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Working Paper Number 163
April 1998

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Presented at the International Workshop in Transition Economics
A CEPR/WDI Workshop Hosted by CERGE-EI
Prague, 9/12 July 1998

European Union Trade and Investment Flows U-Shaping Industrial Output in Central and Eastern Europe: Theory and Evidence

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Acknowledgements: The Research was undertaken as part of a Marie Curie Research Training Grant, ERB4001GT965163, "Employment Restructuring and Unemployment in Western and Transition Economies" given to Patrick Paul Walsh. We thank Sergio Alessandrini for access to the Bocconi FDI data set and Marvin Jackson for his work on the LICOS Industrial Data Base. We are also grateful to Marvin Jackson for his encouragement to undertake this research project. The paper was presented to the 12th Irish Economic Association, April 1998. We thank all participants for their helpful suggestions.

Abstract

We undertake an analysis of the evolution of industrial output in Bulgaria, Hungary, Poland and Romania over the period 1989-1995. We theoretically and empirically model the growth dynamics of EU oriented output within sectors of industry, ex-post trade and market liberalisation, as investment induced Schumpeterian waves of product innovation. Greater assess to the EU market and investors is estimated to have induced growth with increasing convexity over-time in all sectors of each country but particularly in traditionally larger sectors. This growth, unconstrained by the transition process, was in product categories that already exported to the EU before 1989. We estimate the growth dynamics of non-EU oriented output within sectors as unobservable deterministic sector and country specific heterogeneity. We demonstrate that the evolution of non-EU industrial output followed the pattern as that observed in CIS countries. The different shape in the industrial output of CEE compared to CIS countries is explained mainly by the evolution of traditionally EU oriented production that benefited greatly from increased access to the EU market and EU investors.

Introduction

In this paper we propose to model the evolution of industrial output in Bulgaria, Hungary, Poland and Romania over the period 1989-1995. We theoretically and empirically model the growth dynamics of EU oriented output within sectors of industry, ex-post trade and market liberalisation, as investment induced Schumpeterian waves of product innovation. We show that the EU oriented production that existed before 1989 in CEE countries is not constrained by the transition process but driven by the greater access to the European market and access to foreign capital. The dynamics of non-EU oriented industrial output is estimated to follow the same patterns as that observed in CIS counties. The U-shape in industrial output is explained by the dominance of the collapse in, what was previously, production for the CMEA market in early periods followed by the dominance of growing EU oriented production in latter periods. The large presence of EU oriented production before 1989 and its evolution since 1989 U-shaped Industrial output in Central Eastern Europe. We use the introduction to develop our argument and summarise the main findings of the paper.

Using data from official sources, converted in to a NACE classification system, allows us uncover the evolutionary path of industrial output and the heterogeneity in sector experience within industrial output over the period 1989-95. Analysis of our data, in section II of the paper, indicates that the initial size distributions of industrial sectors within each country were almost identical coming out of the planning system in 1989. What may be surprising is that the final size distributions of industrial sectors converged again by 1995. Over this period sectors initially small in 1989 increased their share of output. This shift in sector composition of industrial output was common across countries.

We intend to explain shifts in sector sizes by estimating the heterogeneous shifts in output within sectors of industry from non-EU to EU oriented production. To this end, in section II, we also undertake an analysis of sector trade data. Hoekman and Djankov (1997) show that changes in the structure of exports were similar across our four countries over the period 1990-1996. In the years before 1989 these open economies already exported more to Europe than centrally planned economies. With the introduction of the market system, and the reduction of trade restrictions and presence of trade agreements, as outlined in Rodrik (1994), we observe an expansion in export growth to the EU over the period 1990-96, particularly evident from 1993 onwards. Rodrik (1994) noted re-orientation of products, previously oriented to CMEA, to the EU market was not a feature of the transition period. The export share of previously CMEA oriented trade declined rapidly in the first few years of transition with a slight recovery over the period 1993-96. His analysis suggests that up to 1993 certain factors had a strong negative impact on product categories historically dependent on CMEA trade and a weak but positive impact on product categories historically exporting to the EU. Thereafter we observe a recovery in what was CMEA trade and strong growth in products historically exporting to the EU. We set out to show that the factors behind the movements and compositional changes in exports, in these countries, where also behind the dynamics of products within sectors of industrial output.

In our analysis of trade statistics at the 7 digit product category level we observe that EU oriented products were hosted across all 2 digit sectors of industry. What may be surprising is that the larger industrial sectors under planning had the greater share of EU oriented products. Exports for the EU grew in all sectors of industry particularly after 1993. The performance of all sectors was exceptionally with Food, Beverage and Tobacco, Textiles and Textiles Products, Chemical Products and Rubber and Plastic Products lagging behind.

The later industries may have being constrained by price undertakings managed by EU Anti-Dumping Legislation. We do not have trade data on 7 digit product categories that were traditionally CMEA oriented. In addition we do not know the initial distribution of these products across our 2 digit sectors of industry and their relative performance overtime. Our methodology is to write down a theoretical and empirical model that allows us to model the degree to which sector growth within each country has been driven by the increased access to the EU market and investors. The experience of the CMEA oriented product categories is modelled empirically as unobserved deterministic heterogeneity within sectors of industry in each country. This will allow us to find empirical evidence for our theoretical model and estimate the proportion of each sectors growth within each country that is driven by the EU and non- EU market developments.

Our theoretical framework, in section I, builds the microeconomic foundations behind the growth dynamics of EU oriented production. Our framework is built around the endogenous growth model of Aghion and Howitt (1992). Trade and market liberalisation ensured that product specific investments became an endogenous outcome driven by international market forces, exogenous shifts in consumer willingness to pay (or market size) and in the outside option for product specific investment resources. In a two-stage framework we derive the impact of exogenous shifts in market size and outside investment options on the expected evolution of product specific investment, output and price dynamics in a steady state equilibrium.

In stage II we model how product specific investment resources are allocated between current production and research aimed at increasing the expected arrival rate of vertical innovations. The maintained assumption, as in Aghion and Howitt (1992), is that innovations (endogenous shifts in the demand curve), within the product category are undertaken, in a least cost manner, by the entry and exit of firms rather than restructuring of practices within firms. Growth in the model is determined by Schumpeterian waves of firm *creative destructive* within products. The intervals between each wave being determined by the level of investment and the share that is being put into research for product innovations. In stage I we model the steady state level of product specific investment assuming full anticipation of the expected outcomes in stage II. Two key determinants of the level of investment are the size of the market and the outside option for the investment resources. Empirically we observed an increase in investment flows targeting production of EU oriented products. The theory predicts that as investment increases a higher share of investment resources will be put into research for product innovation. This in turn is predicted to induce an initial expansion in steady state production with expectations of increased growth, due to increasing rates of *creative destruction*, overtime. By modelling the micro-economic foundations of endogenous product growth we can also model the evolution of sector output by assuming independent product sub-markets and product specific investment within sectors. This allows us to aggregate over the weighted product experience to the level of the sector.

In our empirical section, section III, we model the proportion of sector growth that was driven by *creative destruction* in EU oriented production, within the sector over-time. The later is instrumented with the initial flows of investment into the sector in the aftermath of trade and market liberalisation. Our investment data is by 2-digit industrial and captures the EU investment flows into each sector of each country in 1990. Investments that were strongly linked to product categories that were EU export oriented, see Aturupane, Djankov and Hoekman (1997).

We construct a Creative Destruction Index (CDI) using export data on 7 digit EU oriented product categories within each 2-digit industrial sector. The Index captures the, product size weighted, turbulence induced by entry, expansion, contraction and exit of products that produce for EU export within each sector of each country. The observed changes would be expected to have a positive relationship with firm turnover. We model the CDI index as suggested by our theory, with the initial increase in investment flows in 1990. We use the predicted values of the CDI to model sector growth in a pooled regression across our four countries over the 1989-95. Using panel data techniques we model the influence of traditionally CMEA oriented products as unobserved but deterministic heterogeneity across sectors and countries. Our results suggest that the U-shape in industrial output is induced by a common experience across all sectors in the four countries. EU oriented products induced sector growth in every year but the effect is particularly strong from 1993 onwards. Products previously sold into the CMEA market collapsed in the first few years of transition and only recovered in Hungary and Poland after 1994. These two offsetting forces induced the observed U-shape in aggregate industrial output in these countries.

The results also indicate that the experience was heterogeneous across sectors. The U shape in net output is estimated to be flatter in smaller sectors. In the early periods the CMEA shock did not dominate the EU trade shock as much as in the larger sectors. In the latter periods the dominance of the EU trade shock were not as great as in the larger sectors. This implied that the reallocation of output within sectors to EU oriented products away form previously CMEA oriented products was not as great in smaller sectors. Even though the smaller sectors did not perform as well on the basis of EU exports they still increased their share of industrial output over-time. This was because they suffered much less from the power of the CMEA shock and its slow recovery. This explains the observed inter-sector shifts in industrial output observed across the four countries.

In addition we show that the evolution of non-EU industrial output followed the same patterns as observed CIS countries. The experience of EU oriented output within sectors is shown to be fundamentally different to that estimated for non-EU oriented products. The evolution of EU oriented output is modelled theoretically and empirically as investment induced Schumpeterian waves of product. The determinants of the collapse, and the constraints on the recovery process, in what was known previously as the CMEA market is likely to be explained by existing theories on the transition process (to be reviewed). The main lesson from this paper is that the U- shape observed in the evolution of industrial output of CEE is driven mainly by the performance of traditionally EU oriented production that was not constrained by the transition process. In the next section we write down our theoretical framework.

Section I: Endogenous Product Growth and Trade Liberalisation : The Schumpeterian Approach

Our framework for modelling growth is based on the Aghion and Howitt (1992) endogenous growth model. Growth in our model is induced by endogenous shifts in the demand function rather than shifts in the production function. We also allow the steady state level of investment in our model to be determined endogenously in a two-stage framework. Trade and market liberalisation ensured that product specific investments became an endogenous outcome driven by market forces. Investment under the planning system was determined by the state. We proxy the effects of liberalisation as exogenous shifts in consumer willingness to pay (or market size), S, and exogenous shifts in the outside option, A, for product specific investment resources. In this model we wish to derive the impact of these factors on the expected evolution of product specific investment, output and price dynamics in a steady state equilibrium.

In the model product specific investment resources are allocated between current production and research aimed at increasing the expected arrival of vertical innovations that in turn will change the consumer willingness to pay for the product. The maintained assumption, as in Aghion and Howitt (1992), is that innovations (endogenous shifts in the demand curve), within the product category are undertaken, in a least cost manner, by the entry and exit of firms rather than restructuring of practices within firms. Growth in the model is determined by Schumpeterian waves of firm *creative destructive* within products. The intervals between each wave being determined by the level of investment and the share that is being put into research for product innovations. We model product growth in a two-stage framework. In Stage I the investment decision is made conditional on having perfect foresight on the uncertain outcomes of Stage II. Hence we model stage two first.

Stage II: We assume a given and continuous amount of product specific investment resources, I, which can be used either in current production (x) or in research (n). Research seeks to develop an improved vertical attribute for the product type. The research is aimed at creating an "innovation" that will make the current product obsolete when the new product arrives on the market. Innovations are assumed to arrive randomly with a Poisson arrival rate of λ for each unit of investment put into research. Growth in this model is generated from a succession of uncertain arrivals of product innovations and new producers. The expected arrival rate of such innovations is determined by λn. The following equation acts as a *accounting equation.*

$$I = x + n \tag{1}$$

The investment allocation between current production and research will equalised the expected discounted rate of return from the allocation. The following ***arbitrage equation*** is also binding,

$$r_t = \lambda V_{t+1}$$

(2)

r_t is rate of return accrued by an investment resource dedicated to current production while λV_{t+1} is the discounted expected rate of return that results from allocating an unit of investment in to the search for a new innovation. One should note that t denotes the current innovation level and not time. The value of V_{t+1} is determined by the following asset equation:

$$R\, V_{t+1} = \pi_{t+1} - \lambda\, n_{t+1} V_{t+1}$$

(3)

The left-hand-side is the discounted expected income from the licence to produce a product with the (t+1) innovation level over the expected duration of its life. The right hand side is the rent flow minus the expected loss when the new innovation arrives. The net present value of an asset, yields a certain π_{t+1} until it disappears, which it does at the expected rate of λn_{t+1}, the expected duration of monopoly rents. The model becomes operational by solving for x from the following optimisation problem.

$$\underset{x}{Max} \quad \pi_t = (P_t - r_t)x_t$$

(4)

We model our inverse demand curve and production function as an exact form. The results of the model are robust to general specifications.

$$P_t = \frac{S\,\gamma^t}{Y} = \frac{S\,\gamma^t}{x^{\alpha}} \tag{5}$$

Where the Cobb Douglas production function exhibits decreasing returns to scale $0 < \alpha < 1$. The size of the market, S, or willingness to pay, shifts by a factor γ each time a new product arrives with an innovation in its vertical attribute. Each incumbent producer faces an exogenous market size defined in terms of S and the vertical attribute. Market size has two components. The endogenous component which depends on the number innovations undertaking for the product in history, including that undertaken by the current manufacturer before entering the market and the exogenous component, S, which is predetermined by exogenous factors such as the degree of market regulation and trade liberalisation.

The optimal manufacturing level, within a product niche, is determined by a monopoly. The solution function for the above optimisation problem and the sign of the partial derivatives are as follows,

$$x_t = \left(\overset{+}{S}\ \overset{+}{\gamma^t}\ \overset{-}{r_t}\right) = \left(\frac{S(1-\alpha)\gamma^t}{r_t}\right)^{1/\alpha} \tag{6}$$

Using (1) and (6) we can express r_t as a function of the n_t, an expression that is conditioned on the (6) holding. We express the relationship and the its partial derivatives in the steady state as follows,

$$r = g\left(\overset{+}{S}\ \overset{+}{\gamma^t}\ \overset{-}{I}\ \overset{+}{n}\right) = \frac{S(1-\alpha)\gamma^t}{(I-n)^{\alpha}} \tag{7}$$

In the steady state we drop the subscript t except in the case of the endogenous vertical attribute whose given value to the incumbent depends on t the number of innovations undertaken in history. Using the arbitrage equation, condition (2), and (6) we can also express r_t as a function of the n_{t+1} and we express the relationship and the partial derivatives in the steady state as,

$$\bar{r} = f\left(\overset{+}{S}\ \overset{+}{\gamma}^{t+1}\ \overset{-}{n}\ \overset{+}{\lambda}\ \overset{-}{R}\right) = \left(\frac{\lambda\alpha}{(R+\lambda n)(1-\alpha)}\right)^{\alpha}\left(S(1-\alpha)\gamma^{t+1}\right) \qquad (8)$$

We undertake comparative static exercises on our accounting and arbitrage equations, (7) and (8) assuming a steady-state equilibrium and (5) is binding. We express the partial derivatives of the solution functions in terms of the partial derivatives of the above equations.

$$r^{0}(\overset{+}{S},\overset{+}{\gamma},\overset{-}{I},\overset{+}{\lambda},\overset{-}{R}):\quad r^{0}_{s} = g_{s} > 0 \quad and \quad r^{0}_{I} = \left(\frac{g_{I} f_{n}}{f_{n} - g_{n}}\right) < 0 \qquad (9)$$

$$n^{0}(\overset{0}{S},\overset{0}{\gamma},\overset{+}{I},\overset{+}{\lambda},\overset{-}{R}):\quad n^{0}_{s} = 0 \quad and \quad n^{0}_{I} = \left(\frac{g_{I}}{f_{n} - g_{n}}\right) > 0$$

The explicit solution functions for (9) can be found in appendix I. In the steady state equilibrium we are concerned with the impact of I and S on the allocation of resources between production and research and on the equilibrium rate of return to investment projects. The greater the amount of investment resources available the greater the share that goes into research. This in turn increases the expected arrival rate of innovations in equilibrium. The rate of return to current and future projects falls as the expected life cycle of each innovation is shortened. A change in the exogenous determined market size has no effect on the allocation of investment between current production and research but it does increase the current and discounted expected rate of return on a unit of investment. This will be important for the determination of steady state investment in stage I.

Stage I: In stage I the level of steady state investment is determined in full anticipation of the expected outcomes in stage II. Investment maximises, a surplus function, the steady state rate of return net of an exogenous outside option, A. We express the steady state optimisation surplus function as the following,

$$\max_{I} \Omega = \left(r^{o} - A\right)^{\varepsilon} \tag{10}$$

The first order condition takes account of the changes in the steady state rate of return as investment changes and we express it as follows,

$$\Omega_I = \varepsilon \left(r^{o}\left(\overset{-}{I},\overset{+}{S}\right) - A \right)^{\varepsilon-1} \frac{\partial r^{*}}{\partial I}\left(\overset{-}{I},\overset{+}{S}\right) = 0 \tag{11}$$

Using (11) as our equilibrium we can perform comparative static exercises, using (9) and the first and second derivatives of (7) and (8), with respect to all the exogenous variables in our model on steady state investment. The explicit functional form for the steady state level of investment can be found in appendix I. We report our results as follows,

$$I^{*}\left(\overset{-}{A},\overset{+}{S},\overset{+}{\gamma},\overset{+}{\lambda},\overset{-}{R}\right) \tag{12}$$

The exogenous level of market size and the endogenous shift in the market size after each innovation have a positive impact on the overall level of steady state investment. Factors such as a rising outside option or discount rate in evaluating expected future returns from innovations reduce steady state investment levels. Equation (11) has the property that investors in steady state equilibrium only earn an expected return equal to the outside option. We turn to the analysis of steady state output and price dynamics in the event of endogenous movements in investment resources made available to products in the aftermath of trade liberalisation.

Steady State Output Dynamics: Using the expression for (6) in steady state, we can express steady state output as follows,

$$Y^{o}_{t+1} = x^{**}_{t+1} = \gamma \, Y^{o}_{t} \tag{13}$$

The expected growth rate is a random step function, the interval between each step being exponentially distributed by steady state level of λn and is determined, amongst other factors, by the steady state level of investment and the other factors in (9). Investment in turn depends, amongst other factors, on the exogenous size of the market and the outside option for investors. Expected growth in our steady state equilibrium can be expressed as follows,

$$\dot{y} = \lambda \, n^{*}\left(I^{*}\left(\dot{S}, \bar{A}\right)\right) \ln \gamma \tag{14}$$

The expected growth in steady state output during real times, τ, depends on the amount of innovations that take place over the defined real time interval,

$$\ln y_{\tau+1} = \ln y_{\tau} + \psi(\ln \gamma) \tag{15}$$

Where the expected growth rate of output over a defined real time interval depends on the number of innovations ψ over the interval which is dictated by equation (14). Output for defined real time intervals is expected to grow at an increasing rate. Innovations or endogenous increases in the market size ensure that the innovation rate itself is expected to increase over time. Trade and market liberalisation through its effect on market size and on the outside option for investors is also an important determinant of the level of investment and hence the steady state level of current production and its expected growth overtime. An increase in the endogenous level of investment increases both x and n but lowers the ratio of x/n. Outputs expected growth path is higher on two accounts. Innovations are expected to arrive at a greater rate over defined real time intervals due to an increase in overall investment but also because a greater share goes into research. The core implication of our model is that a product facing a positive investment shock will increase steady output but concentrate more of the increased investment resources into research and thus increases the expected rate of output growth with increasing convexity overtime. The expected benefits of the positive shock are spread overtime.

Steady State Price Dynamics: By substituting (6) in to (5) and setting r = A to satisfy the condition in (11) we can express the steady state prices as follows,

$$P = \frac{A}{(1-\alpha)} \tag{16}$$

The price for the product after trade and market liberalisation is a mark-up on the outside option for investment resources. The mark-up tends to zero as the degree of competitiveness in the market increases ($\alpha \to 0$). The prediction of the model is that price movements in steady state over-time become independent of output movements. We would expect the export price of goods to reflect their trading partners in the event that they compete for the same pool of investment resources.

Implications for Sector Output Dynamics: Assuming products form independent sub-markets and investment is product specific, we aggregate over products to predict the evolution of sector output. Our theory predicts that has investment grows, a higher share will be put into research for product innovation. This in turn is predicted to induce an initial expansion in sector production and a large expansion in sector growth overtime induced by increasing rates of *creative destruction*. The above model shows the role of discrete changes in investment patterns not only dictate contemporaneous output levels but also their evolution over time. This model will form the basis of our empirically agenda. We first describe and undertake a brief analysis of the data used in our empirical work.

Section II: Sector Analysis of Industrial Output, EU Export Oriented Products and EU Foreign Direct Investment.

We wish to examine the forces behind sector and industrial output growth in Bulgaria, Hungary, Poland and Romania over the period 1989-1995. We merge three important data sets that allow us undertake an empirical investigation of the dynamic processes put forward in the theoretical section of this paper. We describe each data set and undertake an analysis of the variables we intend to use in the empirical section of the paper.

The LICOS Industrial Data Base: This data base contains industrial output data by branch/sector of Industry in the NACE classification outlined in table 1 over the period 1989-1995. An INCO-COPERNICUS project (CIPA-C-93-0003) on the region converted data from official sources, using a common methodology, in to a common NACE classification system. We have constant output data for all our four countries by sector of industry in the form of a cumulative output index. The value of this index is always equal to 1 in base year 1989 for all branches.

Using this data we can analysis the degree of sector heterogeneity in the evolution of Industrial output in Bulgaria, Hungary, Poland and Romania over the period 1989 and 1995. We undertake the analysis with a number of simply indexes. We calculate a discrete measure of growth over the period t-1 to t in sector i and country j as the following,

$$Growth_{ijt} = \left(\frac{y_{ijt} - y_{ijt-1}}{(y_{ijt} - y_{ijt-1})/2} \right) \tag{17}$$

We wish to examine the contribution of rising and declining sectors to the overall evolution of output. To do this we sum the growth rates of each rising sector (POS) weighted by the sector size and sum over the absolute growth rates of each declining sector (NEG) weighted by their size.

$$\begin{aligned} Pos_{jt} &= \sum_{i=1}^{n} s_{ijt}\, y_{ijt} \qquad if\ y_{ijt} > 0 \\ Neg_{jt} &= \sum_{i=1}^{n} s_{ijt} \mid y_{ijt} \mid \quad if\ y_{ijt} < 0 \end{aligned} \tag{18}$$

The net change in industrial output and the excess reallocation of output between sectors within countries over and above that necessary to generate the net outcome are calculated as follows,

$$\begin{aligned} NET_{ijt} &= POS_{ijt} - NEG_{ijt} \\ EXCESS_{ijt} &= POS_{ijt} + NEG_{ijt} - \left| NET_{ijt} \right| \end{aligned} \tag{19}$$

In table 2 we outline the year to year growth rates in industrial output, the contribution of rising and declining sectors to the overall net changes in industrial output and the excess reallocation of output between sectors within Bulgaria, Hungary, Poland and Romania. Excess reallocation are also reported when conditioned on giving equal weights to each sector in (18). This allows us to see whether the turbulence was greater in the smaller sectors in industry.

The U-Shaped Industrial Output Curve can be seen to be present in all four countries. Bulgaria and Romania had negative growth rates till the end of 1993 and since then we see the recovery. Romania grew strongly one year later than Bulgaria. It is only since 1992 that we observe simultaneous expansions and contractions of sectors inducing reallocations of output across sectors to be significant in Bulgaria and Romania. The heterogeneity in sector experience measured from 1992 onwards increases when we give small sectors equal weighting in industrial output.

Changes in sector composition of industrial output did not appear in Bulgaria and Romania until the period 1992-1993. Structural change in Poland started earlier. We observe a large collapse in output in the period 1989-1990 followed by large reallocations of output between sectors in the following years up to the end of 1992 and stable and homogeneous growth in all sectors since. The collapse in Hungarian output was spread over the years up to 1992 and output was reallocated across sectors in the period 1992-1993. During the reallocation periods more change is observed when we give equal weights to the small sectors.

As shown in fig.1 the initial size distributions of sectors within each country were similar coming out of the planning system in 1989. Even though the timing of change in sector composition of output was very different in each of the four countries the final size distributions of sectors converged again by 1995. As indicated in table 3 the variation in the absolute change in sector size across countries was less than the variation between different sectors within countries over the period 1989-1995. This indicates that structural change tended to be induced by common sector specific shocks rather than country specific shocks.

In fig.2 we examine the shift in the size distributions of sectors within countries and note the shift to the right in the distribution. This indicates that sectors initially small in 1989 increased their share of output relative to the traditional large sectors by 1995. Heterogeneity in sector experience is presence throughout this period the determinants of which seem to be common across all four countries. The aim of the paper is to decompose the observed sector experience into that driven by EU trade and investment and other components. We wish to show that the intra sector compositional changes are the driving force behind the observed differences in sector experience. To allow us estimate the role of intra sector compositional changes over this period in terms of EU versus non-EU oriented production we turn to an analysis of the trade data by sector of industry.

EUROSTAT Trade Statistics: Is an electronic statistical yearbook of the European Union. This high quality database contains annual data on trade flows by 7-digit product categories between the 12 Member States and some 200 non-Community countries. We obtained exports for Bulgaria, Hungary, Poland and Romania for the period of 1988-1995 by taking the EU12 trade flows by partner countries, measured in thousands of ECUs. In order to link the foreign trade data with the data on industrial output we used NACE CLIO (1970) product classification system (see "Système européen de comptes économiques intègrès" EUROSTAT, Luxembourg, 1979). NACE CLIO 44 is a regrouping of the product categories into industrial branches for the input-output tables (44 branches and 7 sub-branches) in the integrated European economic system of accounts. We use the IMF financial statistics yearbooks to obtain the value of trade flows in 1989 prices. The trade data is in 1000 ECU-s. The deflator used in this case was the CPI in the twelve Western European countries reported in the country tables in the IMF Financial Yearbook. The twelve countries are the same ones that are reported on the EUROSTAT CD ROM as EU12. We used the weighted sum of the

CPI for EU12 with weights being the countries' respective shares of their GDPs in current USD in each year. The GDP value in national currency is reported in the country table. To convert it to dollars, we used the exchange rates for USD (end of period).

Hoekman and Djankov (1997) provide us with a good analysis of the export structure in Central and Eastern Europe. Table 4 is constructed from their analysis. There are an number of important observations to be made. First, the export share of the EU before the collapse of the Soviet Union was greater than CMEA trade. This has the implication that these countries had undertaken a lot of restructuring of products with an EU orientation before 1989. Secondly, we observe the export share to former centrally planned economies and to the EU changing in a dramatic fashion. A large initial decline in exports to the former CMEA is observed up to 1993 with a recovery only evident in the later period of 1993-1996. The positive impact of EU trade was apparent in early periods but the real expansion can only be observed in the later period. This suggests that the mechanisms suggested by our theoretical framework may be present.

In table 6, we report, among other things, the distribution of export share by sector of industry in 1988 and the initial size of sectors in industry, averaged over the four counties. We note that all sectors of industry contained products that were exported to the EU before 1989 and the larger sectors in industry under the planning system had the greater share of industrial exports to the EU. We wish to examine the experience of products at the 7 digit level of Industry within these 2 digit sectors over the period 1989-1995. We do this by constructing the following products for EU Export Creative Destruction Index (CDI) for each 2 digit sector of Industry in country j over a defined period t-1 to t. We express the index as in the following,

$$CDI_{ijt} = \sum_{k=1}^{k}\left[\frac{x_{kijt}}{X_{ijt}}\left(\frac{|x_{kijt} - x_{kijt-1}|}{|x_{kijt} + x_{kijt-1}|/2}\right)\right]$$

(20)

We construct the CDI in sector i of country j in period t from the export level of products, k, at the 7 digit level of industry. For each product we calculate the absolute change in the level of exports over the period t-1 to t and divide it by the average size of the product exports over the defined time interval. This term is bounded between 0 and 2. To get the size weighted average of products turbulence classified within 2 digit sectors of industry we aggregate over products up to the sector level. Each products contribution is weighted by the share of its exports in ijt to the overall sectors exports, X, in ijt. Expansion, contractions, entry and exit of product categories, for EU export, generates turbulence and moves the index closer to two. This likely to reflect firm turnover and the introduction of products with better vertical attributes as outlined in our theoretical section.

In table 5 we examine the year to year evolution of our CDI index by Country, weighting by the size of sectors within industry. To allow us see whether the smaller sectors experience was different we also report the index given each sector an equal weight. In Hungary the average product exported to the EU generated turbulence in the order of 22 per cent of its export size over the period 1989-90. This turbulence increased over time particularly after 1993 to the order of 82 per cent of product export size over the period1994-95. Giving an equal weighting to the size weighted product experience of each sector we observe that the products in the smaller sectors generated more turbulence. These patterns are also transparent in the other three countries.

In table 6, the present of product for EU export Creative Destruction, averaged over the four countries, is evident in all sectors. With the exception of Basic Metal and Fuel Production, the index is greater in sectors that were traditionally small in output and in their share of EU exports under the planning system. In all sectors the size-weighted turbulence of products is greater in the later period, 1992 to 1995. By 1995 sectors such as Leather and Leather Products, Wood products, Electrical and Optical Equipment and Transport Equipment, traditionally small sectors, had on average product turbulence greater than a 100 per cent of the export size in the previous year. In the last column of table 6 we document a concentration index of product sizes within sectors, averaged across the four countries. We report an augmented Herfdinahl index which is normalised for the number of products in the sector by taking the value of the Herfdinahl index assuming each product has an equal share of exports away for the value of the standard index. The closer the index is to one the further away we are from having a distribution of equal export share across products in the sector of industry. In general we find that bigger sectors do not have higher degree of concentration of products in export structure when compared to smaller sectors with the exception of Fuels Production. In addition there is not much change in the degree of concentration. If anything product share of sector exports in many cases is becoming slightly more fragmented.

Our analysis suggests that the factors behind the evolution of the CDI coefficient seem to be common across countries and sector specific. Aturupane, Djankov and Hoekman (1997) and McDowell and Thom (1998) document a large increase in Intra-Industry Trade between the EU and Central East European countries over this period. Ninety per cent of this is vertical in nature. They also find, consistent with our analysis, that 85 per cent of the variation in Vertical Intra Industry Trade is not country specific but industry specific. They report that higher levels of Intra-Industry Trade are observed in sectors engaged in vertical product differentiation and foreign direct investment. We now turn to the analysis of the initial EU Foreign Direct Investment flows in 1990 by sector of industry and by country. Investment is the key determinant of the reduction in real time between Creative Destruction intervals in our theoretical model. We intend to model the observe patterns in our CDI index with initial EU Foreign Direct Investment flows by sector of Industry. Having the instrumented values of our CDI index we intend to estimate the portion of sector growth in each country that can be explained by vertical innovations in product categories exporting to the EU over the period 1989-95.

Bocconi Foreign Direct Investment Data Base: The data was collected as part of a research project commissioned by DG III of the European Commission (Ref: SUB/96/83328/U.B.) The data base was collected from two general sources. First, published lists of foreign investors collected by national investment promotion agencies and international organisations. Agencies were interviewed in March and April 1997. Secondly, from Journals, Specialised Magazines and Newspapers. The data bank contains information on 2385 investment operations across twelve host countries including, Bulgaria, Hungary, Poland and Romania, by NACE code. The amount of initial investments in Millions of ECUs were aggregated to the higher level of 13 NACE manufacturing branches (DA, DB,...,DM) by summing up over FDI the operations. To be counted as a FDI the investment should insure a lasting interest and control in the management of the enterprise object of the investment. The investment can be an Acquisition, a Greenfield Investment or a Joint Venture. The reliability of the data, cumulated initial values of investments, compares favourable to official FDI flows measured by EUROSTAT, European Union Direct Investment Yearbook 1996, on a home country basis for the period 1992-1994.

In table 7 we summarise the data on the amount of initial FDI investments in 1990 (Millions of ECUs) aggregated up to the level of our 13 NACE manufacturing branches of Industry. Hungary and Poland got the larger share of the Investment flows. Macro-Stability was a key factor in attracting the flows (see EBRD, *Transition Report*, various years). The investment were also sector specific with some traditionally small sectors attracting large investments. The distribution across the sectors was similar in each country but the magnitude was higher in each sector in the Visegrad countries. Many of the FDI investments were joint ventures and the values of FDI could suggest that much larger investment activities were present. In the next section we undertake an econometric analysis of the link between initial EU FDI flows, the Creative Destruction in product categories for EU export overtime and sector output dynamics.

Section IV: The Econometric Analysis

In this section we estimate the impact of the product for EU export Creative Destruction Index on sector output changes using panel data modelling techniques. The CDI variable is instrumented using, initial EU Foreign Direct Investment flows, initial sector size, sector, country and year dummies and interactions terms. We use the predicted values to model growth in sector i, country j during the interval t-1 to period t. We wish to decompose sector growth into that determined by the observable EU trade developments (induced by innovations in products using foreign capital), unobservable but deterministic sector developments (market developments in non-EU products) and a random element. The growth model may be written as follows,

$$Growth_{ijt} = \alpha + \beta_1 \hat{CDI}_{ij} + \beta_2 \hat{CDI}_{ij} * ISIZE_{ij} + \beta_3 YEAR_t + v_{ij} + \varepsilon_{ijt}$$

(21)

To address the question whether the instrumented values of CDI had a heterogeneous impact by size of sector we interact it with ISIZE. Unobserved determinants of growth in sector ij are controlled for with the inclusion of a unit specific fixed effect, vij. Unobserved heterogeneity in sector ij is controlled for by the inclusion of a unit specific residual, vij, which are comprised of a collection of factors not in the regression that are ij specific and constant over time. Not only do we control for the collection of factors not related to the EU trade that are ij specific and constant but we also control for ij time varying effects. For example, we have no data on the product turbulence within sectors generated from the negative impact of the decline and recovery of the former CMEA market. We also do not control for disorganisation and other supply side problems that may constrain such products performance. The intercept and trend in the regression allow us to estimate the baseline intercept shift and evolution overtime of the unobservable deterministic factors. The recovered sector ij fixed and ij time varying effects will be taken away for the overall intercept shift and time trend to estimate the unobserved deterministic sector ij effect.

The results of our instrumented regression on sector output growth are presented in the table 8. The instrumented CDI has a significant positive impact on growth but its estimated impact depends on sector size. Even though smaller sectors exhibit more turbulence in product categories the estimated impact on growth per unit of change is less compared to large sectors.

In table 9 the growth rate in (21) by sector ij is decomposed into the portion of growth estimated to have been induced by innovations in products for EU export and deterministic unobservable factors related to the collapse of the CMEA market. We sum over sectors, weighting by sector size, in each year to get the contribution of EU and Non-EU products performance to the aggregate growth rate of manufacturing output. The net change predicted shows us the estimated impact of these compositional changes within sectors on aggregate industrial growth. Excess reallocation is the sum of the absolute, size weighted, growth rates of EU and non-EU products by sector over and above that necessary to generate the observed net growth rate predicted for manufacturing output. The greater the simultaneous expansion of EU and contraction of non-EU products within sectors the bigger the index. We also report the predicted net change in the manufacturing year to year growth rate and the reallocation of output within sectors, to producing EU rather than previously CMEA oriented products, given equal weights to all sectors. This will illustrate whether the smaller sectors are predicted to have had a different experience.

Comparing the within sector analysis in table 9 to the between sector analysis in table 2 we see that most of the observed changes in the aggregate output curve are induced by changes within sectors rather than between sectors. The U-Shape in industrial output results from the net impact of offsetting developments within sectors. Products for EU export induced sector growth in each year but the effect is particularly strong from 1993 onwards. Products previously sold into the CMEA market collapsed in the first few years of transition and only recovered in Hungary and Poland after 1994. In table 9 we see that that the experience was heterogeneous across sectors. In particular, by given equal weights to the smaller sectors we observe two points. First, the U shape in the net change predicted for manufacturing output due to the within sector experience is flatter. In the early periods the CMEA shock did not dominate the benefits of the EU trade shock as much as in the larger sectors. In the latter periods the dominance of the EU trade shock were not as great as in the larger sectors. Secondly, the reallocation of output within sectors to EU oriented products away form previously CMEA oriented products was not as great in smaller sectors. The positive and negative shocks on the traditionally smaller sectors were smaller in magnitude. Even though the smaller sectors did not perform as well on the basis of EU exports they still increased their share of industrial output over-time. This was because they suffered much less from the power of the CMEA shock and its slow recovery.

In table 10 we report the sector analysis averaged over the four countries. The countries had a similar sector specific experience. The estimated EU trade shock and the collapse of the CMEA shock on each sector are reported as well as the actual output growth experience of the sector in question. We see clearly the points inferred from table 9 when considering the experience of small versus large sectors. The U-shaped in sector output is flatter in small sectors. Both the trade and CMEA shocks are smaller in magnitude in the small sectors. In addition the CMEA shock is relatively weaker compared to the EU trade shock with the smaller sectors allowing them to have a bigger share in industrial output by the end of the six years.

Our econometric work allows us to estimate the of the evolution of non-EU industrial production. In fig. 3 we compare the evolution of non-EU oriented industrial output in CIS to our four CEE countries. We observe a relatively steep decline in non-EU industrial output in the first few years of transition in CEECs. One can argue that the CEECs started restructuring earlier as we observe a convergence between cumulative output indices of the two groups of countries in the later years of transition. The graph illustrates that the U-shape in CEE industrial output resulted mainly from the existence of EU oriented production before 1989 and its rapid expansion since 1989 fuelled by the increased access to the EU market and EU investment.

Conclusions

In summary, we decomposed changes in industrial output during the period 1989-1985 into that induced by the increase in trade and capital flows to and from the European Union, respectively, and that induced by the evolution of what was previously called the CMEA market. We have shown that the experience of EU oriented output within sectors has been fundamentally different to that estimated for non-EU oriented products. Greater assess to the EU market and investors has induced growth with increasing convexity over-time in all sectors of each country but particularly in traditionally larger sectors. This growth was in product categories that already exported to the EU before 1989. The dynamics of EU oriented output, ex-post trade and market liberalisation, is modelled theoretically and empirically as an investment induced Schumpeterian wave of product innovations. Our results suggest that transition issues such as reallocation, restructuring and disorganisation were not of first order importance when considering this component of industrial output. This might be expected given that these products already exported to the EU before 1989, minimising the need to restructure the products attributes, and hence attracted the use of foreign capital, inputs and expertise of European companies to take full advantage of increased market access.

One interesting point is that the evolution of non-EU industrial output follows the same patterns as CIS countries. This paper indicates that the U-shape we observe in the evolution of industrial output in CEE countries, is mainly driven by the evolution of EU oriented production that existed before 1989. The shape of the non-EU component of industrial output varies from sector to sector. In some case we observe a U-Shape in others an inverse J-Curve. It is unlikely, as in the case of EU oriented output, that this component of industrial output is an efficient outcome induced solely by trade and market liberalisation.

Most of the theoretical literature thus far explains the collapse of industrial output as an inefficient outcome driven by supply side rigidities that constrain the transition process.

As outlined in Blanchard (1997), there are two key elements of the transition process, reallocation and restructuring. Reallocation refers to the movement of production away from state to private ownership. Restructuring refers to changing the level and technical composition of labour and capital in search of cost and productive efficiency in production. A distinction can be made between initial restructuring and deep or strategic restructuring. Initial restructuring refers to reducing over-manning levels in response to the hardening of budget constraints. Deep or strategic restructuring requires that fundamental actions be taken aimed at improving the long run performance of the firm. This type of restructuring can include various actions such as an increase in investments into new technology, vertical innovations in products and replacement of obsolete capital. In the absence of distortions, the level of output that results from the transition process should be a first best outcome that reflects efficient eradication of distortions that existed in the microeconomic environment of the planning system

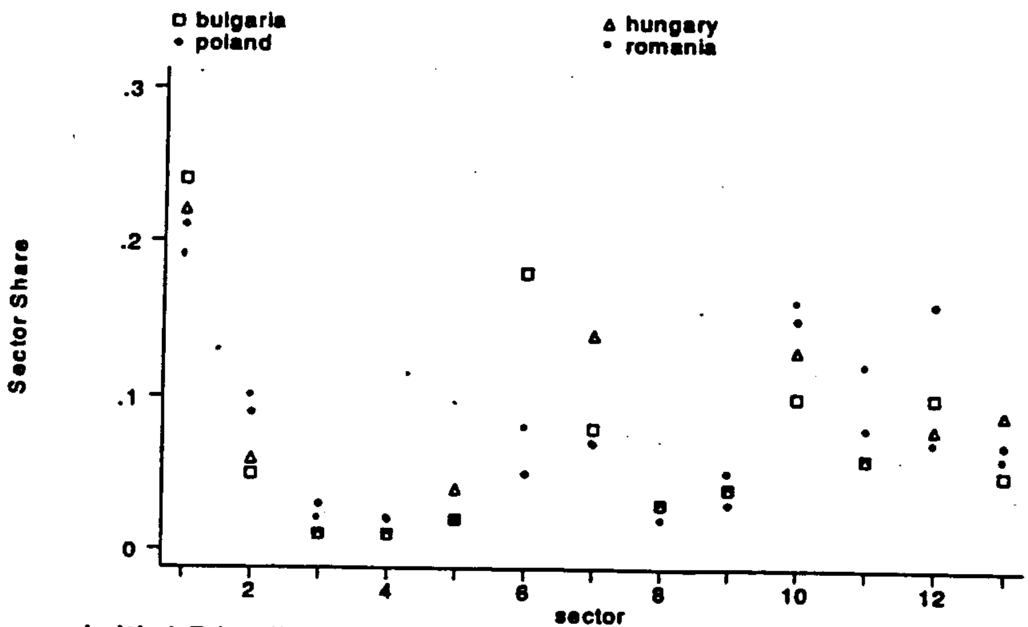
To date the theoretical explanations put forward for the initial collapse in Industrial Output are based on the presence of supply side rigidities that constrain the transition process. Atkeson and Kohoe (1995) blame the presence of labour market frictions that result from the sector shifts within output and a lack of investment into the reorganisation of human capital. Wei Li (1994) explain the decline by noting that while central planners behaved like a single vertically integrated monopoly liberalisation lead to multiple monopolies charging monopoly prices to downstream monopolies constraining the transition process. Blanchard (1997) explains the decline as a second best outcome driven by the presence of downward real wage rigidities during transition. Finally, Blanchard and Kremer (1997) and Roland and

Verdier (1997) provide us with the microeconomic foundations for understanding why *disorganisation* in the links of production, lead to a short-term output contraction after market liberalisation and a recovery thereafter. Blanchard and Kremer (1997) model "disorganization" as disruption in the production links that had been established during central planning. Under central planning bilateral relationships existed between suppliers and buyers. Liberalisation of the market gave suppliers an outside option. An assumed presence of information asymmetries on the outside option of suppliers created disruption in their model. Firms cannot find out the price that alternative buyers are willing to pay to the supplier. As a result they may not pay a price that prevents suppliers switching to new buyers thus creating disruption in the production links and a fall in output during transition.

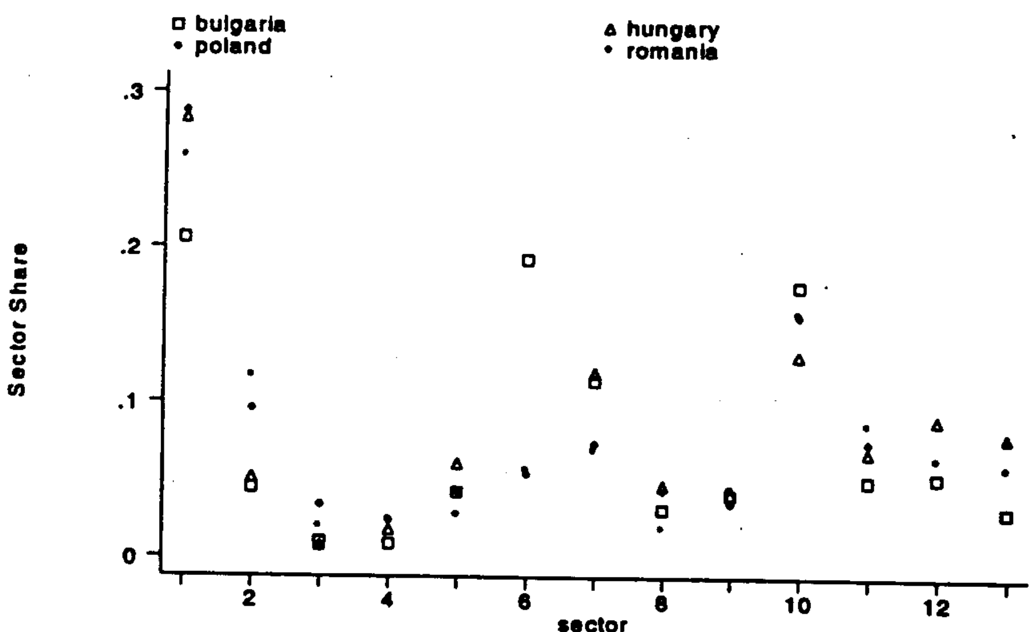
Roland and Verdier (1997) also model "disorganization" in production during the transition process. They prefer not to rely on inefficiencies in the bargaining process between initial buyers and suppliers but focus on the role of search frictions created from the desire to find new partners in the chain of production. The outside option is endogenous in a model of two sided search and matching. In the long-term more efficient opportunities are available to all. Suppliers and buyers will maintain existing links until one finds a better match. Search by many bad buyers creates congestion and reduces the quality of matches in the short-run. The fall in output is not generated by the breakdown of supplier and buyer relationships that existed in the planning system but due the assumption that investments will not be undertaken in production until a long-term partner is found. No investments take place during search. Aggregate output in the years after liberalisation contracts due to a fall in investment demand and the failure to replace obsolete capital. Our model is not so different to Roland and Verdier (1997) expect that investment patterns are demand driven and are not shaped by supply side considerations.

The above theories are likely to explain the experience of products that traditionally sold into previously CMEA market. The firms producing products traditionally exporting to the CMEA had three choices; Exit, re-orientated their production to western markets or improve the technical efficiency of production to make products of the quality required to compete on previously CMEA markets. The later was driven by the decline in market demand and the availability of foreign imports. Rodik (1994) rules the second choice out. For traditional firms that did not exit problems of reallocation, restructuring and disorganisation may have become first order in importance. Yet, this may have being induced by the need to adjust to the changing taste patterns, competitive pressure from imports and changes in the size of the markets. The interaction of the negative demand shock and supply side rigidities may well be an important determinant of the slow recovery that is estimated by us in our empirical work. These issues can only be disentangled using firm level data on a sample of firms that existed under central planning *and* produced for the CMEA market.

Figure 1.

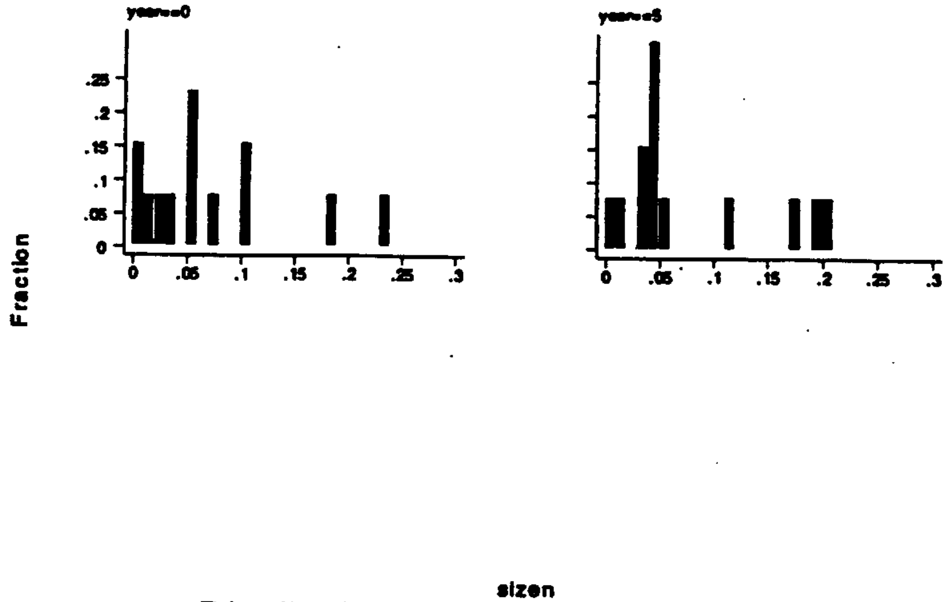


Initial Distribution of Sector Size Across Countries

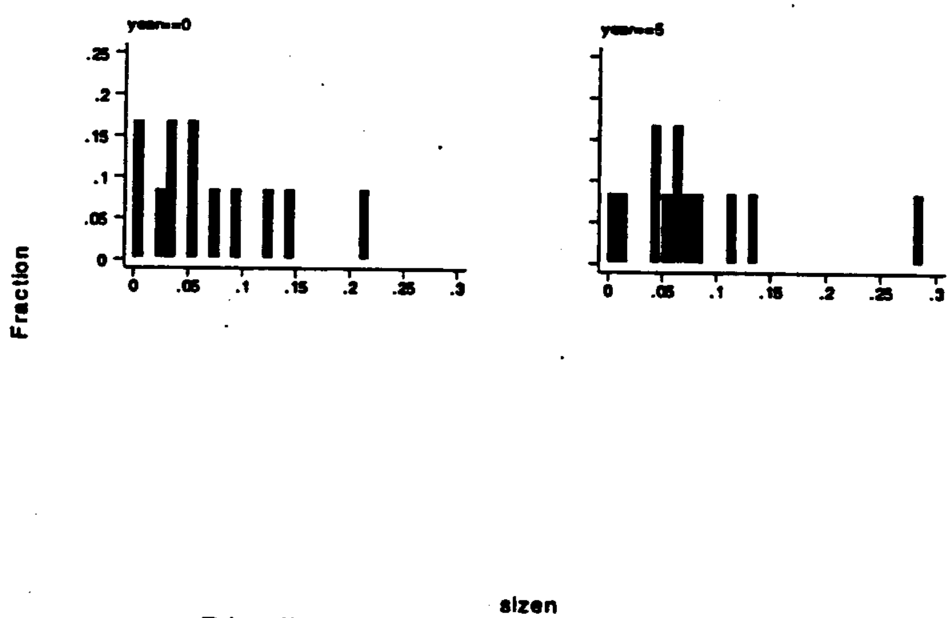


Final Distribution of Sector Size Across Countries

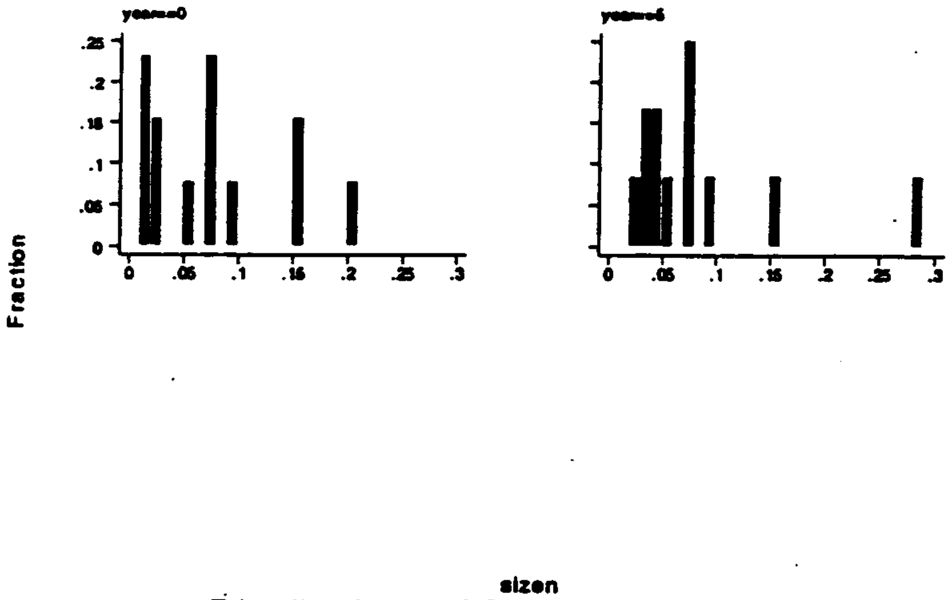
Figure 2



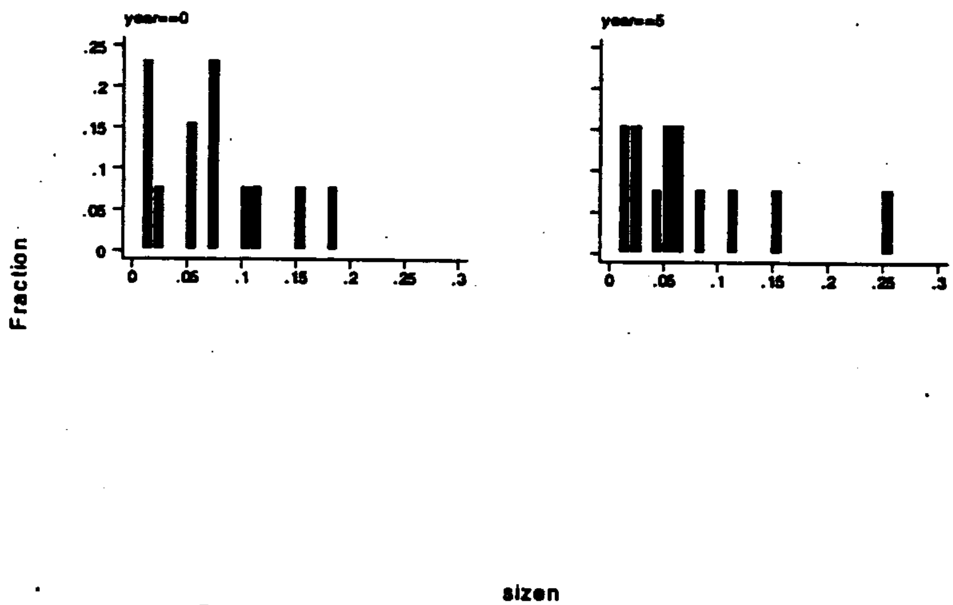
Distributions of Sector Size, Bulgaria



Distributions of Sector Size, Hungary



Distributions of Sector Size, Poland



Distributions of Sector Size, Romania

Figure 3.

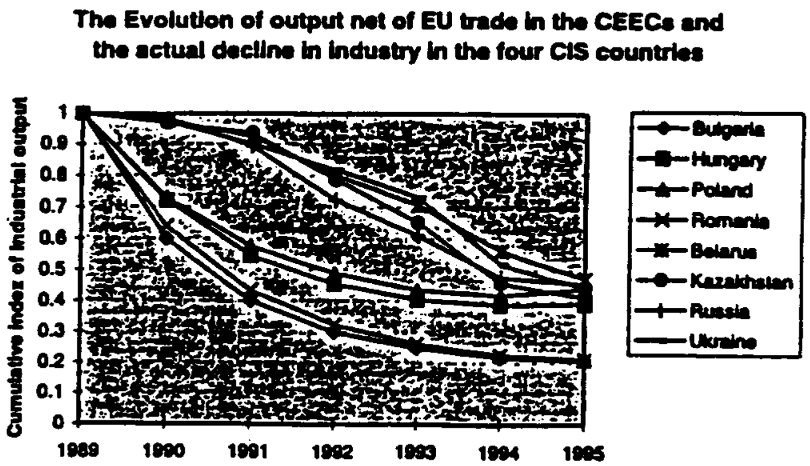

The Evolution of output net of EU trade in the CEECs and
the actual decline in industry in the four CIS countries
Cumulative index of industrial output
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
1989
1990
1991
1992
1993
1994
1995
Bulgaria
Hungary
Poland
Romania
Belarus
Kazakhstan
Russia
Ukraine

Table 1: Total Manufacturing D (NACE)

1	Food, Beverage and Tobacco	DA	(15,15.1-8,15.9,16)
2	Textiles and Textile Products	DB	(17,18)
3	Leather and Leather Products	DC	(19.1-2,19.3)
4	Wood Products	DD	(20)
5	Paper, Printing and Publishing	DE	(21,22)
6	Fuels Production	DF	(23)
7	Chemicals Products, Fibers	DG	(24, 24.1/2/7, 24.3-6)
8	Rubber and Plastic Products	DH	(25,25.1,25.2)
9	Mineral Materials and Products	DI	(26,26.1-4)
10	Basic Metals and Fab products	DJ	(27,28)
11	Machinery, excluding electrical	DK	(29)
12	Electrical and Optical Equipment	DL	(30,31,32,33)
13	Transport Equipment	DM	(34,35)
14	Other Manufactured Products	DN	(36)

Table 2

Aggregate Growth Rate of Manufacturing and Sector Heterogeneity, In Bulgaria

Year	89-90	90-91	91-92	92-93	93-94	94-95
Rising Sectors	.001	.003	0	.012	.159	.076
Declining Sectors	.204	.272	.176	.144	.015	.006
Net Change	-.20	-.27	-.18	-.13	.14	.07
Excess Reallocation	.002	.01	0	.024	.03	.013
Excess Reallocation (Equal Weights)	.003	.006	0	.041	.044	.043

Aggregate Growth Rate of Manufacturing and Sector Heterogeneity, In Hungary

Year	89-90	90-91	91-92	92-93	93-94	94-95
Rising Sectors	.0003	.0001	0	.056	.104	.080
Declining Sectors	.117	.211	.202	.015	0	.004
Net Change	-.12	-.211	-.202	.041	.104	.08
Excess Reallocation	.0005	.0003	0	.031	0	.009
Excess Reallocation (Equal Weights)	.004	.0013	0	.012	0	.023

Aggregate Growth Rate of Manufacturing and Sector Heterogeneity, In Poland

Year	89-90	90-91	91-92	92-93	93-94	94-95
Rising Sectors	.0005	.107	.091	.117	.119	.094
Declining Sectors	.346	.107	.075	0	0	.002
Net Change	-.346	.0004	.016	.117	.117	.092
Excess Reallocation	.001	.214	.150	0	0	.004
Excess Reallocation (Equal Weights)	.004	.075	.107	0	0	.008

Aggregate Growth Rate of Manufacturing and Sector Heterogeneity, In Romania

Year	89-90	90-91	91-92	92-93	93-94	94-95
Rising Sectors	0	0	.002	.010	.068	.112
Declining Sectors	.254	.178	.138	.054	.026	0
Net Change	-.254	-.178	-.136	-.044	.042	.112
Excess Reallocation	0	0	.004	.019	.052	0
Excess Reallocation (Equal Weights)	0	0	.011	.029	.098	0

Table 3

The Dispersion of the Absolute Change in Sector Size 1989-95, Across Countries

Sector	1990-1995 Dispersion
1	.3066079
2	.5562773
3	1.007565
4	.695196
5	.4055287
6	.7550341
7	1.054785
8	.7053145
9	.7091658
10	1.693644
11	.9126049
12	1.067526
13	.7531161

The Dispersion of the Absolute Change in Sector Size 1989-95, Within Countries

Country	1990-1995 Dispersion
Bulgaria	1.591638
Hungary	2.341486
Poland	2.72175
Romania	2.446637

Table 4

Structure of Exports to Former CMEA Markets and The EU 1990-1996

Country	Export Growth* 1990-93	Export Growth* 1993-96	Share of Exports** EU (90)	EU (93)	EU (96)	CMEA (90)	CMEA (93)	CMEA (96)
Bulgaria	13.4	22.3	40	46	51	30	16	19
Hungary	7.1	14.3	50	56	71	34	14	21
Poland	5.9	16.2	51	70	69	33	11	21
Romania	6.2	16.7	36	40	54	35	11	10

Source: Heckman and Djankov (1997)
*Annual Average Percentage Growth
**Percent

Table 5

The Year to Year Growth in (Sector Size Weighted and Equal Weights (E)) EU Export Creative *Destruction* Overtime by Country

Interval	89-90	90-91	91-92	92-93	93-94	94-95
Bulgaria	.22	.50	.67	.61	.77	0.93
(E)	.31	.64	.83	.76	.92	1.00
Hungary	.22	.41	.51	.58	.63	.82
(E)	.26	.47	.63	.67	.75	.96
Poland	.35	.48	.53	.53	.63	.85
(E)	.34	.54	.62	.67	.77	.99
Romania	.62	.65	.65	.77	.73	.84
(E)	.56	.70	.75	.84	.78	.81

Table 6

Products for EU Export *Creative Destruction* by Sector (Averaged Over Countries).

(a) Creative Destruction Index, Average over 1989-92

(b) Creative Destruction Index, Average over 1992-95

(c) Initial Share of EU Exports in 1988

(d) Initial Size of Sector in 1989

(e) Concentration of Product Contribution by Sector 1995 (1989)

	(a)	(b)	(c)	(d)	(e)
1	.40	.47	.16	.22	.36(.40)
2	.45	.64	.08	.08	.36(.31)
3	.67	1.3	.02	.02	.59(.50)
4	.61	.88	.04	.02	.27(.28)
5	.59	.80	.05	.03	.62(.71)
6	.58	.87	.19	.10	.59(.78)
7	.51	.56	.14	.09	.41(.37)
8	.43	.63	.02	.03	.54(.50)
9	.57	.83	.03	.04	.27(.32)
10	.46	.81	.18	.14	.29(.32)
11	.43	.69	.06	.08	.23(.29)
12	.45	.85	.03	.10	.30(.39)
13	1.0	1.4	.03	.07	.43(.31)

Table 7

EU FDI by Sector, Across Countries

Sector	Mean Value(ECUs)	Coefficient of Variation	Sector Size 1989
1	407	.872	.22
2	46	.958	.08
3	1.5	1.769	.02
4	3.75	.620	.02
5	47.25	.965	.03
6	3.5	1.769	.10
7	127.25	.729	.09
8	42.75	1.312	.03
9	160.25	1.645	.04
10	89.75	1.008	.14
11	61.5	.673	.08
12	545	1.298	.10
13	124.75	.996	.07

EU FDI within Country, Across Sectors

Country	Mean Value(ECUs)	Co.Variation
Bulgaria	8.153846	2.42
Hungary	250.8462	1.82
Poland	227	1.09
Romania	24.84615	1.14

Table 8 : Regression Results .

Growth*	Fixed Effects
R^2 Overall	0.24
Constant	-.35 (7.8)*
CDI	-.06 (0.5)
CDI x Isize	2.3 (2.1)*
Year	.06 (4.7)*
Observations	306
Heterosced.	$\chi2(52)$= 15.3
AR1	$\chi2(1)$ = 7.62
AR4	$\chi2(4)$ = 1.41

*a. T-statistics in parenthesis..

b. Significant at the 5% level.

c. Use predicted Values of CDI instrumented with initial values of FDI, initial sector size, country, sector and year dummies and their interactions. Interactions of Year x Country x Sector are included in the Fixed Effect Model. Only Fuels Production in Bulgaria and Romania turn out to have a different time varying ij effect compared to that estimated in the pooled sample.

Table 9

Aggregate Growth Rate of Manufacturing and Within Sector Heterogeneity, In Bulgaria

Year	89-90	90-91	91-92	92-93	93-94	94-95
EU Products	.08	.11	.14	.15	.20	.24
Non-EU Products	-.40	-.33	-.26	-.17	-.12	-.05
Net-Change Pred.	-.32	-.22	-.12	-.02	.08	.19
Excess Reallocation	.16	.22	.28	.30	.24	.10
Net-Change Pred. (Equal Weights)	-.28	-.19	-.11	-.01	.06	.14
Excess Reallocation (Equal Weights)	.12	.15	.19	.24	.17	.08

Aggregate Growth Rate of Manufacturing and Within Sector Heterogeneity, In Hungary

Year	89-90	90-91	91-92	92-93	93-94	94-95
EU Products	.07	.09	.11	.13	.16	.18
Non-EU Products	-.28	-.24	-.17	-.11	-.04	.01
Net-Change Pred.	-.21	-.15	-.06	.02	.12	.19
Excess Reallocation	.14	.18	.22	.22	.08	0
Net-Change Pred. (Equal Weights)	-.20	-.12	-.05	.02	.01	.17
Excess Reallocation (Equal Weights)	.10	.14	.17	.18	.01	.04

Aggregate Growth Rate of Manufacturing and Within Sector Heterogeneity, In Poland

Year	89-90	90-91	91-92	92-93	93-94	94-95
EU Products	.09	.11	.13	.15	.17	.17
Non-EU Products	-.27	-.21	-.15	-.11	-.04	.05
Net-Change Pred.	-.18	-.10	-.02	.04	.13	.22
Excess Reallocation	.18	.22	.26	.22	.08	0
Net-Change Pred. (Equal Weights)	-.15	-.07	.01	.08	.16	.24
Excess Reallocation (Equal Weights)	.12	.16	.21	.12	.05	.01

Aggregate Growth Rate of Manufacturing and Within Sector Heterogeneity, In Romania

Year	89-90	90-91	91-92	92-93	93-94	94-95
EU Products	.16	.17	.19	.20	.21	.22
Non-EU Products	-.36	-.32	-.26	-.19	-.13	-.07
Net-Change Pred.	-.20	-.15	-.06	.02	.12	.19
Excess Reallocation	.32	.34	.39	.37	.22	.10
Net-Change Pred. (Equal Weights)	-.23	-.16	-.08	.01	.06	.13
Excess Reallocation (Equal Weights)	.22	.23	.25	.26	.17	.08

Table 10

(a) EU Products and (b) Non-EU Products for Export contributions to annual growth by Sector (Averaged Over Countries), (c) Actual annual growth by Sector (Averaged Over Countries), (g) Initial Size of Sector in 1989.

	89-90	90-91	91-92	92-93	93-94	94-95	(g)
1 a	.16	.18	.20	.22	.24	.26	.22
b	-.37	-.31	-.25	-.19	-.13	-.07	
c	-.12	-.11	-.05	-.06	.06	.05	
2 a	.05	.06	.08	.10	.11	.13	.08
b	-.27	-.21	-.15	-.10	-.03	.03	
c	-.12	-.19	-.13	-.02	.08	-.01	
3 a	.03	.03	.03	.04	.04	.05	.02
b	-.22	-.16	-.10	-.04	.02	.08	
c	-.24	-.10	-.15	-.06	.01	-.01	
4 a	.02	.02	.02	.03	.03	.04	.02
b	-.16	-.10	-.04	.02	.08	.14	
c	-.11	-.13	-.02	-.04	.15	-.01	
5 a	.02	.03	.03	.04	.05	.05	.03
b	-.13	-.07	-.01	.05	.11	.17	
c	-.18	-.14	.09	.13	.14	.09	
6 a	.15	.18	.17	.21	.23	.25	.10
b	-.50	-.40	-.29	-.18	-.07	.03	
c	-.38	-.44	-.09	.08	.20	.12	
7 a	.05	.07	.10	.12	.14	.16	.09
b	-.30	-.24	-.18	-.12	-.06	.00	
c	-.24	-.15	-.15	-.04	.07	.05	
8 a	.02	.02	.03	.04	.04	.05	.03
b	-.20	-.14	-.08	-.02	.04	.10	
c	-.25	-.16	-.04	.03	.07	.08	
9 a	.04	.05	.06	.07	.08	.09	.04
b	-.23	-.17	-.11	-.05	.01	.07	
c	-.16	-.24	-.13	.03	.05	.07	
10a	.13	.16	.18	.21	.23	.26	.14
b	-.37	-.31	-.25	-.19	-.13	-.07	
c	-.31	-.26	-.11	.03	.16	.09	
11a	.06	.08	.09	.11	.13	.14	.08
b	-.32	-.26	-.20	-.14	-.08	-.02	
c	-.25	-.24	-.19	-.10	-.001	.19	
12a	.08	.11	.13	.16	.19	.21	.10
b	-.36	-.30	-.24	-.18	-.12	-.06	
c	-.37	-.16	-.38	.05	.12	.10	
13a	.15	.17	.18	.20	.22	.23	.07
b	-.37	-.31	-.25	-.17	-.13	-.07	
c	-.31	-.30	-.23	.06	.02	.19	

APPENDIX I

Stage II: The following accounting equation (1), arbitrage equation (2) and the asset equation (3) constitute the core of the model. At any period t an innovator who has a monopoly on producing good x_t chooses its value by maximising the following profit function taking (5) as given:

$$\pi_t = \max_x [p_t(x_t)x_t - r_t x_t] \tag{A1}$$

This profit maximisation yields the following value for x:

$$x_t = \left(\frac{S(1-\alpha)\gamma^t}{r_t} \right)^{1/\alpha} = x_t(\overset{+}{S}, \overset{+}{\gamma^t}, \overset{-}{r_t}) \tag{A2}$$

Using accounting equation and (A2) gives (taken I_t as given):

$$r = \frac{S(1-\alpha)\gamma^t}{(I - n)^\alpha}$$

$$= g(\overset{+}{S}, \overset{+}{\gamma^t}, \overset{-}{I}, \overset{+}{n}) \tag{A3}$$

Applying the envelope theorem (using FOC from profit maximisation for x) and using the arbitrage equation, (2) gives a second equation in r:

$$r = \left(\frac{\lambda\alpha}{(1-\alpha)(R+\lambda n)} \right)^\alpha S(1-\alpha)\gamma^{t+1}$$

$$= f(\overset{+}{S}, \overset{+}{\gamma^t}, \overset{-}{n}, \overset{+}{\lambda}, \overset{-}{R}) \tag{A4}$$

Solving (A3) and (A4) gives the following optimal levels of n, r and p:

$$n^{\circ} = \frac{\gamma^{1/\alpha}\lambda\alpha I - R + R\alpha}{(1-\alpha+\alpha\gamma^{1/\alpha})\lambda} \tag{A6}$$

$$r^{\circ} = S(1-\alpha)\gamma^{t+1}\left(\frac{\lambda\alpha}{1-\alpha}\right)^{\alpha}\left[R+\lambda n^{\circ}\right]^{-\alpha} \tag{A7}$$

$$P_t = \frac{S\gamma^t}{x_t^{\alpha}} = \frac{S\gamma^t}{\left[\left(\frac{S(1-\alpha)\gamma^t}{r_t}\right)^{1/\alpha}\right]^{\alpha}} = \frac{S\gamma^t r_t}{S\gamma^t(1-\alpha)} = \frac{r_t}{(1-\alpha)} \tag{A8}$$

<u>Stage II</u>: The level of investment is endogenous and it is assumed that the optimal level of r resulting from any level of current investment I is perfectly known. The level of investment is determined from the maximisation problem in (10): The value of optimal investment in this case is given by

$$I_t^0 = -\frac{R}{\lambda} + (1-\alpha+\gamma^{\frac{1}{\alpha}})\left(\frac{S}{A}\right)^{\frac{1}{\alpha}}(1-\alpha)^{\frac{1}{\alpha}-1}\gamma^{\frac{t}{\alpha}} \tag{A9}$$

<u>Output and Price Dynamics in the steady state</u>

We assume the following functional form for the production function in our model:

$$Y_t = x_t^{\alpha} \tag{A10}$$

The following expression gives the rate of growth of output between the two innovations:

$$\frac{Y_{t+1}}{Y_t} = \frac{x_{t+1}^{\alpha}}{x_t^{\alpha}} = \frac{S(1-\alpha)\gamma^{t+1}}{r^{*}_{t+1}} \frac{r_t^{*}}{S(1-\alpha)\gamma^{t}} =$$

$$= \gamma \frac{A}{A} = \gamma \tag{A11}$$

$$P_t = \frac{A}{(1-\alpha)} \tag{A12}$$

<u>Time dimension of the model</u>

By definition of the Poisson process, the following holds true: Pr{An innovation occurs during a time period Δt if n researchers are currently active}=Δt λ n_t. (Pr) Denote this probability P_0. Then (Pr) implies that

$$\Delta t \lambda n_0 = (t_1 - t_0)\lambda n_0 = P_0 \tag{A13}$$

For an innovation definitely to occur between time points t0 and t1, P_0 must equal 1. We thus obtain the recursive formula for the length of the time period between the two innovations:

$$t_2 - t_1 = \frac{1}{\lambda n_1}(\underset{(-)}{S}) \tag{A14}$$

The amount of researchers in every time period is growing monotonously with market size, S. (A14) implies that the innovations arrive faster with the increase in S.

References

Aghion, P. and Howitt, P. (1998). *Endogenous Growth Theory*, The MIT Press, Cambridge, Massachusetts

Aghion, P., Howitt, P. (1992)"A Model of Growth through Creative Destruction", *Econometrica* 60: pp323-51.

Atheson, A. and P. Kehoe (1995) "Optimal Social Insurance, Incentives and Transition", mimeograph, Federal Reserve Bank of Minneapolis.

Aturupane, C., Djankov, S. and Hoekman, B. (1997) "Determinants of Intra-Industry Trade between East and West Europe. CEPR Discussion Paper No. 1721

Blanchard O. (1997). *The Economics of Post-Communist Transition*. Clarendon Press Oxford.

Blanchard. O. and Kremer (1997). "Disorganization", *Quarterly Journal of Economics*, Vol. 111, pp. 1091-1126.

Hoekman B., Djankov, S. (1997) "Determinants of the Export Structure of Countries in Central and Eastern Europe", The World Bank Economic Review, Vol. 11, No. 3, pp. 471-87

Kornai, J. (1993). "Transformational Recession. A general Phenomenon Examined Trough the Example of Hungarys Development", *Economie Appliquée* Vol. 46, No.2, pp. 181-227.

Rodrik, D. (1994). "Foreign trade in Eastern Europe's Transition: Early Results", pp.319-56 in Blanchard O., Froot K. and Sachs, J. (eds.) The Transition in Eastern Europe, vol.2 (Chicago, IL: NBER and University of Chicago Press.

Roland, G. And Verdier, T. (1997). "Transition and the Output Fall", *CEPR Discussion Paper* 1636, May.

Li, Wei (1994) "A Tale of Two Reforms", mimeograph Fuqua School of Business, Duke University.