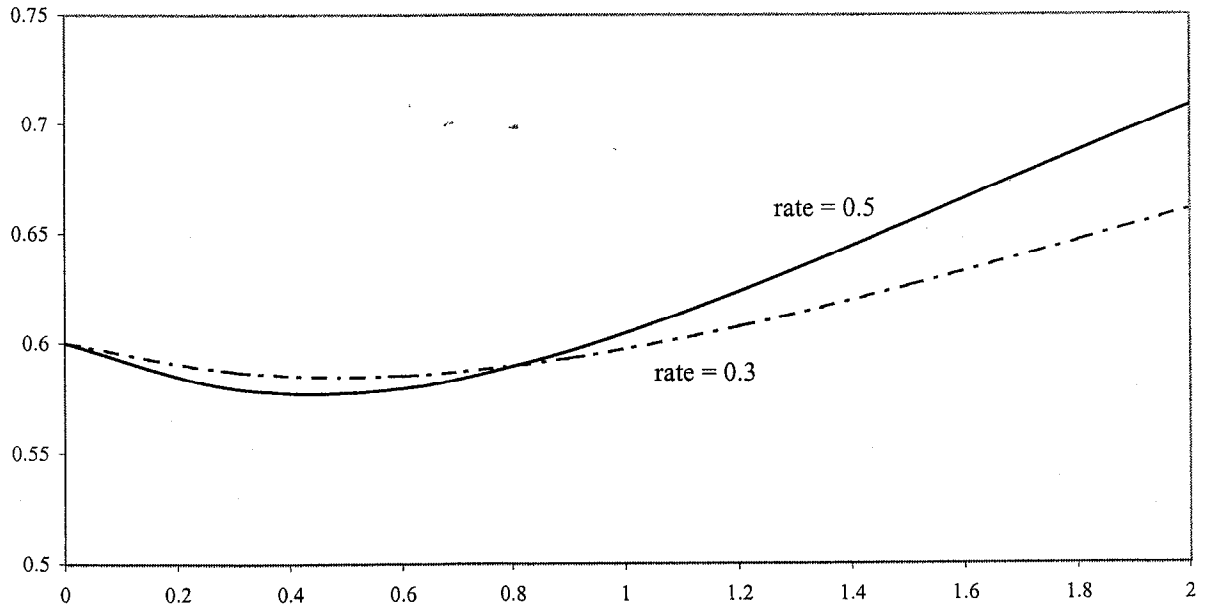
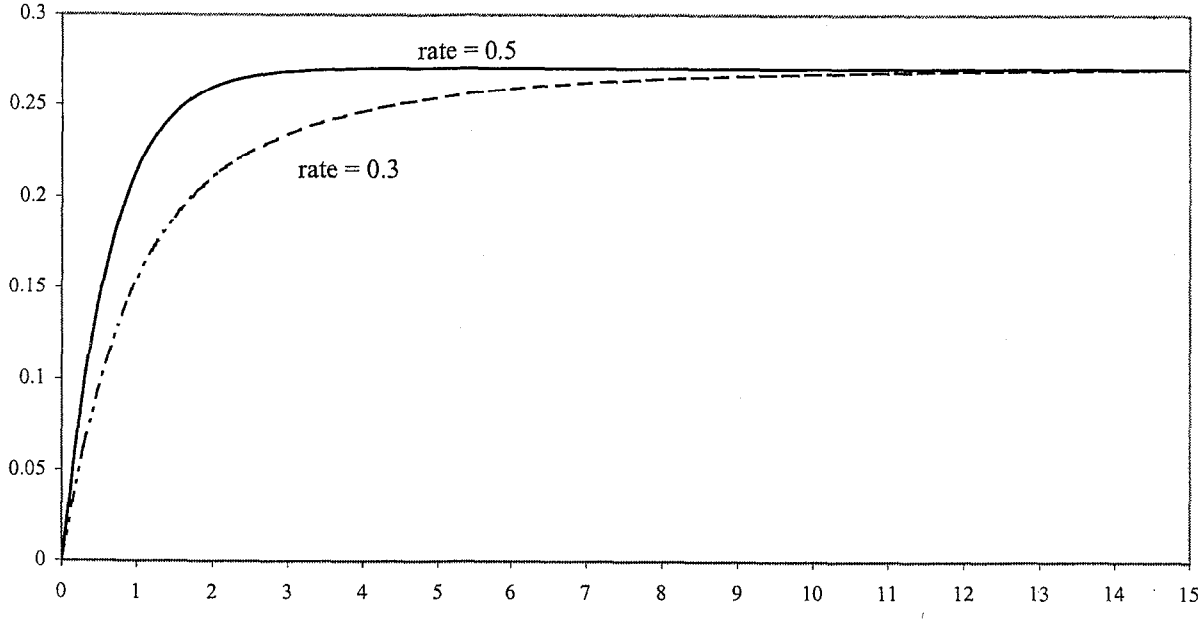
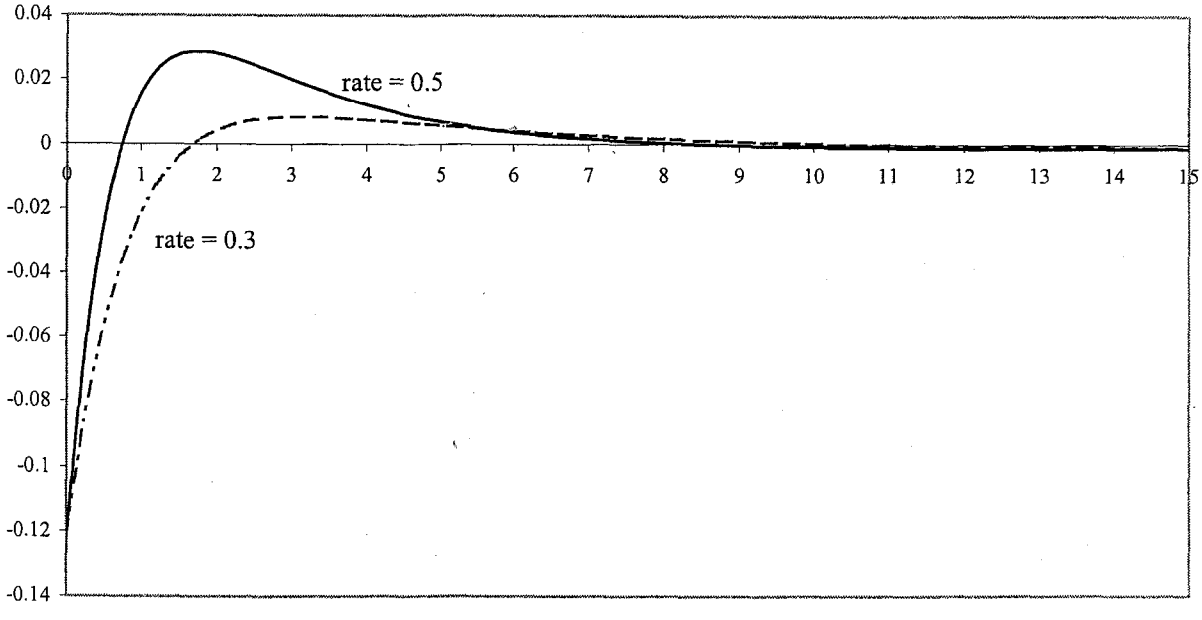


Figure 7. Informal Sector Employment and Government Budget Deficits
under Different Rates of State Sector Closure

7a. Informal Sector Employment



7b. Government Budget Deficits



REFERENCES

Aghion, Phillipe and Olivier Blanchard, 1994, "On the Speed of Transition in Central Europe," in *NBER Macroeconomics Annual*, 1994, ed. by Stanley Fischer and Julio Rotemberg (Cambridge, Massachusetts: MIT Press), pp. 283-320.

Allison, Christine, and Dena Ringold, 1996, "Labor Markets in Central and Eastern Europe, Transition in 1989-1995," World Bank Technical Paper No. 352 (Washington: World Bank).

Atkeson, Andrew, and Patrick Kehoe, Patrick, 1995, "Industry Evolution and Transition: Measuring Investment in Organizational Capital," Federal Reserve Bank of Minneapolis, Staff Report No. 201 (Minneapolis, Minnesota: Federal Reserve Bank of Minneapolis).

Barro, Robert, 1992, "Human Capital and Economic Growth," in *Policies for Long-Run Economic Growth*, by the Federal Reserve Bank of Kansas City (Kansas City, Missouri: Federal Reserve Bank of Kansas City), pp. 199-216.

Benacek, Vladimir, 1993, "Toil and Trouble of an Aboriginal Entrepreneur During Transition: The Case of the Czech Republic," (Unpublished; Prague: Center for Economic Research and Graduate Education of Charles University).

Bilsen, Valentijn, and Jozef Konings, 1998, "Job Creation, Job Destruction, and Growth of Newly Established Private Firms in Transition Economies: Survey Evidence from Bulgaria, Hungary, and Romania," *Journal of Comparative Economics*, Vol. 26 (September), pp. 429-45.

Boeri, Tito, Michael Burda, and János Köllo, 1998, *Mediating the Transition: Labour Markets in Central and Eastern Europe*" (New York: Institute for East West Studies).

_____ and Mark Keese, 1992, "Labour Markets and the Transition in Central and Eastern Europe," *OECD Economic Studies*, Vol. 18 (Spring), pp. 133-163.

Borish, Michael and Michel Noel, 1996, "Private Sector Development During Transition: the Visegrad Countries," *World Bank*, Discussion Paper No. 318 (Washington: World Bank).

Brezinski, Horst and Michael Fritsch, 1996, "Introduction: The Scope for Bottom-Up Transformation in Post-Socialist Countries," in *The Economic Impact of New Firms in Post-Socialist Countries: Bottom-Up Transformation in Eastern Europe*, ed. by Brezinski and Fritsch (Brookfield, Vermont: Edward Elgar), pp. 1-6.

Brixiova, Zuzana and Nobuhiro Kiyotaki, 1997, "Private Sector Development in Transition Economies," *Carnegie-Rochester Conference Series on Public Policy*, Vol. 46 (June), pp. 241-80.

Buckberg, Elaine, 1997, "Legal and Institutional Obstacles to Growth and Business in Russia," IMF Paper on Policy Analysis and Assessment (Washington: International Monetary Fund).

Central Statistical Bureau of Latvia, 1997, *Enterprises Created in Latvia between 1991 and 1994: Findings of a Sample Survey*, ed. by D. Dimitre (Riga, Latvia).

Chadha, Bankim; Fabrizio Coricelli, and Kornelia Krajnyak, 1993, "Economic Restructuring, Unemployment, and Growth in a Transition Economy", *IMF Staff Papers*, International Monetary Fund, Vol. 40 (December) pp. 744-80.

De Melo, Martha and Gur Ofer, 1994, "Private Service Firms in a Transition Economy: Findings of a Survey in St. Petersburg," World Bank Studies of Economies in Transformation, Paper No. 11 (Washington: World Bank).

European Bank for Reconstruction and Development, 1997, *Transition Report, 1997* (London: European Bank for Reconstruction and Development).

Faggio, Giulia and Jozef Konings, 1998, "Gross Job Flows in Transition Countries: Results from Company Accounts Data for Bulgaria, Estonia, and Romania," Leuven Institute for Central and East European Studies, Working Paper No. 77/1998 (Leuven, Belgium: Leuven Institute for Central and East European Studies).

Fan, C. Simon and Michael Spagat, 1994, "Human Capital and Long-Run Growth in Russia: A Cautionary Perspective," Brown University Department of Economics, Working Paper No. 94-15 (Providence, Rhode Island: Brown University).

Godfrey, Martin and Peter Richards, 1997 "The Struggle Against Unemployment: Medium-Term Policy Options for Transition Economies," in *Employment Policies and Programmes in Central and Eastern Europe*, ed. by Godfrey and Richards (Geneva: International Labor Office).

Green, Edward, 1993, "Privatization, the Entrepreneurial Sector, and Growth in Post-Comecon Economies," *Journal of Comparative Economics*, Vol. 17 (June), pp 407-17.

Hernández-Catá, Ernesto, 1997, "Liberalization and the Behavior of the Output during the Transition from Plan to Market," *Staff Papers,* International Monetary Fund, Vol. 44, (December) pp. 405-29.

Hopenhayn, Hugo. and Richard Rogerson, 1993, "Job Turnover and Policy Evaluation: A General Equilibrium Analysis," *Journal of Political Economy*, Vol. 101 (October), pp. 915-38.

Johnson, Simon and Daniel Kaufman, 1999, "In the Underground," paper prepared for the IMF conference on "A Decade of Transition: Achievements and Challenges" (Washington, D.C.).

Johnson, Simon and Gary Loveman, 1995, *Starting over in Eastern Europe: Entrepreneurship and Economic Renewal* (Boston, Massachussetts: Harvard Business School Press).

Jovanovic, Boyan, 1982, "Selection and the Evolution of the Industry," *Econometrica*, Vol. 50 (May), pp. 649-70.

Kluve, Jochen; Hartmut Lehmann, and Christoph Schmidt, 1999, "Active Labor Market Policies in Poland: Human Capital Enhancement, Stigmatization, or Benefit Churning?", *Journal of Comparative Economics*, Vol. 27 (March), pp. 61-89.

Konings, Jozef; Hartmut Lehmann, and Mark Schaffer, 1996, "Job Creation and Job Destruction in a Transition Economy: Ownership, Firm Size, and Gross Flows in Polish Manufacturing 1988-91," *Labour Economics*, Vol. 3 (October), pp. 299-317.

_____, and Patrick Paul Walsh, 1999, "Employment Dynamics of Newly Established and Traditional Firms: A Comparison of Russia and the Ukraine," *The Leuven Institute for Central and Eastern European Studies*, Working Paper No. 81/1999.

Kovacs, Janos and Virag, Ildiko, 1995, "The Social-Economic Role of Education Today", in *Technological Lag and Intellectual Background: Problems of Transition in East Central Europe,* edited by Janos Kovacs, Darmouth Publishing Company, pp. 199-217.

Laporte, Bruno and Schweitzer, Julian, 1994, "Education and Training", in *Labor Markets and Social Policy in Central and Eastern Europe*, Nicholas Barr ed., Oxford University Press, pp. 260-287.

Lehmann, Hartmut and Walsh, Patrick Paul, 1999, "Gradual Restructuring and Structural Unemployment in Poland: A Legacy of Central Planning," Leuven Institute for Central and East European Studies, Working Paper No. 78/1999 (Leuven, Belgium: Leuven Institute for Central and East European Studies).

Li, Wenli, 1997, "Entrepreneurship and Government Subsidies under Capital Constraints: A General Equilibrium Analysis," Federal Reserve Bank of Richmond Working Paper No. 97/9 (Richmond, Virginia: Federal Reserve Bank of Richmond).

Pissarides, Francesca, 1998, "Is Lack of Funds the Main Obstacle to Growth?" EBRD Working Paper No. 33 (London: European Bank for Reconstruction and Development).

Puhani, Patrick A., 1999, "Advantage through Training?" paper prepared for the 4th Annual International Conference on Transition Economics, (Beijing, China).

Richter, Andrea and Mark Schaffer, Mark, 1996, "The Performance of *De Novo* Private Firms in Russian Manufacturing," in *Enterprise Restructuring and Economic Policy in Russia*, ed. by Simon Commander, Qimiao Fan, and Mark Schaffer (Washington: World Bank), pp. 253-73.

Sandi, Ana Maria, 1992, "Why Is It So Difficult? Misconceptions about Eastern European Education in Transition," *International Review of Education* (November), Vol. 38, pp. 629-39.

Smallbone, David, Urve Venesaar, and Bogdan Piasecki, 1996, "Employment Change and Labor Market Issues in Manufacturing SMEs in Poland and the Baltic States: Some Implications for Policy," paper prepared for the 2nd International Conference on "*SME Development Policy in Transition Economies*".

Snower, Dennis, 1996 "The Low-Skill, Bad-Job Trap," in *Acquiring Skills: Market Failures, Their Symptoms, and Policy Responses*, ed. by Alison Booth and Dennis Snower (New York: Cambridge University Press).

Stiglitz, Joseph E., 1999, "Whither Reform? Ten Years of the Transition," paper prepared for the 11th Annual Bank Conference on Development Economics, (Washington, D.C.).

_____, 1998, "Taxation, Public Policy and Unemployment Dynamics," paper prepared for the 54th Congress of the International Institute for Public Finance, (Cordoba, Argentina).

Woo, Wing Thye, Stephen Parker, and Jeffrey Sachs, 1997, *Economies in Transition: Comparing Asia and Eastern Europe,*" (Cambridge, Massachusetts: MIT Press).

World Bank, 1992, *Romania, Human Resources and the Transition to a Market Economy* World Bank Country Study(Washington: World Bank).

World Bank, 1996, *World Development Report 1996: From Plan to Market* (New York: Oxford University Press).

Wyznikiewicz, Bohdan, Brian Pinot, and Maciej Grabowski, Maciej, 1993, "Coping with Capitalism: The New Polish Entrepreneurs," International Finance Corporation Discussion Paper No. 18 (Washington: World Bank).