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CENTRO STUDI LUCA D'AGLIANO
DEVELOPMENT STUDIES WORKING PAPERS

N. 203

November 2005

How Do Trade in Intermediates and Geographical Forces Interact in Determining the Localisation of Industries in Central Eastern European Countries?

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January 23, 2006

Abstract

Growing flows of FDI and increasing integration CEECs' firms in International Production Networks set by EU principals have brought to a rise in trade in parts and components. As a consequence, new patterns of localisation of industrial activities in CEECs have been observed. In this paper I focus on the four sectors in which most of the CEECs' trade in intermediates with old-EU members is concentrated. I estimate a reduced form of a general equilibrium model of trade and production which tries to explain cross-country variations of sectoral output on the basis of home market effect, import of intermediates, comparative advantages and market potential. Results allow me to draw some considerations about the driving forces behind the relocation of industrial activities experienced by CEECs in Furniture, Motor Vehicles, Office Machinery and Telecommunication Equipment industries over the second half of the 1990s.

Key words: Trade in Parts and Components, International Production Network, Market Potential, Industry Localisation

JEL classification: F10, F12, F14, F15

*This research has been partially carried out during the period spent at the NHH (Bergen) as part of the CEPR Research Training Network "Trade, Industrialization and Development". I wish to thank Jan Haaland, Alessandro Sembenelli, Lucia Tajoli, Giorgio Barba Navaretti, Massimiliano Bratti and people at workshops in Glasgow, Urbino and Milano for helpful comments and suggestions on earlier versions of this paper. Financial support from the European Commission and research facilities provided by SNF (Bergen) are gratefully acknowledged.

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1 Introduction

Central Eastern European Countries (CEECs) have undergone massive changes in their patterns of both trade and production specialisation over the 1990s. This transformation process, still not completed, has taken place mainly in response to the stimulations provided by the perspective of accessing the European Union. Increasing *trade integration* with EU as forced CEECs to adjust radically their production structures in order to be able to profit of the involvements in international markets. Substantial flows of inward FDI, EU's delocalisation of production activities, and outsourcing helped the most of transition countries to achieve this goal.

As a result, EU's and CEECs' trade patterns have now reached an almost perfect complementarity.

According to many observers, trade in parts and components seem to have played a major role in determining the trade patterns of the new-members. In fact, the increasing integration of CEECs firms in the International Production Networks set by EU principals have made middle products the fastest growing component of EU-CEECs trade. This has been especially clear since trade statistics based on SITC (Standard International Trade Classification) Rev.2 have become available. In fact, the direct distinction of parts and components in four and five digit product groups has allowed researchers to assess the importance of trade in intermediates at least for some industries, according to the varying degree of differentiation of middle products across commodity groups. In particular, the focus has been on the crucial *machinery* and *transport equipment* product groups, which are among those enjoying the best coverage[1]. On the basis of these data, Kaminski and Ng (2001) show that trade in intermediates represents the largest portion of exchanges between EU and CEECs.

One may expect that changes in trade patterns induced by the rise of trade in intermediates may cause a relocation of industrial activities. De Simone (2005) finds that, if the focus is on CEECs as a whole area, one can observe over the 1990s an astonishing increase in the relative importance of sectors in which most of the trade in intermediates between "new" and "old" EU-members is concentrated along with a significant redistribution of industrial activities. On a country by country basis, trends reveal strong differences among CEECs with some of them leading the process of acquisition of activities as opposite to other countries that seem to experience a despecialisation. These results obtained on the basis of descriptive statistics do not allow for a full indentification of a one-way link between trade in intermediates and the distribution of activities. The reason for this is twofold:

1. Flows of middle products from one location to the other could be generated by different relationships among firms. For example, they could rise because of the presence of subsidiaries of MNCs operating in that country as well as because of independent firms developing an outsourcing contract

[1] Yeats (1998) shows that Machinery and Transport Equipment group (SITC 7) includes approximately 50% of world trade in all manufactures.

with a foreign principal. Thus working at a country-industry level one cannot assess univocally if trade in parts and components is originated by the dispersion or agglomeration forces that fragmentation of production could generate, but can look at the influence that emerging trade patterns can have on the distribution of industrial activities.

2. Just like in the case of *specialisation*, *localisation* may be affected at the same time by many other factors such as comparative advantages (both in terms of endowments and technologies), market structure and market potential.

In particular, with respect to the latter element in point 2, it should be stressed that the fact that market potential plays a key-role in shaping the distribution of activities across locations is a very well established finding in New Economic Geography theorethical and empirical literature. The underlining idea is that firms will prefer to settle in locations that allow them to minimize trade costs related to the purchase and the sale of intermediate inputs (forward and backward linkages). Midelfart-Knarvik et al. (2000) shows that these kinds of linkages have been very effective in determining the localisation of industrial activities across EU-15 in the 1980-97 period[2]. For what concerns CEECs, their accession to the EU surely entails also huge modifications of different areas' market potential. Brülhart et al. (2004) find that alterations in market acces implied by EU-25 may induce significant relocation of economic activities with diversified effects across countries on the basis of geographic proximity or remoteness.

The case of increasing trade and production integration of EU and CEECs over the 1990s is certainly interesting for those who wish to investigate one of the possible ways in which trade in middle products, changing market potential and other possible causes interact in dermining the localisation of industrial activities.

This is precisely what I try to do in this paper. In Section 2 I define a framework where localisation of industries at the country level is the outcome of the action of several determinants: agglomeration and dispersion forces generated by trade in parts and components, market potential, comparative advantages and home market effect. I introduce an econometric implementation of the model in Section 3, and I discuss the case study and the data used in the estimation in Section 4. In Section 5 I present results obtained estimating the model on a panel with 9 CEECs and 4 sectors over the second half of the 1990s. Concluding remarks are in Section 6.

2 The model

A simple way to deal with the distribution of industrial activities across countries is to look at the shares of world production of a certain industry taking place

[2] A comprehensive survey of the evidence on the EU case can be found in Amiti (1998).

in single locations. This is what Overman et al. (2003) suggest by defining a straightforward *localisation index*,

$$l_i^j = \frac{D_i^j}{\sum_j D_i^j}, \tag{1}$$

where D_i^j denotes the production of industry i in country j and $\sum_j D_i^j$ indicates total world production in that sector.

Considering that there could be huge differences in size across countries and sectors, one may wish to normalize the localisation index. This can be done by dividing it by the share of a country j in total world production $S^j = \dfrac{\sum_i D_i^j}{\sum_j \sum_i D_i^j}$.

Thus a new comprehensive measure called *location quotient* can be defined as follows:

$$h_i^j = \frac{l_i^j}{S^j}. \tag{2}$$

The location quotient can be considered as an assessment of the *localisation* of industry i in j, relative to the localisation of industrial production as a whole in j. A value equal to 1 describes a situation in which the fraction of global output in sector i localised in contry j is perfectly equal to the world's average share. Thus, a value greater than 1 means that activity i is relatively more concentrated in country j. The opposite holds for values lower then 1.

Notice that by mean of the share of industry i in the total world production, $S_i = \dfrac{\sum_j D_i^j}{\sum_j \sum_i D_i^j}$, the location quotient can be expressed also as

$$h_i^j = \frac{D_i^j}{S^j S_i}. \tag{3}$$

This definition will be at the basis of both the theoretical and the empirical work of this paper. The idea is to provide it with a functional form coming from a framework in which cross-country variations of sectoral output are explained on the basis of both trade in intermediates and market potential along with comparative advantages and home market effect, controlling by relative sizes of sectors and countries. The model builds on Choudhri and Hakura (2001) as modified in De Simone (2004) and Midelfart-Knarvik et al. (2000), and can be considered an attempt to integrate New Trade Theory with New Economic Geography and traditional frameworks (Ricardo, Heckscher-Ohlin).

2.1 The demand side

Let I be the number of monopolistic-competitive industries in the J countries considered. It is possible to define the consumer demand for each variety produced in every single industry on the basis of a Dixit and Stiglitz (1977) utility function. Thus, assuming that the demand for final products and the demand for intermediates take the same form, country m demand for a variety produced in the sector i of a country j can be written as

$$d_i^{jm} = \frac{E_i^m \left(P_i^j B_i^{jm}\right)^{-\sigma}}{\sum_{k\epsilon J} n_i^k \left(P_i^k B_i^{km}\right)^{1-\sigma}} = \left(P_i^j B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}$$

where $i = 1, ...I$ indexes sectors.

$G_i^m = \left[\sum_{k\epsilon J} n_i^k \left(P_i^k B_i^{km}\right)^{1-\sigma}\right]^{\frac{1}{1-\sigma}}$ is the price index for industry i in country m, E_i^m is the total expenditure in country m on domestic and foreign varieties produced in the considered sector, $P_i^j B_i^{jm}$ is the price on country m's market of the variety produced in country j's industry (home price for a foreign variety)[3], n_i^j is the number of firms (each producing one variety) in the sector i and σ is the elasticity of substitution that is assumed identical across industries[4].

The aggregation over m yields the value of industry i total production in country j:

$$D_i^j = \sum\nolimits_m d_i^{jm} = n_i^j \left(P_i^j\right)^{-\sigma} \sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}, \tag{4}$$

and plugging (4) in (3), one can obtain

$$h_i^j = \frac{D_i^j}{S^j S_i} = \frac{n_i^j}{S^j S_i} \left(P_i^j\right)^{-\sigma} \sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}. \tag{5}$$

This is a measure of the systematic cross-country variation in sectoral output as captured by the location quotient in its functional form.

2.2 The supply side

Assuming that each variety is produced by every single firm in a plant with CRS and requires a certain fixed amount of headquarter services, it is possible to define the production function at the plant level as

$$q_i^j = \alpha_i^j F_i^{pj}, \tag{6}$$

where q_i^j is the output of the plant, α_i^j is the technical coefficient (productivity) and F_i^{pj} is the quantity of the composite factor employed in the plant.

F_i^{pj} is a function of the vectors of primary factors, $\mathbf{V}_i^{pj}$, and intermediate goods, $\mathbf{Z}_i^{pj}$, employed in the plant; it follows that $F_i^{pj} \equiv \phi_i(\mathbf{V}_i^{pj}, \mathbf{Z}_i^{pj})$, where the function $\phi_i(.)$ is homogeneous of degree one and identical across countries. Thus equation (6) allows for technology differences among countries only of the Hicks-neutral type.

[3] Price in country j multiplied by an industry specific trade barriers index.

[4] Allowing for elasticity to vary across industries would most likely enrich the theoretical analysis, but would make the model less treatable from an empirical point of view.

A unit of the composite factor can be employed incurring in the cost

$$C_i^j = \chi_i(\mathbf{W}^j, \mathbf{P}_i^{zj}),$$

where $\mathbf{W}^j$ is the price vector for primary factors and $\mathbf{P}_i^{zj}$ is the price vector for intermediate inputs. The unit variable cost can be easily obtained from (6), $\frac{C_i^j}{\alpha_i^j}$, and from the profit maximization process at the firm level it follows

$$P_i^j = \left(\frac{\sigma}{\sigma - 1}\right)\frac{C_i^j}{\alpha_i^j}. \tag{7}$$

The production of headquarter services requires the employment of a fixed amount of composite factor defined as a function of primary factors ($\mathbf{V}_i^{hj}$) and intermediates ($\mathbf{Z}_i^{hj}$),

$$F_i^h \equiv \phi_i(\mathbf{V}_i^{hj}, \mathbf{Z}_i^{hj}).$$

In order to preserve the empirical tractability of the framework, headquarter technology is assumed to be identical for all countries.

Thus fixed headquarter costs equal $F_i^h C_i^j$ and the zero-profit condition can be stated as follows

$$\frac{F_i^h C_i^j}{q_i^j} + \frac{C_i^j}{\alpha_i^j} = P_i^j.$$

Using the equations (6) and (7), one can get the employment of the composite factor at the plant level as a function of the composite factor required by headquarter operations

$$F_i^{pj} = (\sigma - 1)\, F_i^h. \tag{8}$$

Equation (8) permits to derive the number of firms in the industry i of the country j as a function of the total amount of the composite factor employed in the industry, $F_i^j \equiv n_i^j \left(F_i^{pj} + F_i^h\right)$[5]:

$$n_i^j = \frac{F_i^j}{\sigma F_i^h}, \tag{9}$$

which can be written also in the following form

$$F_i^j = n_i^j \sigma F_i^h,$$

that allow one to use the total employment of the composite factor, F_i^j, as a proxy for the number of firms operating in the sector, n_i^j. Thus, the total employment of the composite factor is a component that explicitly accounts for the way in which sizes of both country and sector affect localisation of

[5] In fact, each firm uses the amount F_i^{pj} at the plant and F_i^h a t the headquarter.

activities. In fact, according to new theories[6], fixed costs and transport costs could induce differentiated-product industries to concentrate in locations with larger domestic markets. This tendency is usually referred at with the name: *home market effect*.

Let A_i^j represent the Total Factor Productivity (TFP) of the industry i in the country j, defined as $A_i^j = \frac{Q_i^j}{F_i^j}$, where $Q_i^j \equiv n_i^j q_i^j$ is the industry output. By (6) and (8) one can identify the relationship existing between the coefficient α_i^j (technology) and the TFP

$$\alpha_i^j = A_i^j \frac{\sigma}{\sigma - 1},$$

by which one obtains

$$P_i^j = \left(\frac{\sigma}{\sigma - 1}\right) \frac{C_i^j}{\alpha_i^j} = \frac{C_i^j}{A_i^j} \tag{10}$$

Now it is possible to go back to equation (5) in order to enrich the relation by incorporating the findings of the production side of the model. By means of (9) and (10) I obtain

$$h_i^j = \frac{1}{\sigma F_i^h} \frac{F_i^j}{S^j S_i} \left(\frac{C_i^j}{A_i^j}\right)^{-\sigma} \left[\sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma - 1}\right]. \tag{11}$$

Thus industry localisation depends on three factors.

First, the total employment of the composite factor in country j in the given sector i controlling for the sizes of country and sector in the world economy. The reason why a normalization by country and sector shares of world production is adopted becomes clear when one considers that by F_i^j one tries to capture a possible home market effect. In their series of influential contributions on this issue, Davis and Weinstein (1996, 1999, 2003) show that the home market effect can be identified only in presence of idiosyncratic demand differences between countries. Hence, it emerges only when a country is deviating from rest-of-world demand patterns in the given industry. This implies that in order to single out the more than one-for-one movement of production in response to idiosyncratic demand (home market effect), one should clear out the base level of production that a country is expected to achieve given its own size and world's average allocation of resources in that industry.

The second key-element in equation (11) is represented by country j's comparative advantages in the sector i as captured by the "cost of factors - productivity" ratio. The cost of employment of the composite factor (C_i^j) can be considered as the economic evaluation of country's endowments of primary factors and intermediates (Heckscher-Ohlin), whereas the Hick-neutral differences

[6] This issue was outlined first by Krugman (1980) with respect to export patterns of countries. Helpman and Krugman (1985) extended the result showing possible magnification effects on production.

in technology across countries (Ricardo) are captured through the productivity term (A_i^j).

Finally, industry localisation depends on the demand variation as captured by the sum in squared brackets that can be considered as a measure of the *market potential* of industry i in country j. In fact, if there were no trade costs (all $B_i^{jm} = 1$) then price indices and market potentials would take the same value in all locations and production would be determined by cost and size factors alone; if not, geographical forces would matter.

So the right hand side of equation (11) contains a description of both "supply capacity" and "market capacity" of country j. It is convenient to notice that both of these capacities capture part of the role played by the internationalisation of production and the subsequent cross-border splitting of the value chain. In fact, as part of international production network, firms in a country will use imported intermediates on the supply side (F_i^j) and sell new varieties of them according to location's market potential.

3 The econometric implementation

3.1 Trying to disentangle the role played by internationalisation of production

How to account for the effect of trade in parts and components on concentration of industrial activities? Notwithstanding well established theoretical findings, this issue has not enjoyed many attempts to be addressed openly in the empirical literature. So far the role played by imported intermediates in the determination of systematic cross-countries variation in sectoral output has been inferred from more general findings rather than directly assessed[7].

In this paper I try to go one step further and I account explicitly for imported middle products by introducing some assumption about the functional form of F_i^j.

Assume that the industry total use of the composite factor in sector i of country j is defined by a Cobb-Douglas function

$$\ln F_i^j = w_i \ln L_i^j + \sum_r \theta_i^{zr} \ln Z_i^r, \tag{12}$$

where L_i^j is the amount of labour employed, Z_i^{jr} is an aggregate measure of the intermediate inputs produced in sector r and employed in sector i; w_i and θ_i^{zr} are the shares in which labour and middle products are used to form one unit of the output. Of course, the sum of coefficients will equal 1.

To simplify one can write

$$\ln F_i^j \approx w_i \ln L_i^j + \ln I_i^j, \tag{13}$$

[7] See Midelfart-Knarvik et al. (2000) and Haaland et al. (1999) for applications on the economic geography of EU-15; Hildebrandt and Wörz (2004) for a study of the industrial location patterns in CEECs.

where $lnI_i^j = \sum_r \theta_i^{zr} \ln Z_{it}^{jr}$ is the quantity of intermediates employed.

Domestically produced intermediates (DI_i^j) are used along with imported intermediates (MI_i^j) to obtain the composite factor employed in sector i. One can distinguish among the two components

$$\begin{aligned} \ln I_i^j &= \sum_r \theta_i^{zr} \ln Z_i^{jr} = \sum_r \theta_i^{zr} \ln Z_i^{jr} + \sum_r \sum_{m \neq j} \theta_i^{zr} \ln Z_i^{mr} \\ &\simeq \ln DI_i^j + \ln MI_i^j \end{aligned}$$

and rewrite the (13) in the following way

$$\ln F_i^j \approx \ln N_i^j + \ln MI_i^j \tag{14}$$

where the employment of composite factor is expressed as a function of the sum of the primary factor and domestic intermediates, $\ln N_i^j \approx w_i \ln L_i^j + \ln DI_i^j$, and imported intermediates (MI_i^j).

N_i^j still captures the country-sector size effects depending now on domestic supply-side components only.

On the other hand, the aggregate of imported intermediates, MI_i^j, accounts directly for the role played by trade in parts and components in determining the localisation of industry in country j by making foreign produced middle products available to domestic firms. It can also be seen as an indirect measure of country j's ability to engage in international networks of production. The explicit inclusion of a variable such as MI_i^j in the functional form of the location quotient obtained from the structural model and, thus, the direct assessment of the influence of imported middle products on localisation patterns allow me to contribute effectively to the empirical literature in the field.

3.2 A comprehensive and estimable functional form for the location quotient

Equation (11) can be now rearranged by means of equation (14) and estimated in the following log form

$$\begin{aligned} \log h_{it}^j &= \beta_0 + \beta_1 \log \left(\frac{N_{it}^j}{S_t^j S_{it}} \right) + \beta_2 \log \left(\frac{MI_{it}^j}{S_t^j S_{it}} \right) \\ &\quad + \beta_3 \log CA_{it}^j + \beta_4 \log MP_{it}^j + \epsilon_{it}^j \end{aligned} \tag{15}$$

where $MP_{it}^j = \left[\sum_m \left(B_i^{jm} \right)^{-\sigma} E_i^m \left(G_i^m \right)^{\sigma - 1} \right]$ accounts for the role played by the market potential, $CA_{it}^j = \left(\frac{C_i^j}{A_i^j} \right)$ captures the influence of comparative advantages on localisation patterns, $\beta_0 = \dfrac{1}{\sigma F_i^h}$ accounts for sectoral fixed effects,and an error term ϵ_{it}^j and a time subscript have been added.

The relationship between the employment of the composite factor $(\dfrac{F_i^j}{S^j S_i})$ in equation (11) and its two components (N_i^j and MI_i^j) in equation (14) deserves further explanation. As said above, the normalized F_i^j in equation (11) accounted for home market effect. Hence, a value of 1 for the associated coefficient would describe a country that achieves its own base production given its relative size and the average sectoral size in the world economy. On the other hand, values greater (smaller) than 1 would imply more (less) than one-for-one movement of production in response to idiosyncratic demand.

The splitting up of the composite factor into two elements implies a different interpretation of coefficients. In order to establish whether or not an home market effect is in operation, responses to idiosyncratic demand of domestic factors and intermediates (N_i^j) should be considered along with variations in the demand of imported intermediates (MI_i^j) on the domestic market.

It is worth to be notice that the comparative advantages' coefficient would give us a measure of the elasticity of substitution between varieties: $\beta_3 = -\sigma$. Furthermore, the structural model implies the following linear restriction on coefficients: $\beta_1 + \beta_2 \approx \beta_4 = 1$. The interpretation procedes as follows: if the home market effect is not in operation ($\beta_1 + \beta_2 = 1$), then the impact of demand for domestic factors and intermediates and imported intermediates should equal the influence of market potential in determining the degree of specialisation of country j in sector i.

The model predicts a positive impact of possible home market effect, imported intermediates and market potential on agglomeration. In fact, for reasons discussed above, according to the theory all of the three regressors should be positively correlated with location quotient. On the other hand, being built as a ratio of factors cost and productivity, comparative advantages are expected to be inversely correlated with the dependent variable, since an increase in absolute terms may be due either to an increase of the cost of factors or to a decrease in productivity or both. This would imply a loss of attractiveness for the location.

4 Estimation

4.1 What are sectors of interest?

Yeats (1998) finds that parts of motor vehicles, office machinery, telecommunication equipment and switch gears account for about the 70% of total world trade in parts and components. As stated above, Kaminski and Ng (2001) observe this is reflected by the EU-CEECs' patterns, as well. Thus, they focus on Motor Vehicles, Office Machinery, Telecommunication Equipment and Furniture, motivating the inclusion of the latter with the fact that a well established international production network has been effective for a long time within this sector.

Considering CEECs[8] as a whole, the relevance with respect to the total manufacturing output of the four sectors listed above has almost doubled in the second half of the 1990s: their share of CEECs' total manufacturing output has risen from 8.9% in 1995 to 17.5% in 1999, with Motor Vehicles being the fastest growing sector[9] (Figure 1).

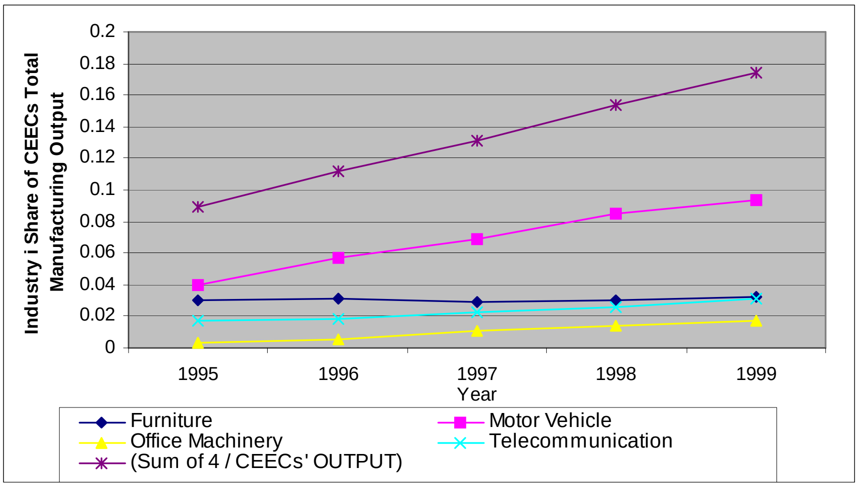

Figure 1: Industry i share of CEECs' total manufacturing output.

De Simone (2005) finds that over the second half of the 1990s , Estonia and Poland are the only locations with a share of output in the Furniture sector constantly and significantly greater with respect to the CEECs average, while Czech Republic seems to gradually despecialise over the period.

Motor Vehicles industry seems to be relatively more localised in Hungary, Slovakia and Czech Republic, whereas the share of output of the Baltic countries is far below the CEECs average in the sector. Poland reduces its location quotient through the passing of the years.

All countries are significantly below the area average in the production of Office Machinery and Equipment, with the only exception of Hungary which is a far more attractive location with respect to the others. Estonia, Bulgaria and Latvia loose quickly the larger than the average shares that they had at the beginning of the period.

[8]CEECs are actually CEECs-9 since lack of data on sectoral production for Slovenia restricts the group to Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, and Slovakia.

[9]Computations are made on the basis of data available in the UNIDO Industrial Statistic Data Base.

Similar trends are observed for the Telecommunication Equipment industry, with Hungary exhibiting an escalation in the location quotient and Lithuania gradually despecialising over the period.

Hence it seems sensible to try to identify what forces are behind the subsequent redistribution of activities across CEECs in the four sectors. I do so by estimating the model presented above on a panel of 4 sectors and 9 countries over the time period: 1995-1999.

4.2 Data

As defined in equation (14), F_i^j represents a key-variable in this model. In fact, two crucial components of the reduced form (N_i^j, MI_i^j) are originated from it. Moreover, knowing labour and intermediates shares in the production of one unit of the composite factor allows one to compute productivity (A_i^j) and the unit cost (C_i^j) that are the two components of the comparative advantage variable in the model.

Since data on domestic production of middle products are unavailable, I proxy the size variable accounting for idiosyncratic demand variation in the sector i of country j, $\log\left(\frac{N_{it}^j}{S_t^j S_{it}}\right)$, as log of the number of employees in the industry relative to the country and industry shares of world manufacturing output as defined in Section 2. Data on sectoral employment and output are drawn from UNIDO Industrial Statistics Data Base integrated when necessary with the WIIW Industrial Database Eastern Europe.

The aggregate value of imported intermediates employed by each sector i in each country j, $\log\left(\frac{MI_{it}^j}{S_t^j S_{it}}\right)$, can be computed on the basis of the data collected in the UN COMTRADE database[10]. Again, country and industry shares of world manufacturing output are computed as specified in Section 2, with data provided in the UNIDO Industrial Statistics Data Base.

In the theorethical framework, comparative advantages are captured by a ratio: cost of employment of the composite factor over productivity. It follows that, as long as labour is the only primary factor considered at the basis of the composite factor[11], a consistent way to proxy that ratio is to use data on

[10] Products group in the UN COMTRADE database are classified according to the SITC codes. Kaminski and Ng (2001) provide a table about parts and components for each of the considered industry as identifiable in SITC rev.2. I rearrange it for SITC rev.3 in order to assign each intermediate input to its final product group in the ISIC classification. I follow the concordance codes SITC rev.3 - ISIC rev.3 available in the World Matrix of Sectoral Economic Data (http://www.hwwa.de/wmatrix/Home.html). The table is reported in the Appendix A.

[11] Unavailability of data such as the stock of capital at the sectoral level (K_i^j) for most of the countries in the sample prevents one to consider this factor along with labour among those contributing in the formation of the composite factor. A way to overcome this problem would be estimating the values for the sectoral stock of capital through the well known Perpetual Inventory Method. But this methodology requires long series of data on sectoral investment that are unavailable, as well. Only relying on series that cover at least 10-15 years long time

Unit Labor Cost (ULC). In fact, ULC itself is computed for each country as sectoral real yearly wages, W_{it}^{j}, divided by labour productivity (real output per employee), π_{it}^{j}. In this case, drawing series from UNIDO Industrial Statistics Database and WIIW Industrial Database on Eastern Europe, one can compute sectoral ULC for all countries. Namely,

$$\log CA_{it}^{j} \simeq \log ULC_{it}^{j} = \frac{W_{it}^{j}}{\pi_{it}^{j}}.$$

The standard analytical definition of market potential dates back to Harris (1954) that describes it as the capability for location j to access purchasing power across the economy:

$$MP_i^j = \sum_m PP_i^m (dist^{jm})^{\delta} \tag{16}$$

PP_i^m is the expenditure of location m in sector i and $dist^{jm}$ is a measure of distance between the two location $(j,\ m)$ which has a negative impact on market potential ($\delta = -1$). Carstensen and Toubal (2004) and Brülhart et al. (2004) proceed to a direct estimation of this expression in two applications related respectively to the transition of CEECs to the market economy and the enlargement of the European Union. Head and Mayer (2003) point out that a measure such as MP_i^j does not take in consideration adjustment for variation in the price index at the basis of the functional definition of market potential. Thus, they suggest to rename it in a more appropriate way: Nominal Market Potential. The underlying idea is that in Harris' definition the impact of distance on market potential (δ) is assumed to be the same regardless of location and sector considered. This assumption would be too strict and unrealistic in the present analysis that involves both orders of variation.

Sector specific values for δ can be derived as suggested in Davis and Weinstein (2003). One can estimate a gravity equation where industry level bilateral trade is regressed over country dummies and trade costs as proxied by the distance between countries. δ is the cofficient on bilateral distance $(dist^{jm})$[12]. Given the fact that EU absorbes nearly all the exports of CEECs in the four sectors considered in the analysis, the set of possible parteners for each country includes only the rest of CEECs and EU-15. Data on bilateral trade can

period would allow one to obtain a sensible estimation of the benchmark value of the stock of capital from which it would be possible to start deriving values from the following years. However, since the dataset used in the analysis covers a time span of five years only (short run), capital does not seem to be essential.

[12] The specification of the gravity model is a parsimonious version of the one that allows Redding and Venables (2004) to estimate coefficients at the basis of what they call Market Access:

$\ln X_m^{ij} = \mu_m^i \mathrm{reporter}_i + \lambda_m^j \mathrm{partner}_j + \delta_m \,\mathrm{lndist}_m^{ij} + u_m^{ij}$,

where X_m^{ij} are the bilateral exports between country i and the partner j in sector m, $\mathrm{reporter}_i$ and $\mathrm{partner}_j$ are location dummies, and dist_{ij} is the bilateral distance between the two locations. The estimated δ_m gives a measure of the impact of trade costs at the sectoral level.

be drawn from UN COMTRADE database; bilateral distances among pairs of countries are collected in the CEPII Distances Dataset[13]. Data on sectoral expenditure are not available, but can be easily proxied by means of sectoral absorption (output + import - export). Data on country level of output are taken from UNIDO Industrial Statistics Data Base rev.3. Being dependent on prices adjustments at the industry level, this new measure accounts for Real Market Potential (RMP_i^j) of each location.

Production data taken from UNIDO Industrial Statistics Data Base rev.3 are also used to build series concerning the dependent variable, $\ln h_i^j$, as described in Section 2.

5 Results

5.1 A first step: fixed or random effects?

Variables in my sample present three orders of variation: across countries, across sectors, over time. In order to single out the impact of regressors at the industry level, I interact each of them with four sectoral dummy variables. For simplicity's sake I rename the first regressor in the following way $lnNE(i) = \log\left(\frac{N_{it}^j}{S_t^j S_{it}}\right) * SD_i$, where SD_i is the sectoral dummy, and i = furniture, motor vehicles, office machinery, telecommunication equipment. I index other regressors likewise.

Given the shortness of the time span considered (5 years), one may think that independent variables such as comparative advantages could present a small variability over time since they reflect the endowment of factors. On the other hand, at the sectoral level, there could be not much variability of Real Market Potential over individuals, since countries belong to a rather homogenous geographic area. These sorts of considerations may imply that the structure of the error term in our model should account not only for idiosyncratic disturbances (ϵ_{it}^j).

Thus, as a first step, I perform a general regression over the whole set of countries and sectors applying both fixed and random effects methodologies with specific time effects. This allows one to understand how robust is the appropriateness of fixed effects implied by the theoretical framework. Results are reported in Table 1.

Where significant, signs of the coefficients are in line with theoretical prediction under both methodologies: all determinants have a positive effect on localisation of industries, with the exception of comparative advantages (CA_{it}^j). The fit of the model is very high under fixed effects (80%) and a considerably lower (60%) under random effects. Coefficients obtained by means of the two estimators look stable. The hypotheses that differences in coefficients under the

[13] In this dataset bilateral distances are computed as weighted arithmetic distance over all region-to-region distances between country j and m.

two methodologies is not systematic is accepted (Hausman test: P-value > chi2 = 0.72).

It is not sensible to provide an interpretation of the coefficients' values at this stage because of the endogenous determination of some of independents. But the outcomes above suggest that the most theorethically appropriate methodology (fixed effects) performs well in capturing trends and features existing in the yet narrow dataset. Thus, I will stick to this approach to tackle the simultaneity problem.

Table 1: Overall Estimates with Fixed and Random Effects

Panel of Annual Data from 1995 to 1999 9 Countries - 4 Industries Dependent Variable: $\log h_{it}^{j}$		
Estimation Technique:	Fixed Effects with Specific Time Eff.	Random Effects with Specific Time Eff.
lnNE(furniture)	0.59 (0.41)	0.80 (0.31)**
lnNE(motor vehicles)	0.91 (0.13)**	1.02 (0.13)**
lnNE(office mach.)	0.30 (0.15)*	0.47 (0.12)**
lnNE(telecomm.)	0.83 (0.16)**	0.78 (0.15)**
lnMI(furniture)	0.03 (0.18)	0.02 (0.15)
lnMI(motor vehicles)	0.29 (0.10)**	0.26 (0.10)**
lnMI(office mach.)	0.40 (0.11)**	0.38 (0.10)**
lnMI(telecomm.)	- 0.09 (0.22)	-0.30 (0.19)
lnCA(furniture)	-0.48 (0.45)	-0.54 (0.44)
lnCA(motor vehicles)	-0.74 (0.11)**	-0.68 (0.10)**
lnCA(office mach.)	-0.47 (0.10)**	-0.50 (0.10)**
lnCA(telecomm.)	-0.09 (0.09)	-0.09 (0.09)
lnRMP(furniture)	0.84 (0.67)	0.29 (0.22)
lnRMP(motor vehicles)	1.09 (0.37)**	0.42 (0.17)*
lnRMP(office mach.)	1.59 (0.71)*	0.03 (0.19)
lnRMP(telecomm.)	1.45 (0.54)**	0.31 (0.19)
No. of Obs	180	180
R-sq within	0.80	0.78
R-sq between	-	0.57
R-sq overall	-	0.60
Hausman test:	P-value > chi2 =	0.71
NOTE:	Std.Err. in parenthesis. * = Sign. 5%; ** = Sign. 1%. Coeff. of time dummies and constant not reported.	

5.2 Addressing the simultaneity issue

The endogenous determination of real market potential in equation (15) poses a problem with the estimation. Head and Mayer (2003) argue that since Nominal

Market Potential «does not depend on locations of firms or on industry level costs, both of which are endogenous in economic geography models, [it] might be a good instrument for RMP». Thus, I use Harris' MP_i^j as an instrumental variable for RMP_i^j.

To find an appropriate instrument for idiosyncratic variation of demand ($\frac{N_{it}^j}{S_t^j S_{it}}$) is much more difficult. In fact, this is an endemic problem in the empirical literature on home market effect and no conclusive remedies have been put forward up to now. A reasonable instrument would be one that accounts for the size of the economy ("thickness" of the market) being, at the same time, uncorrelated with the concentration of industrial activities at the sectoral level. The absolute level of population in a country is certainly correlated with the demand for products in the home market, and it is likely to be correlated with the absolute level of production in that country. But it is not necessarely correlated with the relative level of production (h_i^j) at the industry level. In fact, as discussed in the theoretical section, the absolute level of demand would affect concentration of industrial activities just indirectly and by means of idiosyncratic variation of demand the are already captured by the independent variable $\frac{N_{it}^j}{S_t^j S_{it}}$. I think this makes the level of population a reasonable instrument for home market effect[14]. Since population is industry invariant, I interact it with four sectoral dummies (SD_i, where i = furniture, motor vehicles, office machinery, telecommunication equipment).

Hence I perform a general instrumental variable regression over the whole set of countries and sectors and the time period 1995-99 with fixed effects and specific time effects. Results are reported in Table 2.

The use of instruments for $\ln NE(i)$ and $\ln RMP_i^j(i)$ seems not to affect substantially the coefficients on other variables (compare with Table 1).

Focusing on coefficients' values obtained on each regressor at the industry level, I observe that the contribution of the imported intermediates has a relevant impact on localisation of activities at least in the Office Machinery and Motor Vehicles industries. At higher levels of import of middle products, and thus at higher degrees of involvement in international networks of production, correspond higher relative shares of sectoral production.

[14] Series about population for all Central Eastern European Countries may be drawn from the International Monetary Fund IFS data base.

Table 2: Estimates with Instrumental Variables

Panel of Annual Data from 1995 to 1999	
9 Countries - 4 Industries	
Dependent Variable: $\log h_{it}^{j}$	
Estimation Technique:	Fixed Effects with Specific Time Eff.
lnNE(furniture)	0.15 (1.06)
lnNE(motor vehicles)	0.80 (0.21)**
lnNE(office mach.)	0.67 (0.64)
lnNE(telecomm.)	0.64 (0.24)**
lnMI(furniture)	0.01 (0.20)
lnMI(motor vehicles)	0.31 (0.12)**
lnMI(office mach.)	0.45 (0.13)**
lnMI(telecomm.)	- 0.08 (0.24)
lnCA(furniture)	-0.26 (0.66)
lnCA(motor vehicles)	-0.82 (0.12)**
lnCA(office mach.)	-0.64 (0.30)*
lnCA(telecomm.)	-0.07 (0.09)
lnRMP(furniture)	0.87 (0.80)
lnRMP(motor vehicles)	1.92 (0.50)**
lnRMP(office mach.)	-0.14 (2.34)
lnRMP(telecomm.)	1.15 (0.71)
No. of Obs	180
R-sq within	0.77
R-sq between	-
R-sq overall	-
NOTE:	Std.Err. in parenthesis. * = Sign. 5%; ** = Sign. 1%. Coeff. of time dummies and constant not reported.

Again, comparative advantages appear to be a significant determinant of the localisation patterns in the Motor Vehicles and in the Office Machinery sectors. The localisation of these two industries seems to be very sensitive to both remuneration and productivity dynamics of labour, but the scope of the negative impact of an increase in the unit labour cost is higher in the former than in the latter.

Turning to the role played by market potential I observe that it does not seem to be a key-determinant for localisation of the industries in the sample, with the remarkable exception of Motor Vehicles production. This last results is not much surprising. In fact, it might explain why the automotive sector is actually much more concentrated in CEECs that are closer to border with EU-15.

Considered on their own, coefficients on $lnNE(i)$ are not very close to the unity for none of the sectors. And if I consider them along with those on imported intermediates I can see that just in both Motor Vehicles and and Office Machinery some home market effect might be in operation ($\beta_1 + \beta_2 \simeq 1.1 > 1$). But the production response to idiosyncratic demand differences is not much higher than one, so these results cast doubts on the presence of an effective home market effect.

5.3 One step further

Can one exclude that the four determinants of localisation of industrial activities play a significant role at a general level regardless of specific sectoral characteristics? A way to answer this question is to impose linear restrictions over sectoral coefficients ($\beta(i) = \overline{\beta}$, where i = furniture, motor vehicles, office machinery, telecommunication equipment) and test their significance. This would reveal whether or not any of the variables is playing a definite common role in all industries. I present the results of these tests in Table 2.

Table 3: Tests of linear restrictions over sectoral coefficients (fixed effects)

Coefficients from **fixed effects** estimates		
Linear restriction imposed	Test Results	H_0
lnNE(furn.) = lnNE(motor)= lnNE(office) = lnNE(telecomm.)	Chi2(3) = .53 Prob > Chi2 = 0.912	accepted
lnMI(furn.) = lnMI(motor)= lnMI(office) = lnMI(telecomm.)	Chi2(3) = 5.53 Prob > Chi2 = 0.137	accepted
lnCA(furn.) = lnCA(motor)= lnCA(office) = lnCA(telecomm.)	Chi2(3) = 23.67 Prob > Chi2 = 0.0000	rejected
lnRMP(furn.) = lnRMP(motor)= lnRMP(office) = lnRMP(telecomm.)	Chi2(3) = 2.01 Prob > Chi2 = 0.569	accepted

On the basis of these estimates one cannot exclude that imported parts and components have a unique cross-industry impact in the determination of localisation of production. The same can be said of real market potential and idiosyncratic demand differences, but not of comparative advantages. As shown in the previous section, coefficients on comparative advantages provide a measure of the elasticity of substitution between varieties ($\beta_3 = -\sigma$). Thus, it is not surprising at all that a restriction that imposes elasticity of substitution to be the same at the sectoral level is rejected.

In Table 4 I report results obtained by running an instrumental variables regression where acceptable restrictions are imposed.

Table 4: Estimates with Linear Restrictions

	Panel of Annual Data from 1995 to 1999 9 Countries - 4 Industries
Dependent Variable: $\log h^j_{it}$	
Estimation Technique:	Fixed Effects with Specific Time Eff.
lnNE	0.76 (0.15)**
lnMI	0.27 (0.06)**
lnCA(furniture)	-0.85 (0.37)*
lnCA(motor vehicles)	-0.73 (0.11)**
lnCA(office mach.)	-0.67 (0.10)**
lnCA(telecomm.)	-0.08 (0.09)
lnRMP	1.10 (0.36)**
No. of Obs	180
R-sq within	0.77
R-sq between	-
R-sq overall	-
NOTE:	Std.Err. in parenthesis. * = Sign. 5%; ** = Sign. 1%. Coeff. of time dummies and constant not reported.

I observe that imported parts and components have now the same significant and positive impact on the concentration of activities for all industries, suggesting that the higher is country j's ability to engage in international networks of production the larger is the share of CEECs production achieved. Comparative advantages keep their importance at the sectoral level and become a relevant determinant for location in the low-tech Furniture sector, as well. Real Market Potential seems to play a new a significant role once it is no longer considered as sector specific. Thus, in this specification, it seems that Motor Vehicles industry is not the only one that takes advantage of proximity to EU15. Furthermore, its coefficient is not statistically different from 1, as predicted by the theoretical model ($H_0 : \beta_4 = 1$, Prob > chi2 = 0.78). Coefficient on $lnNE$ is lower than one. When I consider it jointly with the coefficient on the imported intermediates ($\ln MI$), I can see that the home market effect is not in operation ($H_0 : \beta_1 + \beta_2 = \beta_4 = 1$, Prob > chi2 = 0.87) and that the linear restriction imposed by the structural model is empirically verified. Thus, idiosyncratic demand differences across-countries are not an effective determinant of the localisation of industrial activities across CEECs. Production response to variation of demand and market potential is one-to-one.

5.4 Is this a test for competing theories?

Davis and Weinstein (1996, 1999, 2003) use a setting under some respects similar to the one in this paper to attach far broader implications to the value of coefficients on home market effect. They estimate the effects of home market effect on output levels of a certain variety of a good by means of an equation augmented by a vector accounting for endowments. According to them, an estimated coefficient on home market bias equal to 0 would suggest that we are in a frictionless world where location of industry is determined by comparative advantages or IRS only. A coefficient grater than 0 but below (or equal to) the unity would imply a world where comparative advantages are in operation along with transport costs (frictions). A coefficient greater than one would support the idea that geographical forces (home market effect and market potential) are the main determinants of localisation of production. Thus, they use coefficients' values to test for either acceptance or rejection of three fundamental theoretical hypotheses.

If these implications should be trusted, results in this paper (Table 4) seem to point to the direction of a world that lies in between the second and the third type. In fact, in this case comparative advantages keep playing a significant role along with geographical forces. This is in contrast with results obtained by Davis and Weinstein that seem to support the hypothesis of a third-type world. One may argue that differences in empirical findings are due to differences in the equation estimated. This is certainly true, but in the present paper comparative advantages are not treated just as a control: they descend directly from the theoretical model as a force determining the distribution of industrial activities. Furthermore, here I account also for possible "third country effects" by including explicitly in the model the Real Market Effect. In fact, as Behrens et al. (2004, p.5) point out: «the appeal of a country as a production site for firms depends on both attraction and accessibility. This happens because in equilibrium the endogenous international distribution of firms is such that better attraction and accessibility are offset by fiercer competition, until operating profits are equalized across countries. (...) an increase in one country's expenditure share may well map into a less than proportionate increase in its output share as other countries 'drain away' some firms». Hence, only after controlling for cross-countries differences in accessibility a possible home market effect should appear in the data.

The comprehensiveness of equation estimated here suggests that results obtained are reliable and tend to exclude the presence of the home market effect. The fact that geographical forces look as an important determinant of localisation along with comparative advantages is not really surprising. Following Amiti (1998) one could argue that the uneven spatial distribution of factors that could be generated by imperfect competition, increasing returns to scale and geographical forces may be at the basis of patterns of trade consistent with the theory of comparative advantages. Thus, in the case of manufacturing industries, one theory can be seen as complementary to the other.

Finally, results on the home market effect obtained here challenge a rather established result of the previous emprical works in the field according to which manufacturing industries are on average more likely to show a *magnification* *effect* on production[15]. In particular, Brülhart and Trionfetti (2005) show that, given the huge response to home biased demand, a model with non competitive market and increasing returns fits particularly well sectors such as Motor Vehicles and Office Machinery and more generally mechanical and electrical engineering industries. Here I show that even in a framework with non competitive market and increasing returns to scale, these sectors might not show any magnification effect on production due to idiosyncratic demand differences, provided that other possible determinants of localisation of industrial activities are included in the analysis.

6 Concluding remarks

Recent works have highlighted that the increasing participation of CEECs firms in the International Production Networks set by EU principals encouraged both changes in the countries' production structures and relocation of industrial activities. This happened mainly in response to relevant modifications of trade patterns induced by the growth of trade in parts and components.

The main idea of this paper is to try to identify factors playing a major role in driving the process of redistribution of activities, singling out the role played by trade in middle products.

I propose a framework in which home market effect, trade in parts and components, comparative advantages and market potential are considered all together as possible determinants of the localisation of activities. The empirical implementation focuses on the four sector in which most of the trade in parts and components with EU-15 is concentrated: Furniture, Motor Vehicles, Office Machinery, Telecommunication Equipment.

Estimates at the sectoral level show that the model proves to be very successful in describing localisation trends for the Office Machinery and Motor Vehicles industries. For both sectors I observe that the contribution of the imported intermediates is substantial: at higher levels of import of middle products correspond higher relative shares of sectoral production. Furthermore, the distribution of output across CEECs seems to be very sensitive to variation in the unit labour cost (comparative advantages). Market potential and home market effect clearly drive the reshaping of economic geography just in the Automotive industry.

A far more parsimonious specification is estimated after having tested the hypotheses that coefficients on the determinants are not sector-specific. I find home market effect is not in operation, whereas both market potential and imported parts and components have a significant and positive impact on the concentration of activities for all industries. Findings on trade in middle products suggest that the higher is country j's ability to engage in international networks of production the larger is the share of CEECs production achieved. Comparative advantages keep their industry-specific importance at the sectoral level.

[15] This point is extensively discussed in Head and Mayer (2003).

Finally, I argue that the comprehensive framework proposed in this paper may be useful to test for effectiveness of alternative theories of trade (comparative advantages *versus* new theories/economic geography). I contribute to the debate on this issue by providing new evidence that, in the case of manufacturing industries, one theory can be seen as complementary to the other.

APPENDIX

A Concordance table

ISIC rev.3	361 FURNITURE	
	Parts	**Components**
SITC rev.3	82119	8212
	8218	
ISIC rev.3	34 MOTOR VEHICLES, TRAILERS AND SEMI-TRAILERS	
	Parts	**Components**
SITC rev.3	784	7132
	7139	71382
	77833	77831
	77835	77834
	74419	
ISIC rev.3	30 OFFICE, ACCOUNTING AND COMPUTING MACHINERY	
	Parts	**Components**
SITC rev.3	759	
ISICs rev.3	32 RADIO, TELEVISION & COMMUNICATION EQUIPMENT & APPARATUS	
	Parts	**Components**
SITC rev.3	7649	7641
		7642
		776

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