Zagreb International Review of Economics & Business, Vol. 1, No. 2, pp. 65-75, 1998

ISSN 1331-5609; UDC: 33+65

Innovation, Company Co-operation and the Transformation Process in Eastern Europe

Martin Zagler*

Christian Ragacs**

Wirtschaftsuniversität, Vienna

Abstract: Economic theory addresses the scarcity of resources, in particular of physical and human capital, as the underlying reason for inertia in the transformation process in Eastern Europe. In contrast to theory, the empirical dynamics of their growth performance suggests that Central European Economies (CEE) economies have found alternative channels to foster economic growth.

Authors suggest that co-operation between Western and Eastern European companies play a key role in understanding the CEE convergence process.

Based on a genuinely adopted innovation driven endogenous growth model, expected effects of co-operation between companies in transforming and developed economies are analysed, finding that the opening of the economy and especially company co-operation of Eastern and Western European companies within identical market segments clearly lead to positive growth effects.

JEL Classification: O 10, F 23, P 27

Key words: innovation, company co-operation, human capital diffusion, economic growth, transition process

Motivation

The traditional theory of economic growth gives a very pessimistic view of the transformation process in Eastern Europe. Indeed, the models suggest that the average

* Martin Zagler is Assistant Professor of Economics at the Wirtschaftsuniversität, Vienna, Austria

** Christian Ragacs is Assistant Professor of Economics at the Wirtschaftsuniversität, Vienna, Austria

time period to half the distance between the most developed European economies and the transformation economies in Central and Eastern Europe (CEE) is at least 17 years. (e.g. Mankiw, Romer and Weil, 1992)

The engine of growth in all these models can be found in the existence of reproducible and accumulative factors of production (Barro and Sala-i-Martin, 1995). Whilst older theories stressed the importance of physical capital (Solow, 1956), the New Growth theory focuses on the accumulation of human capital (e.g. Romer, 1986). Hence, the reasons for the long period of time for convergence have to be attributed to the scarcity of resources, in particular physical and human capital in the transformation economies. Whilst physical capital can be easily transferred over the global capital markets, and should therefore pose less a problem for the speed of convergence, human capital is embodied in people and institutions, and therefore less or not transferable across borders.

The relevant economic aspect of human capital is typically seen as the sum of ideas an economy has developed in order to exploit existing resources for productive purposes. Conventionally education is interpreted as part of the aggregate human capital accumulation process. However, due to the long time lag, investment into education will not help to foster economic convergence of CEE in the short run. We therefore use the number of employees in R & D as an indicator of the stock of human capital and the expenditure in R & D as a proxy for the short to medium run investment into human capital and of the efficient use of resources. Table one gives an overview over private research and development personnel and expenditure share in GDP. As private entrepreneurs would invest only as long as expected revenues exceed costs, investment decisions are based on economic reasoning, and should therefore be closely related to the convergence process.

Despite the incompleteness of available data, we find that for the stock of human capital, the European Union does exhibit more than twice the number of R & D personnel, indicating an enormous gap in the human capital stock to CEE economies. The gap is indeed increasing, as the flows into human capital in the EU exceed human capital investment in the CEE. The European Union exhibits R & D shares well above one percent of GDP, the previously introduced CEE economies show respective values well below that. Nevertheless, the growth rates, and the dynamics of growth rates suggest a different picture. First, high R & D expenditures do not coincide with high growth rates. Second, and more important, the data suggest (despite the '97 recession in the Czech Republic) that convergence should be reached well before the time suggested by theory.

We conclude that CEE economies have found channels to foster economic growth despite the lack of resources. Whilst we can observe movements in physical capital across borders. Barro, Mankiw and Sala-i-Martin (1995) have shown that this is not sufficient to explain the enormous dynamics of the convergence process. Supposedly

Table 1: Private research and development personnel and expenditure in the European Union and selected Central and Eastern Economies

	1991	1992	1993	1994	1995	1996	1997
Hungary							
GDP Growth Rate in %	..	-3,10	-0,60	2,90	1,50	1,3	3,8
Private R & D Personnel per 1000 Employees	..	1,00	0,96	0,99	0,90	..	..
Private R & D expenditure in % of GDP	0,64	0,61	0,58	0,41	0,39	..	..
Poland							
GDP Growth Rate in %	-7,00	2,60	3,80	5,20	7,0	6,1	6,9
Private R & D Personnel per 1000 Employees	..	..	..	0,87	0,91	..	..
Private R & D expenditure in % of GDP	..	..	..	0,30	0,26	..	..
Czech Republic							
GDP Growth Rate in %	..	-6,40	-0,90	2,60	6,40	3,9	1,0
Private R & D Personnel per 1000 Employees	..	..	..	..	1,15	..	..
Private R & D expenditure in % of GDP	..	..	..	..	0,78	..	..
European Union							
GDP Growth Rate in %	1,6	1,0	-0,5	2,9	2,5	1,7	2,6
Private R & D Personnel per 1000 Employees	2,44	2,49	2,51	..	..	..	..
Private R & D expenditure in % of GDP	1,15	1,16	1,15	1,14	1,13	..	..

Source: OECD Main Science and Technology Indicators, 1997, own calculations

CEE economies have found ways to overcome the factor immobility of human capital.

In the following, we suggest that co-operation between Western and Eastern European companies play a key role in understanding the CEE convergence process. A co-operation is essentially an institution that internalises specific market relationships in order to achieve higher profits as compared to the market outcome. Co-operation neither affect property rights, nor is mere an attempt to exercise market power. Instead, co-operation shares common resources, respectively redistribute resources between the two co-operation partners following economic rationality. A co-operation essentially comprises the exchange of technology, innovations, organisation, human capital, liquidity, marketing skills and market access.

We will show that economic reasoning leads companies to establish co-operation as a means to react to the following four central issues of the ongoing transformation process. First, individual firms generally face an enlargement in the goods market potential. Second, through outsourcing, the production costs of innovative, hence productive firms in the developed region decrease, which causes further impulses for ongoing investment into physical and human capital. Third, a broad market opens up for manufacturing suppliers in both regions, which intensifies the diversification of production and management technologies in both regions. Of course the integration of two regions does not lead to a linear increase of knowledge about production and management, since it has already been partly applied in both parts. It is evident that a stronger increase in knowledge will occur in Eastern Europe. Finally, the transformation to market economy left an inefficient market structure, due to the complexity in particular for human capital markets.

After presenting a simple model of endogenous growth in the following section, we distinguish between a household, a manufacturing and an innovation sector, we analyse the effects of company co-operation on growth rates in CEE within the model framework. The last section discusses policy conclusions and summarises the main results.

The Model

The model comprises three sectors. A household sector, with the number of agents normalised to unity, in which a variety of consumer goods are demanded, a manufacturing sector, which supplies the consumption goods, and a sector of innovation, where the blueprints for intermediate goods are produced. This captures the economic activities of R & D. We have separated the manufacturing and innovation sector in order to elaborate the peculiarities of human capital accumulation more clearly. We assume production without raw capital. This is for theoretical convenience, as free movement of capital reduces the scarcity of this production factor anyhow. The labour market is segmented, with highly skilled and unskilled labour being equally productive in manufacturing, but only high skilled labour exhibiting nonzero productivity in the innovative sector. The wage on the market for unskilled labour, therefore, gives a lower bound for the salaries of highly skilled labour. Each household supplies one unit of labour perfectly inelastic.

Households

Households maximise point-in time utility U_t, given by a standard Dixit-Stiglitz (1977) type CES utility function,

$$U_t = \left[\int_0^{n_t} c_{i,t}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}}, \tag{1}$$

where $c_{i,t}$ is consumption of a particular good i at time t, ranging from zero to the most current, that is n_t, and $\varepsilon > 1$ is the elasticity of substitution between two distinct consumption goods. Households spend income y_t for the purchase of the respective consumption good at price $p_{i,t}$, according to the following budget constraint,

$$\int_0^{n_t} p_{i,t} c_{i,t} di \le y_t, \tag{2}$$

Optimisation of (1) subject to (2) with respect to each consumption good and aggregation over all i yields after some rearrangements

$$\left[\int_0^{n_t} c_{i,t}^{\frac{\varepsilon-1}{\varepsilon}} di \right]^{\frac{\varepsilon}{\varepsilon-1}} = \mu_t y_t, \tag{3}$$

where μ_t is the Lagrange multiplier, or the shadow value of an additional unit of income. The shadow value of additional income is a function of consumption goods prices only, or

$$\mu_t = \left[\int_0^{n_t} p_{i,t}^{1-\varepsilon} di \right]^{\frac{1}{1-\varepsilon}}, \tag{4}$$

as can be derived from the first order condition and (3). This is nothing else but the price index, which we normalise to unity for convenience. We can then use the first order condition to derive demand for a particular consumption good,

$$c_{i,t}^d = p_{i,t}^{-\varepsilon} y_t. \tag{5}$$

Consumption demand depends positively on income and inversely on price with elasticity ε. Due to our normalisation, the household demand for good i is identical to aggregate demand for this particular good.

The Manufacturing Sector

Manufacturers produce a specific consumption good $c_{j,t}$ using the respective blueprint j, which they apply as the sole supplier, and unskilled physical labour $L_{j,t}$ with the labour coefficient a, using the following simple technology

$$c_{j,t} = L_{j,t}/a. \tag{6}$$

Profit maximisation under knowledge of market demand (5) implies,

$$\frac{\partial \pi_{j,t}}{\partial c_{j,t}} = \frac{\varepsilon - 1}{\varepsilon} p_{j,t} - aw_{j,t} = 0. \tag{7}$$

Due to the monopolistic competitive setting, the optimal price equals the mark-up over marginal costs, that is the productivity adjusted real wage aw_t, as implied by the Amoroso-Robinson-rule,

$$p_{j,t} = \frac{\varepsilon}{\varepsilon - 1} aw_t. \tag{8}$$

We then can solve for profits of the individual manufacturer by combining (5) and (6), to eliminate demand for goods, and then by substitution of (8) and (5) to eliminate labour, or,

$$\pi_{j,t} = \frac{w_t L_{j,t}}{\varepsilon - 1} = \varepsilon^{-\varepsilon} \left(\frac{aw_t}{1-\varepsilon} \right)^{1-\varepsilon} y_t, \tag{9}$$

which is strictly positive. An increase in the real wage reduces profits, whilst an increase in income leads to higher profits.

The Innovative Sector

Firms or laboratories in the innovative sector, which is, as already mentioned, separated from manufacturing for convenience, produce new innovations with skilled labour only, to sell them at a maximum price to a new manufacturer (see Grossman and Helpman, 1991). This price q_t of the blueprint must equal the discounted sum of future profits in manufacturing. We use the growth adjusted rate of time preference $\theta+\gamma$, where $0 < \theta < 1$ is the pure rate of time preference and γ is the economic rate of growth, as the discount factor, as one may at present draw on future increases in output. Integrating (9) over time from now to infinity, using the above mentioned discount factor, yields after some algebraic transformations, the manufacturers' market demand for new innovations,

$$\dot{n}_t = \frac{1-\theta}{\theta\varepsilon}\frac{y_t}{q_t}. \tag{10}$$

Evidently, an increase in the price of blueprints reduces demand, whilst an increase in income, leading to higher demand and therefore higher manufacturing profits - from (9), also increases demand for innovations.

In order to supply a new blueprint, a firm in the innovative sector must procure H_t units of high skilled labour. Assuming that high skilled labour has productivity ϕ_t, and furthermore that the level of existing blueprints n_t is beneficiary for future innovations (following Romer, 1990), the production technology for new blueprints is given by

$$\dot{n}_t = \phi_t n_t H_t. \tag{11}$$

We can capture the fact that innovations are typically considered as risky undertakings by interpreting ϕ_t as the idiosyncratic success probability of an individual innovation process, implying an aggregate macroeconomic productivity of the innovative sector of ϕ_t. Assuming perfect competition in the market for innovations, we can normalise the number of innovative firms to unity, hence profit maximisation in the innovative sector implies,

$$\frac{\partial \pi_t}{\partial \dot{n}_t} = q_t - \frac{s_t}{\phi_t n_t} = 0, \tag{12}$$

where s_t are the salaries in the innovative sector. This implies that the price of blueprints must equal marginal costs in the innovative sector.

Closing the Model

We capture the inefficient market structure for human capital by assuming that a share of $1-I$, $0<I<1$, offered blueprints are lost in the market process, whilst the remaining are applied in the manufacturing sector. We may, in accordance with Pagano (1993), interpret I as an indicator of the efficiency of the institutional market setting. Applying the equilibrium condition to (10) and (12), we can eliminate the price of blueprints in order to obtain an expression for the growth rate of our economy, namely

$$\frac{\dot{n}_t}{n_t} = \frac{1-\theta}{\theta\varepsilon}\frac{Iy_t}{s_t/\phi_t}, \tag{13}$$

where Iy_t is the market friction adjusted real output, and s_t/ϕ_t is the innovation productivity adjusted salary. Note that an increase in income leads to an equiproportional increase in the rate of innovation, similar to an increase in the success probability. By contrast, an increase in the salaries of high skilled labour reduces the innovative effort, and hence the rate of innovation. An increase in the market efficiency clearly fosters growth. An increase in patience evidently increases the growth rate of innovation, whilst an increase in the elasticity of substitution decreases it, as rents for the particular specialisation decline.

Following (8), each manufacturer supplies an identical quantity of her consumption goods. Substituting $\mu_t y_t$ for U_t in (1), and solving the integral, we find after application of the price normalisation and the manufacturing production function (6), that the conventionally defined total factor productivity $(y_t/n_t L_t)$ is given by $n_t^{1/(\varepsilon-1)}/a$, which increases *in* spezialisations. This implies that the growth rate of output is given by $\varepsilon/(\varepsilon\text{-}1)$ times the growth rate in the division of labour, despite a constant quantity of factor inputs. Hence, all the above mentioned comparative static of the rate of innovation apply as well for the economy wide rate of growth.

In this approach, in addition to traditional explanations like human capital H_t or research- and development, economic growth is seen as a result of product diversification (given that all manufacturers produce either in different market segments or with different technologies). In addition economic growth stems from profit expectations of the innovative firms in case of a newly developed invention.

Although the supply of labour is limited, qualitative growth takes place in this model. This is because an existing potential of workers in the innovative sector permanently creates new blueprints. Because of that, manufacturers are constantly engaging in new fields of activity, creating jobs (job creation) by attracting labour from existing firms (job destruction), whereby the total factor productivity increases and hence steady-state growth is generated.

The Role of Company Co-operation in the Transformation Process

So far the model has been discussed without national borders. In the following we discuss the possibilities and perspectives of cross border co-operation between companies in developed and transformation economies in Europe. This evidently goes beyond a mere opening of product and capital markets, as it essentially involves the exchange of ideas, with all the above mentioned difficulties. Even if CEE economies have achieved a certain degree of openness, we assume for simplicity that before the opening of the economies, the growth processes of both regions occurred independently but governed by the same economic principles as mentioned above. Even under some degree of openness, the following results hold qualitatively. In the language of our model, this can be expressed simply through different levels of the corresponding variables which are aggregate demand for goods, level of innovation, productivity and therefore wage and price levels.

One has to distinguish whether companies of different regions operate in differentiated or identical markets. In the former case, the model reduces to the one country model introduced earlier, but with a larger goods market and a broader spectrum of manufacturing suppliers. Only in the case of identical markets, companies of different regions principally have two alternatives. There is either the option of competition or that of co-operation. As mentioned above, a co-operation is essentially an institution which internalises specific market relationships, in order to achieve higher profits as compared to the market outcome. For sake of simplicity, we assume that the formation of a co-operation has a lump-sum cost, and therefore does not intervene with the economic decision process as modelled above.

In case of identical markets, competition as defined by Bertrand or Cournot will take place which would destroy or at least substantially weaken the profits described in the previous section. Therefore, competition will stop or at least slow down the growth effect in these market segments in both regions. While firms from economies in transformation have lower costs, the old market economies possess competitive advantages from their higher productivity, which will determine the division of the common market accordingly. Alternatively, in case of a co-operation, the economic surpluses continue, so that company co-operation plays a key role in the development of Eastern Europe, as growth effects must still occur.

The size and nature of the growth effects can be derived by substituting the economic growth rate γ into (13),

$$\gamma = \frac{1-\theta}{\theta(\varepsilon-1)} \frac{Iy_t}{s_t/\phi_t}, \tag{14}$$

which will be applied for the analysis of growth effects in the case of co-operation. Hence in the following we will discuss the effects of co-operation on the productivity in the innovative sector, and on salaries in the innovative sector.

CEE economies still suffer from inefficient allocation and diffusion of innovations, as the relevant market mechanisms were not developed under the command economy, and the emergence of 'innovation markets' requires a considerable initiation period, represented by a relatively lower I. It is quite likely that co-operation between companies in CEE and EU will improve the diffusion process of innovation, and thus reduce time and cost for the acquisition of innovations, corresponding to a decline in marginal costs of innovation, as described by the productivity of the innovative sector ϕ_t, with clearly positive effects on economic growth.

In principle, the acquisition of human capital is a long-term process. Particularly, the creation of human capital with business specific and market specific qualifications requires an extensive effort even when the existing basic training is of high quality. Co-operation speed up and facilitate this process mainly in economies in transformation, so that firms in Central and Eastern European countries receive the necessary human capital, which leads in turn to relatively higher growth rates, in which the western co-operation partners can participate.

Most evidently, Co-operation reduce salaries in the innovative sector due to the access to relatively cheaper, and well educated human capital. However, researches in East European companies have to be exposed to the cumulative stock of ideas, n_t, acquired in its western co-operation partner, which fosters growth.

In the beginning of this paper, we argued that financial markets are sufficiently developed to allow the financing of physical capital investment in Eastern Europe. However, ideas are costly, too. In order to produce a new product, a manufacturer has to purchase the corresponding blueprint at the price q_t, as derived above. Capital markets are known to be resistant to finance venture capital when risks are not idiosyncratic, as it is the case in most CEE economies, with a high country specific risk. Via internal capital markets, Co-operation can help to overcome such capital market imperfections. Co-operation partners have a considerably better possibility to assess risks due to their own knowledge of the industry and have experiences in the economies in transformation. The advantages of Co-operation are such that affluent firms in the developed region can at least reduce the below optimal investment and innovation, given a standing interest in profits.

Conclusions

We have examined above the effects of Co-operation of companies between the economies in transformation and the developed regions in Europe. A discussion in the framework of the new theory of economic growth offers a relevant starting point for analysing macroeconomic effects. Starting from a description of the model, expected effects of Co-operation between companies in transforming and developed regions are analysed. In the analytical setting used, we found that when opening the regions in identical market segments, Co-operation between companies of Eastern and Western Europe are a necessary precondition for continued growth in these segments in both regions. Indeed, as company co-operation increases the mobility of firm specific human capital, they play a key role in understanding the quick convergence process of CEE economies.

Co-operation is achieved for economic interests. Since, the results of the model deviate from the social optimum for several reasons, in particular the imperfect market structure in the goods market and the innovation externality, policy can intervene by changing the incentive structure of economic agents. By shaping incentive structures, macroeconomic policy obtains a trigger for policy interference, which may be executed either by the respective local governments or by supranational bodies (see Zagler and Ragacs, 1999). They seem meaningful when the positive dynamic effects outweigh short-run costs. Policy variables for macroeconomic measures can focus on productivity in the innovation sector, infrastructure investment and the institutional framework.

REFERENCES:

Barro, R. J., Mankiw, N. G., Sala-i-Martin, X., (1995), 'Capital Mobility in Neoclassical Models of Growth', *American Economic Review*, 85: 103-115.

Barro, Robert J., Sala-i-Martin, X., (1995), *Economic Growth*, (New York: McGraw Hill).

Dixit, A. K., Stiglitz, J. E., (1977), 'Monopolistic Competition and Optimum Product Diversity', *American Economic Review*, 67: 297-308

Grossman, G. M., Helpman, E., (1991), *Innovation and Growth in the Global Economy*, (Cambridge and London: MIT Press).

Mankiw, N. G., Romer, D., and Weil, D. N., (1992), 'A Contribution to the Empirics of Economic Growth', *Quarterly Journal of Economics*, 107: 407-437.

OECD, (1997), *Main Science and Technology Indicators*, Vol. 2, (Paris: OECD).

Pagano, M., (1993), 'Financial Markets and Growth, An Overview', *European Economic Review*, 37: 613-622.

Romer, P. M., (1990), 'Endogenous Technological Change', *Journal of Political Economy*, 98: 71-102.

Romer, P. M., (1986), 'Increasing Returns and Long-Run Growth', *Journal of Political Economy*, 94: 1002-37.

Solow, R. M., (1956), A Contribution to the Theory of Economic Growth, *The Quarterly Journal of Economics*, 70: 65-94.

Zagler, M., Ragacs, Ch., (1999), 'Endogenous Growth, Division of Labour, and Fiscal Policy' in: Zagler, M., *Endogenous Growth, Market Failures, and Economic Policy*, (Basingstoke: Macmillan), forthcoming.