How Do Geographical Forces and Fragmentation of Production Interact in Determining the Location of Industrial Activities? Some Evidence From the EU-CEECs Case*

Gianfranco De Simone†

- Preliminary Draft -

May 17, 2005

Abstract

The accession of most Central Eastern European Countries (CEECs) to the European Union is only the final stage of a two-decade long process put into practice by institutions, through negotiations, and by market forces, through growing flows of FDI and increasing production fragmentation. In this paper I focus on the four sectors in which most of the CEECs' trade in intermediates with old-EU members is concentrated. Over the second half of the 1990s, I observe remarkable changes in specialization patterns and market potentials for new-members as well as a significant relocation of industries. I then estimate a reduced form of a general equilibrium model of trade which tries to explain cross-country variations of sectoral output on the basis of country and industry sizes, import of intermediates, comparative advantages and market potentials. Results allow me to draw some considerations about the contribution of agglomeration forces (geography) and dispersion forces (fragmentation of production) in reshaping the industries localisation across CEECs.

Key words: Fragmentation of Production, Market Potentials, Industry Localisation, Specialisation

JEL classification: F10, F12, F14, F15

*This research has been partially carried out during the period spent at the Norwegian School of Economic and Business Administration (Bergen) as part of the CEPR Research Training Network "Trade, Industrialization and Development". I wish to thank Jan Haaland and Alessandro Sembenelli for helpful comments and suggestions. Financial support from the European Commission and research facilities provided by SNF (Bergen) are gratefully acknowledged.

† *Università di Torino* and *Università degli Studi di Milano*. Contacts: Dipartimento di Scienze Economiche, Aziendali e Statistiche - Via Conservatorio 7 – 20122 Milano (Italy). email: *gianfranco.desimone@unimi.it*

1 Introduction

The accession of most Central Eastern European Countries (CEECs) to the European Union is only the final stage of a two-decade long process put into practice by institutions and market forces. It is generally believed that the successful transition of most CEECs from a central planning system to a market system is crucially due to the "integrated approach" adopted by the EU to facilitate the process. The three pillars of the intervention are: a) promotion of the *aquis comunaitaire* (harmonization of the domestic legislation with those of the already-members) and involvement in the *institution-building* of the enlarged Union; b) *trade integration* (dismantling trade barriers and other kinds of trade discrimination); c) *support* to CEECs' productive structure. The last point has been obtained through increasing flows of FDI, delocalisation, and outsourcing which helped the transition countries not to waste a large part of their productive potential and to recover entrepreneurial skills after the planned-economy experience.

Hoekman and Djankow (1997) show that this has brought with itself a significant geographical reorientation of trade flows of CEECs from the former COMECON partners to the EU[1]. In particular, the integration of CEECs firms in the International Production Networks set by EU principals and the consequent rose of trade in parts and components seem to have played a major role in determining the trade patterns of the new-members.

Kaminski and Ng (2001) observe that:

1. CEECs trade with EU in terms of "end-use" categories dramatically decreased in both export and imports of final goods (foods, feeds and beverages, industrial supplies and materials) in the time period 1989-1997, as opposite to a significant expansion of trade in capital goods, automotive vehicle and parts, with an overall trend of convergence towards the EU composition of trade.

2. The EU share in CEEC trade in parts is even larger than either that in total trade or manufactures. Furthermore, the share of aggregate EU-oriented exports (imports) of parts in EU-oriented exports (imports) of manufactured goods shows an upward trend. This made of the EU a sort of "hub" for CEECs trade in parts, with Germany absorbing the largest portion of it.

3. There is a high degree of correspondence between imports and exports: large exports require large imports, which suggests that vertical specialisation (fragmentation of production) is in effect playing a key-role.

4. Trade in parts concentrate in a small group of manufacturing sectors: office equipment, telecommunication equipment, motor vehicles, furniture.

[1] Chiarlone (2002) finds that up to 70% of overall manufacturing exports of Cechz Republic, Poland and Hungary are absorbed by EU-15.

By now, these are very definite *stylized facts* about EU-CEECs trade in parts with no doubts about their soundness.

The enlargement of EU entails huge modifications of different areas' market potential. Brülhart-Crozet-Koenig (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. This result is in line with one of the principal results of New Economic Geography models: market potential plays a key-role in shaping the distribution of activities across locations. The underlining idea is that firms will prefer to settle in locations that allow them to minimize trade cost 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].

Thus, it appears that the role of market potential cannot be neglected when analysing the localisation of industries as it would be determined by trade.

In this paper I analyze the way in which new patterns of trade due to fragmentation of production and changing market potential are reshaping the location of industrial activities in the four sectors in which most of the trade in intermediates between "new" and "old" EU-members is concentrated.

In Section 2 I take a closer look to the ways in which production activities have been relocating in the second half of the 1990s. In Section 3 I discuss how CEECs' market potential has been changing in the same time period. In Section 4 I define a framework where both agglomeration forces (geography) and dispersion forces (fragmentation of production) along with comparative advantages and economies of scale are considered as possible determinants of industrial location. The aim is to understand if the two phenomena are actually pushing in two opposite direction as the theory would predict. The econometric implementation of the model and its estimation allow to identify the elements that are driving the relocation of activities and consequently the specialisation patterns of CEECs. Results are presented in Section 5. I make some concluding remarks in Section 6.

2 Specialisation and localisation. What has been going on?

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 abroad, Kaminski and Ng (2001) observe this is exactly true for what concerns the EU-CEECs case, with the exception of "parts of furniture" replacing "parts of switch gear" among the four top product groups. Some could argue that one of the sectors in which a large part of Outward Processing Trade (OPT) from EU-15 to CEECs is concentrated

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

is Textile and Footwear. But this was true in the early stages of the transition. In fact, OPT in this industry mainly aspired to exploit some kind of absolute cost advantage (i.e. wage differentials for unskilled labor) and the related trade proved to be very volatile and strongly depending on changes in labor cost[3]. Thus my analysis will focus on the top four industries only: Furniture, Motor Vehicles, Office Machinery, Telecommunication Equipment.

As shown in Figure 1, considering CEECs[4] as a whole, the relevance with respect to the total manufacturing output of the four sectors 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[5].

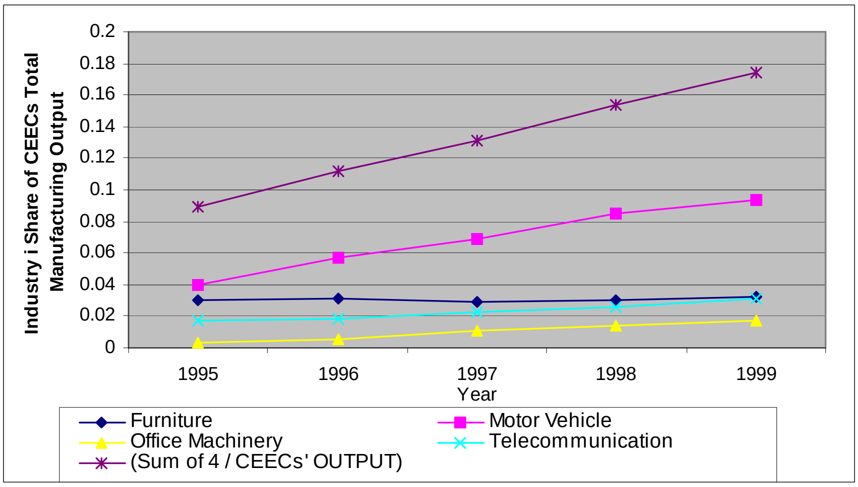

Figure 1: Industry i share of CEECs' total manufacturing output.

But what is happening to individual countries? Are they specializing in one or more of these sectors? And what about the localisation of industrial activities? What shares of sectoral productions are localized in single locations?

A way to answer these questions is by applying the localisation and specialisation indices defined by Overman-Redding-Venables (2003). Denoting the production of industry i in country j as D_i^j, the *specialisation* of industry i can be addressed by looking at D_i^j relative to total manufacturing production of that country:

[3]See Graziani (1996 and 1998) for the effects of OPT in EU-CEECs trade.

[4]Throughout the paper I will refer to Bulgaria, Czech Republic, Estonia, Hungary, Latvia, Lithuania, Poland, Romania, Slovakia as CEECs. Lack of data prevents me to include Slovenia in the group.

[5]Data about trends depicted in Figures 1 to 10 are drawn from the UNIDO Industrial Statistics DataBase rev.3.

$$k_i^j = \frac{D_i^j}{\sum_i D_i^j}, \tag{1}$$

whereas, *localisation* of activities across countries can be measured in terms of the share of country j in the total production of industry i, as stated by the following expression

$$l_i^j = \frac{D_i^j}{\sum_j D_i^j}. \tag{2}$$

In Figure 2 I report the specialisation trends in the Furniture industry over 1995-1999 period. For most CEECs there is a minor increase in the output of the Furniture sector with respect to total manufacturing production, with a 1.5% growth for Estonia.

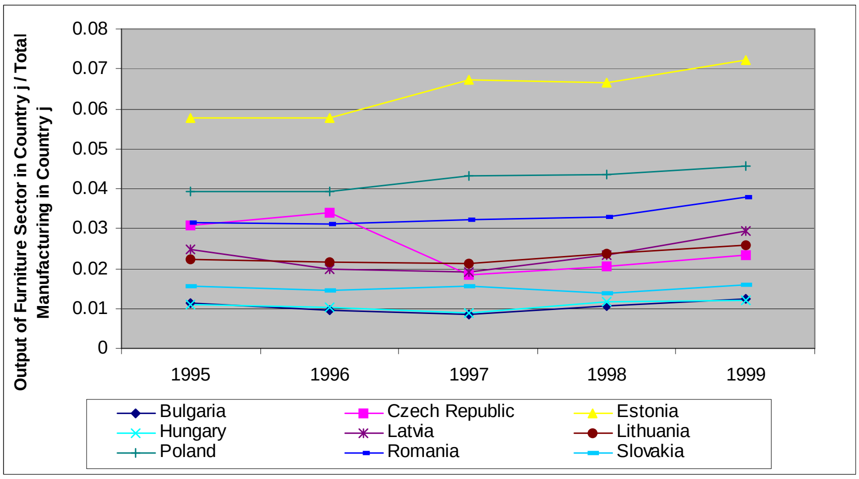

Figure 2: Specialisation trends in the Furniture sector.

A strongly different picture is presented in Figure 3 where I report the far steeper trends that characterize specialisation dynamics in Motor Vehicles industry. In this case, I observe a significant increase in the share of this sector in the national manufacturing production for Hungary (15.8%), Czech Republic (7%), Slovakia (9.3%) and Poland (3%).

Hungary is the only country which is doing undoubtedly well in the Office Machinery industry and in the Telecommunication Equipment industry (Figure 4 and Figure 5). The scope of the raise is significant both in the former (about 9%) and in the latter (about 6%). Other countries are performing comparatively poorly, especially in Telecommunication Equipment.

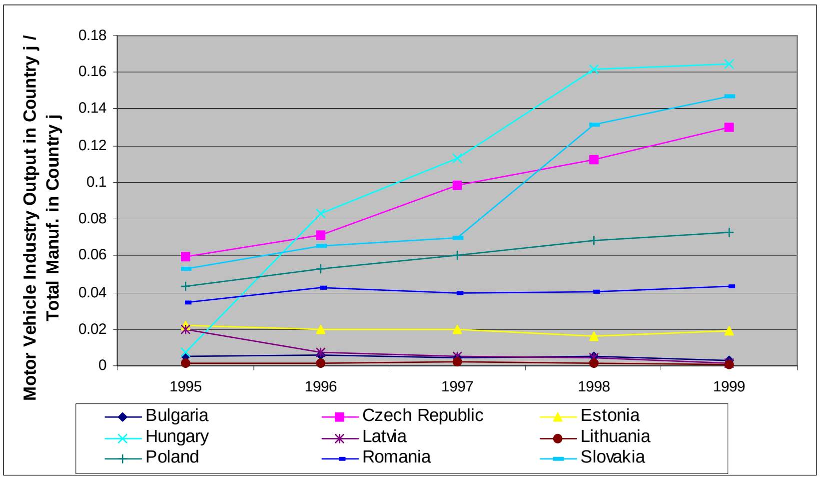

Figure 3: Specialisation trends in the Motor Vehicles sector.

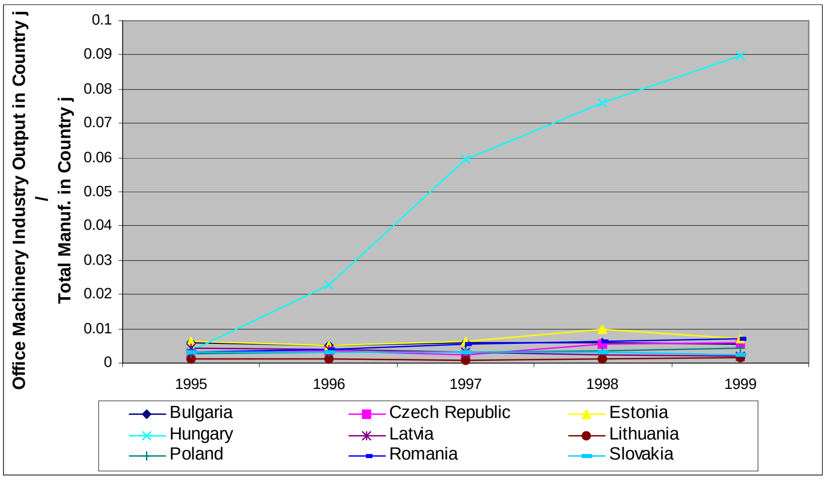

Figure 4: Specialisation trends in the Office Machinery sector.

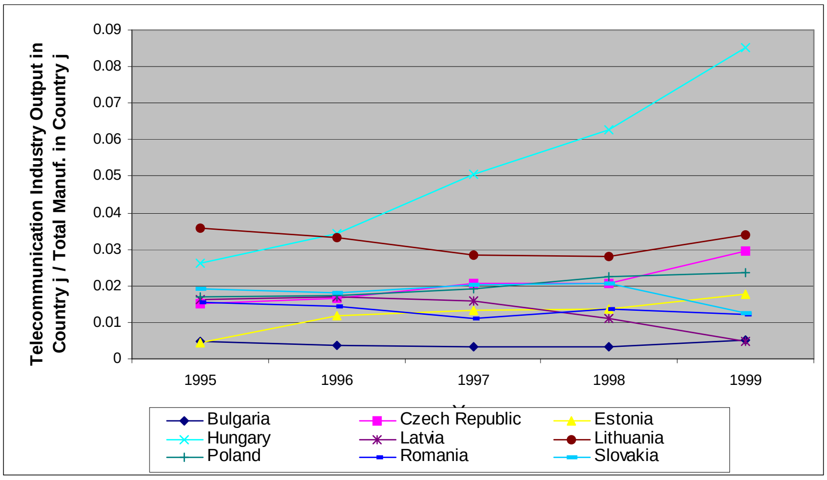

Figure 5: Specialisation trends in Telecommunication Equipment sector.

When I turn to the other side of the coin, I notice that a large part of these trends are reflected in the change of countries' share of sectoral production. In Figure 6 I give an account of what part of total Furniture production is localised in single countries. Major changes have been taking place just for Poland (a 7.7% increase) and for Czech Republic (a 8.3% decrease), while other countries' shares have remained basically the same over the time period considered.

The expansion (Figure 7) of the Hungarian share of total Motor Vehicles output (+23.3%) has produced a decrease in the shares of Poland (-10.6%), Czech Republic (-6%) and Romania (-6%). This testifies a strong relocation of Motor Vehicles industry across CEECs. Which is similar to what I observe in the Office Machinery sector (Figure 8). In this case, the growth of sectoral output share in Hungary (+61%) takes place along with a simultaneous fall in those of Poland (-25%), Czech Republic (-12.6%), Romania (-8.7%), Bulgaria (-7.3%), and Slovakia (-5.2%).

A redistribution of output shares in favor of Hungary (+21.7%) is what happens in the Telecommunication Equipment sector, as well (Figure 9). Romania, Poland and Slovakia loose respectively 11.7%, 7%, 4.5% of their shares.

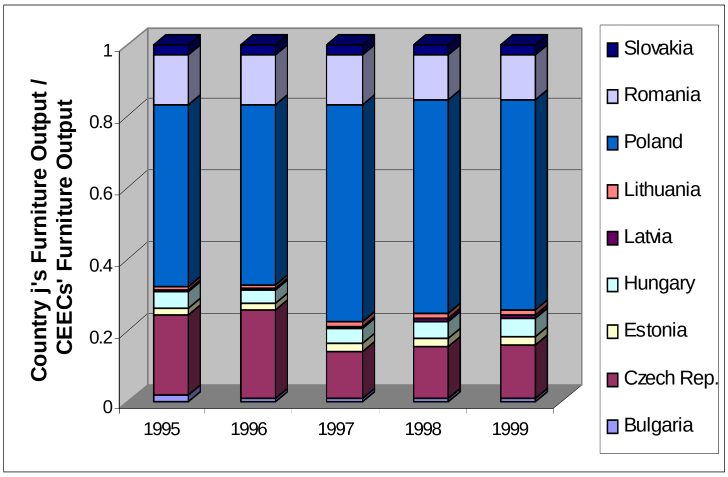

Figure 6: Specialisation trends in the Furniture sector.

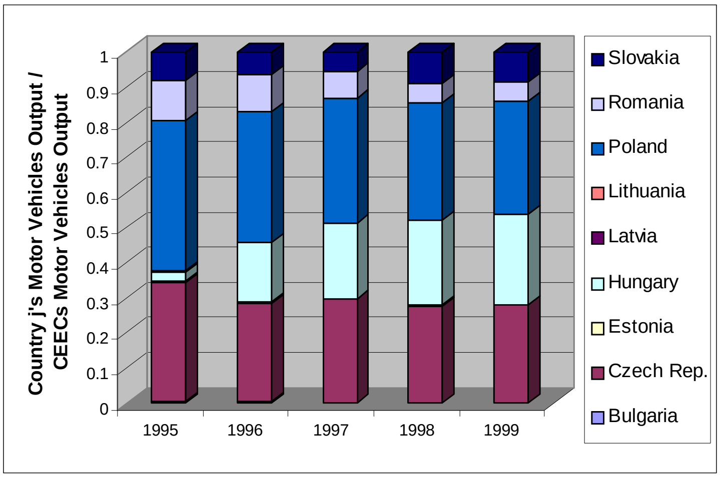

Figure 7: Localisation trends in the Motor Vehicles sector.

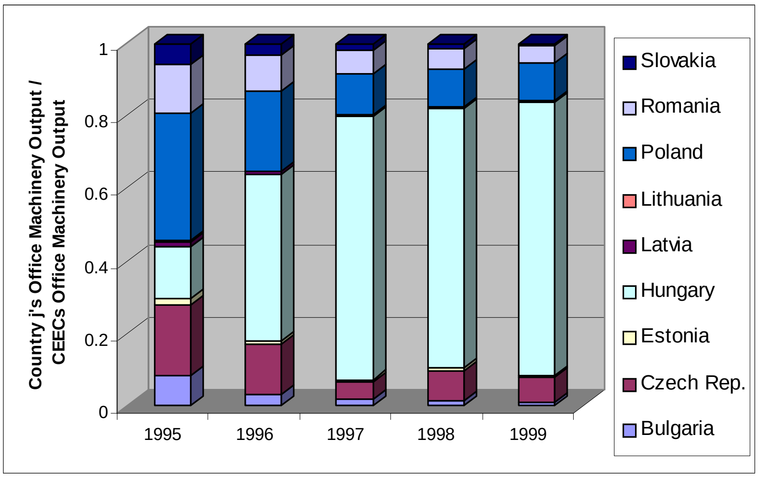

Figure 8: Localisation trends in the Office Machinery sector.

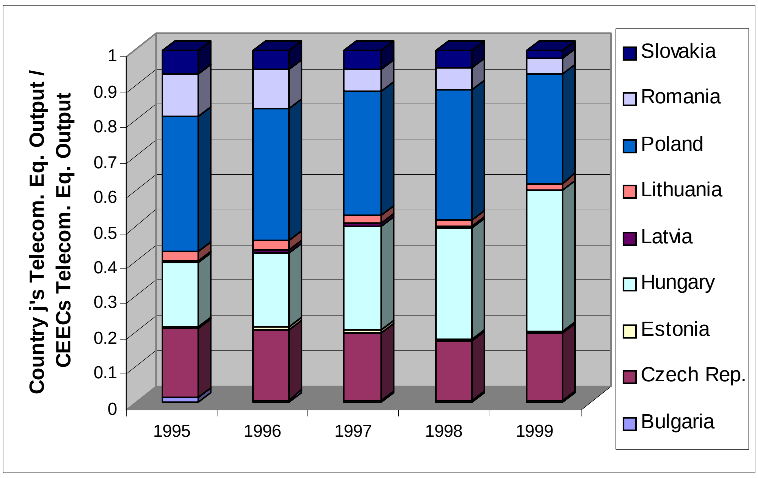

Figure 9: Localisation trends in the Telecommunication Equipment sector.

The astonishing hungarian trends deserve an explanation that can be found in a sort of first move advantage enjoyed by the country. In fact, the first attempt to attract export-oriented, high-technology FDI to Hungary dates back to 1982 when Industrial Free Trade Zones (IFTZs) were introduced in the country. Sass (2004) points out that the regulation of Hungary's IFTZs was «unique[6]» and proved to be very successful especially after 1990. After the fall of Berlin wall the nuber of IFTZs grew very rapidly with a number of transnational corporations (such as General Motors, Suzuki, and Philips) carrying out greenfield investment, soon followed by their competitors and/or suppliers which established their affiliate in an IFTZ (e.g. Ford, Audi, IBM, Nokia, LEAR Corp., United Technologies, Sony, Zollner). Thus, specialisation trends and localisation patterns reported in above figures are not very suprising.

Considering that there could be huge differences in size across countries and sectors, one may wish to normalize the specialisation and localisation indices presented. This can be done by dividing the specialisation index, k_i^j, by the share of industry i in the total CEECs production

$$S_i = \frac{\sum_j D_i^j}{\sum_j \sum_i D_i^j}, \tag{3}$$

and the localisation index, l_i^j, by the share of a country j in total CEECs production

$$S^j = \frac{\sum_i D_i^j}{\sum_j \sum_i D_i^j}. \tag{4}$$

This allows us two define a new measure that summarize both kinds of information and can be called *location quotient*:

$$h_i^j = \frac{k_i^j}{S_i} = \frac{l_i^j}{S^j}. \tag{5}$$

The interpretation of the location quotient is twofold: it can be considered as a measure of the *localisation* of industry i in j, relative to the localisation of activity as a whole in j; equally it is a measure of country j's *specialisation* in

[6] The conditions required by the regulation to set up an IFTZ were the following: firms had to

(i) produce for exports, largely based on imports,
(ii) cover an area of at least 2,000 square meters,
(iii) allow customs control, and
(iv) pay the customs deposit.

A company could set up more than one IFTZ. This enabled assembly companies using only local labour to bring in high-value equipment duty-free for their own use. «Another reason for the growing number of companies in IFTZs was that companies operating there needed a special permit to buy their inputs from the domestic economy and could do so only up to a certain amount. Thus, their traditional suppliers followed them to Hungary and established their affiliates in an IFTZ as well.»

For other details about this special regulation see Sass (2004, p.75).

industry i relative to the share of that industry in total CEECs output. Thus it can be use to make statements about both localisation and specialisation.

I report the trends of the location quotient for individual countries in the four sectors in Figures 10 and 11. Results are represented as deviations from 1, since the unit value describes a situation in which contry j level of specialisation/localisation is perfectly equal to the average level of CEECs. Thus, a value greater than 0 means that country j is relatively more specialised in industry i[7] then the CEECs average. The opposite holds for values lower then 0.

In the Furniture industry I observe that Estonia and Poland are the only locations with a share of output in the sector constantly and significantly greater with respect to the CEECs average. Romania has a share which is greater then the CEECs average, but not constantly high as in the case of the two leading countries. Czech Republic seems to gradually despecialise over the period.

Hungary, Slovakia, Czech Republic seem to be relatively more specialized in the Motor Vehicles industry, whereas the share of output of the Baltic countries is far below the CEECs average in the sector. Poland seems to lose its initial over the average degree of specialisation through the passing of the years.

All countries are significantly below the CEECs average in the production of Office Machinery and Equipment, with the only exception of Hungary which instead is strongly specialised in the sector. Larger then the average shares of Estonia, Bulgaria and Latvia have at the beginning of the period are quickly lost.

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

[7] Or an industry i is relatively more localised in country j.

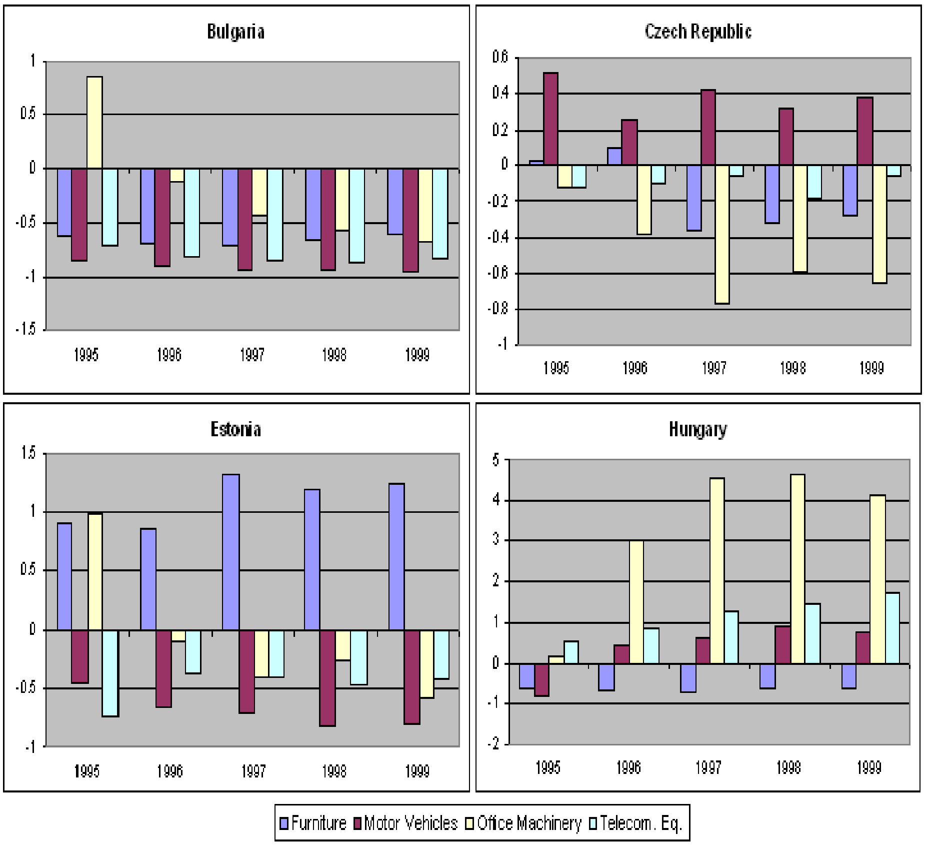

Figure 10: Sectoral Location Quotient: Bulgaria, Czech Republic, Estonia, Hungary.

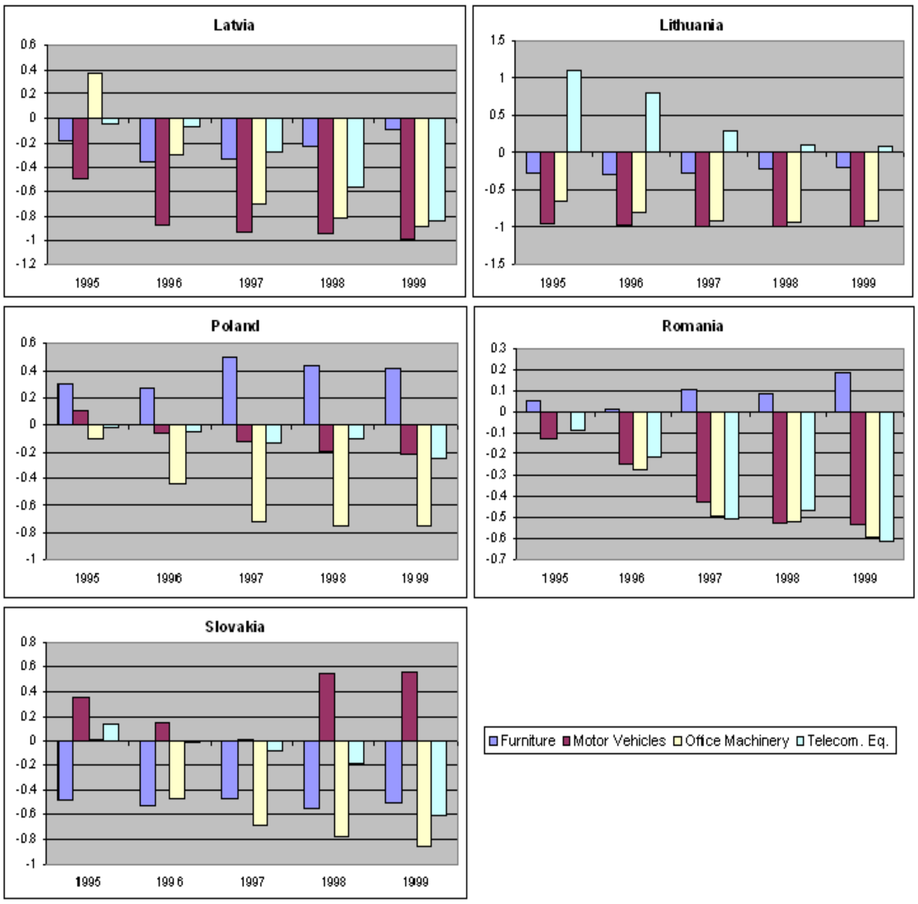

Figure 11: Sectoral Location Quotient: Latvia, Lithuania, Poland, Romania, Slovakia.

3 Has market potential been changing?

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:

$$MP_i^j = \sum_m \frac{PP_i^m}{dist^{jm}} \tag{6}$$

PP_i^m is the purchasing power 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. Redding and Venables (2004) suggest a way to obtain structural estimates for a functional form of equation (6) on the basis of a standard gravity model[8]. The small number of individuals (9 countries) and data constraints do not allow me to apply this methodology. Thus, I follow Carstensen and Toubal (2004) and Brülhart-Crozet-Koenig (2004) who propose a simpler direct approach: market potential of country j in sector i is computed on the basis of sectoral output in each location m divided by the bilateral distance between j and m. Data on the countries' levels of output are drawn from UNIDO Industrial Statistics Data Base rev.3 while distances are taken from the CEPII Distances Dataset[9]. Of course, the set of locations considered here does not include CEECs only, but EU-15 as well.

For the Furniture industry I observe that the share of the industry in the total manufacturing market potential has followed a similar trend for all countries in the considered period: it has been falling from 1995 to 1997 with a general rise in the following two years (Figure 12).

A general increase in the share of total manufacturing market potential is observed in the Motor Vehicles industry (Figure 13). After 1997 trends become steeper. As in the previous sector, considerations about proximity or remoteness seem not to apply since countries showing larger market potential are not necessarely the closest to the EU border.

Hungary distinguish itself from the rest of the group in the Office Machinery sector (Figure 14). After 1997 its market potential has been growing at a substantial faster rate with respect to remaining CEECs. Slovakia attains lower

[8] Following Wolf (2004), in our case the specification to be used would be:
$\log X_{it}^{jm} = \sum_m \alpha_{it}^{jm} + \gamma_1 \log Y_{it}^j + \gamma_2 \log Y_{it}^m + \gamma_3 \log dist^{jm} + \gamma_4 \log bord^{jm} + u_t^{jm}$,
where X_{it}^{jm} is the value of sectoral bilater trade between the two countries at time t, α_{it}^{jm} captures country-pair specific fixed effects, Y_{it}^j and Y_{it}^m are the sectoral output accounting for the size of the exporting country and the importing country respectively, $dist^{jm}$ is a measure of distance while $bord^{jm}$ is a dummy accounting for possible neighbourhood-effects, u_t^{jm} is an error term. The estimated market potential would then be:
$\widehat{MP}_{it}^j = \left(Y_{it}^j\right)^{\gamma_1} + \left\{\sum_m \left[\left(Y_{it}^m\right)^{\gamma_2} \left(dist^{jm}\right)^{\gamma_3} \left(bord^{jm}\right)^{\gamma_4}\right]\right\}$.

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

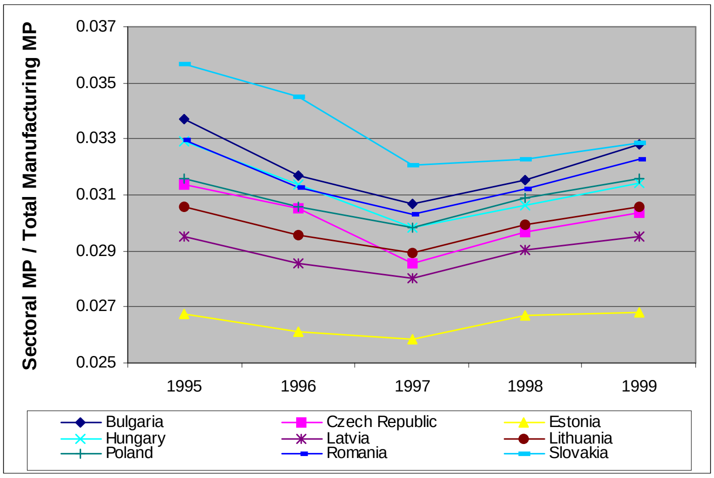

Figure 12: Furniture share of total manufacturing market potential in country j.

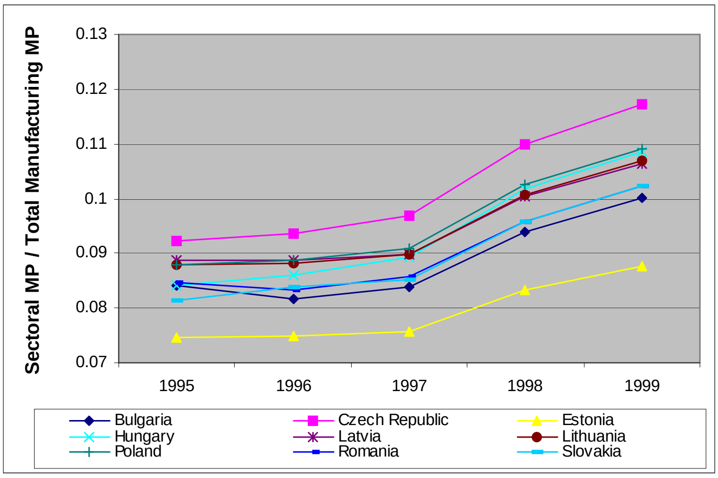

Figure 13: Motor Vehicles share of total manufacturing market potential in country j.

levels of market potential with respect to the rest of the group, but the trend seems to be convergent toward the general level in the industry.

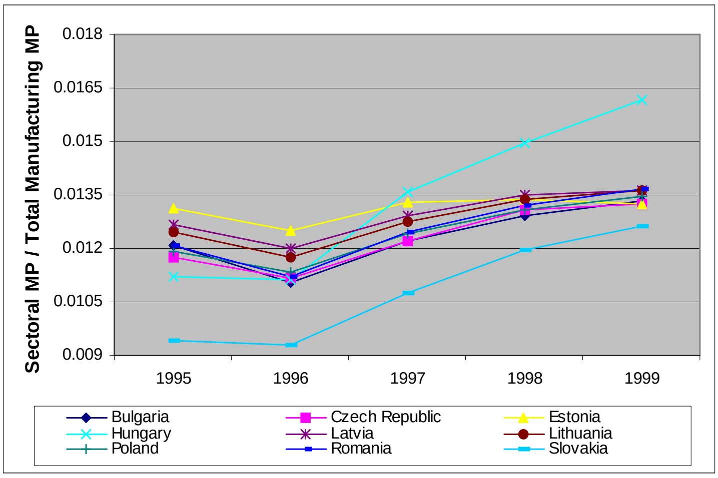

Figure 14: Office Machinery share of total manufacturing market potential in country j.

Countries' market potentials observed for the Telecommunication Equipment industry present a special feature. In Figure 15 it can be seen that Baltic countries (Estonia, Latvia, Lithuania) are charcterized by relatively higher market potentials with respect to other CEECs. Given their proximity to Scandinavian countries which are among the EU countries that are performing better in the sector, I believe these trends suggest a possible "Nokia-Ericsson effect". However, comparatively higher market potentials for Baltic countries are present in the Office Machinery sector, as well (Figure 14).

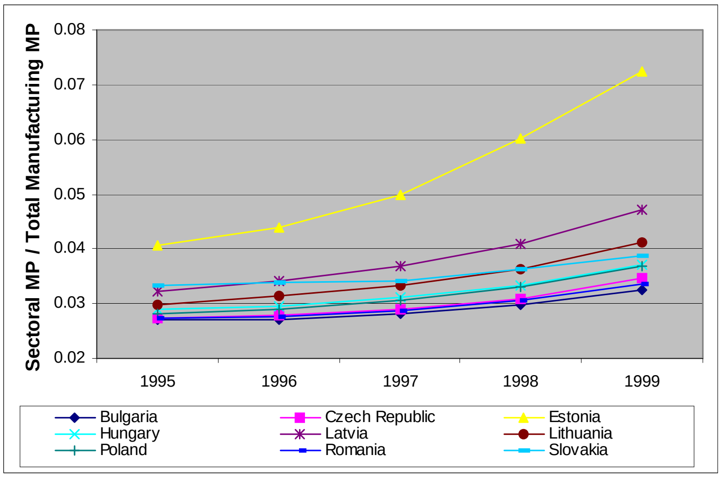

Figure 15: Telecommunication Equipment share of total manufacturing market potential in country j.

4 What is driving relocation of industries?

In the previous two sections I highlighted that there have been significant changes both in specialisation and localisation patterns. On a country by country basis, trends reveal strong differences among CEECs with some of them leading the process of relocation of activities as opposite to other countries that seem to experience a despecialisation. Moreover, I noticed a general increase of market potential for the whole area with again some differences at a country level.

Such a mixed evidence does not allow one to jump to conclusions about the effects of fragmentation of production and changing market potentials on neither the distribution of industries nor specialisation dynamics. This is in contrast with the common belief that fragmentation is likely to lead to a dispersion of economic activities whereas a rise in market potential should imply agglomeration[10].

In order to improve our understanding of the problem I define a framework that explains cross-country variations of sectoral output on the basis of both fragmentation and market potential along with comparative advantages and sectoral size. The model builds on De Simone (2004) and Midelfart-Knarvik et al. (2000), and can be considered as an attempt to integrate New Trade Theory with New Economic Geography and traditional frameworks (Ricardo, Heckscher-Ohlin). Results coming from the empirical estimation of a reduced form of the model will allow me to get further insights on the contribution given by each of these elements to the relocation of industries.

[10] See Jones-Kierzkowski-Lurong (2005) as a recent contribution supporting this view.

4.1 The model

4.1.1 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 have 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)[11], 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[12].

Aggregating over m I obtain the value of industry i total production in country j:

$$D_i^j = \sum_m d_i^{jm} = n_i^j \left(P_i^j\right)^{-\sigma} \sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}. \tag{7}$$

Considering equations (1)-(5) along with (7) I obtain

$$h_i^j = \frac{D_i^j}{S^j S_i} = \frac{n_i^j}{S^j S_i} \left(P_i^j\right)^{-\sigma} \sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}. \tag{8}$$

This is a measure of the systematic cross-country variation in sectoral output. As shown above (see Section 2), h_i^j allows one to make statements about both *localisation* and *specialisation* for the considered sectors and countries.

4.1.2 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

$$q_i^j = \alpha_i^j F_i^{pj}, \tag{9}$$

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

[12] 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.

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 (9) allows for technology differences among countries only of the Hicks-neutral type.

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 (9), $\frac{C_i^j}{\alpha_i^j}$, and from the profit maximization process at the firm level I have

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

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

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

ϕ_i is again assumed identical across 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 (9) and (10) I get the employment of the composite factor at the plant level as a function of the composite factor required by headquarter operations

$$F_i^{pj} = (\sigma - 1)\, F_i^h. \tag{11}$$

Let A_i^j represent the Total Factor Productivity 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 and $F_i^j \equiv n_i^j \left(F_i^{pj} + F_i^h\right)$ represents the total amount of composite factor employed in the industry[13]. By (10) and (12) I identify the relationship existing between the coefficient α_i^j (technology) and the TFP

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

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

through which I get

$$P_i^j = \left(\frac{\sigma}{\sigma-1}\right)\frac{C_i^j}{\alpha_i^j} = \frac{C_i^j}{A_i^j} \tag{12}$$

Equation (11) allows me 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. From the definition of F_i^j I obtain

$$n_i^j = \frac{F_i^j}{\sigma F_i^h}, \tag{13}$$

which can be written also in the following form

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

that allow me to use F_i^j as a proxy for n_i^j.

Now it is possible to go back to equation (8) in order to enrich the relation by incorporating the findings of the production side of the model. By means of (12) and (13) I obtain

$$h_i^j = \frac{1}{\sigma F_i^h}\frac{F_i^j}{S^j S_i}\left(\frac{C_i^j}{A_i^j}\right)^{-\sigma}\left[\sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}\right]. \tag{14}$$

Thus country specialisation and industry localisation depend on the number of varieties produced by country j in the given sector[14], on the sectoral "cost of factors - productivity" ratio (which accounts for country's comparative advantages[15]) and on the demand variation, 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 indeces and market potentials would take the same value in all locations and production would be determined by cost factors alone; if not, geographical forces would matter. So the right hand side of equation (14) 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 fragmentation of production: as part of an international production network, a country will use imported intermediates on the supply side (F_i^j) and sell new varieties of them according to its market potential.

[14] Or, equivalently, on the number of firms, here proxied by the total employment of the composite factor in the industry (F_i^j), double relative to the share of industry i in the total world production (S_i), and the share of a country j in total world production (S^j).

[15] 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 in technology across countries (Ricardo) are captured through the TFP term (A_i^j).

4.2 The econometric implementation

The effects of international fragmentation of production on systematic cross-countries variation in sectors' output can be made explicit 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

$$\ln F_i^j = k_i \ln K_i^j + w_i \ln L_i^j + \sum_r \theta_i^{zr} \ln Z_i^r, \tag{15}$$

where K_i^j is the value of physical capital used, 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, k_i and θ_i^{zr} are the shares in which factors are used to form one unit of the output (the sum of coefficients will equal 1). To simplify I can write

$$\ln F_i^j \approx \ln PF_i^j + \ln I_i^j, \tag{16}$$

where $\ln PF_i^j = k_i \ln K_i^j + w_i \ln L_i^j$ accounts for the use of primary factors and $\ln I_i^j = \sum_r \theta_i^{zr} \ln Z_{it}^{jr}$ is the quantity of intermediates employed.

Of course, domestically produced intermediates (DI_i^j) are used jointly with imported intermediates (MI_i^j) to obtain the composite factor employed in sector i. I 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 (16) in the following way

$$\ln F_i^j \approx \ln N_i^j + \ln MI_i^j \tag{17}$$

where I express the employment of composite factor as a function of the sum of primary factors and domestic intermediates, $\ln N_i^j \approx \ln PF_i^j + \ln DI_i^j$, and imported intermediates (MI_i^j). N_i^j can still be seen as a proxy of country-specific number of firms operating in industry i depending only on domestic supply-side components. On the other hand, the aggregate of imported intermediates, MI_i^j, accounts for country's ability to engage in international networks of production.

Thus I can rearrange equation (14) by mean of (17) and estimate the following log form

$$\begin{aligned} \log h_{it}^j &= \beta_0 + \beta_1 \log \left(\frac{N_{it}^j}{S_t^j S_{it}} \right) + \beta_2 \log MI_{it}^j \\ &\quad + \beta_3 \log CA_{it}^j + \beta_4 \log MP_{it}^j + \epsilon_{it}^j \end{aligned} \tag{18}$$

where $MP_{it}^{j} = \left[\sum_m \left(B_i^{jm}\right)^{-\sigma} E_i^m \left(G_i^m\right)^{\sigma-1}\right]$, $CA_{it}^{j} = \left(\frac{C_i^j}{A_i^j}\right)$.

$\beta_0 = \frac{1}{\sigma F_i^h}$ accounts for sectoral fixed effects; $\beta_1 + \beta_2 \approx \beta_4 = 1$ means that the model implies that the impact of normalized number of firms (varieties) plus the one of imported intermediates should somehow equal the influence of market potential in determining the degree of specialisation of country j in sector i. The comparative advantages' coefficient would give us a measure of the elasticity of substitution between varieties: $\beta_3 = -\sigma$.

An error term ϵ_{it}^{j} and a time subscript have been added.

4.3 The lack of data and the construction of proxies

As defined in equation (17), F_i^j represents a key-variable in this model. In fact, being able to estimate it would mean being able to recover values for both the number of varieties (N_i^j) and the aggregate of imported intermediates (MI_i^j) employed in sector i. Moreover, knowing primary factors and intermediates shares in the production of one unit of the composite factor would allow me to compute the TFP (A_i^j) and the unit cost (C_i^j) that are the two components of the comparative advantage variable in the model[16].

However, unavailability of data such as the stock of capital at the sectoral level (K_i^j) for most of the countries in my sample prevents me to follow this methodology and forces me to find an alternative way to estimate the model[17].

I compute the variable accounting for the number of varieties produced (equally, firms operating) 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 (3) and (4). Data on sectoral employment are mainly drawn from UNIDO Industrial Statistics Data Base with series for Estonia and Romania obtained from the WIIW Industrial Database Eastern Europe. The aggregate value of imported intermediates employed by each sector i in each country j, $\log MI_{it}^j$, can be computed on the basis of the data collected in the UN COMTRADE database[18]. Comparative advantages, $\log CA_{it}^j$, are obtained through the well-known Balassa (1965) Revealed

[16] See De Simone (2004) for details on the ideal construction of series.

[17] A way to overcome this problem would be estimating the values for the sectoral stock of capital used 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 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.

[18] 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. I rearrange it 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.

Comparative Advantage Index

$$RCA_{it}^{j} = \frac{x_i^j / X^j}{x_i^w / X^w}, \tag{19}$$

where x_i^j is country j's export to the EU in sector i; $X^j = \sum_i x_i^j$ is country j's total export of manufactures to the EU; $x_i^w = \sum_{j \in EU} x_i^j$ is CEECs' total external export to the EU in the sector i, and $X^w = \sum_{j \in EU} \sum_i x_i^j$ is CEECs' total external export of manufactures to the EU. Data needed to compute RCA_{it}^j are drawn from UN COMTRADE database, as well. Series concerning the dependent variable, $\ln h_i^j$, and the market potential value, $\ln MP_i^j$, are computed as described respectively in Section 2 and 3.

5 Estimation results

I perform a general regression over the whole set of countries and sectors and the time period 1995-99. Results[19] are reported in Table 1. I observe that under fixed effects the size variable ($\ln NE$) seems to play a relevant role in three sectors out of four. On the other hand, the market potential has not a significant impact on the localisation choices of the industry. Comparative advantages appear to be a significant component of the specialisation patterns in the Motor Vehicles industry only, while fragmentation of production is a relevant reason just in the Office Machinery sector. The fit of the model is acceptable (58%) and increases significantly when I run the regression under the stronger assumptions of random effects methodology (75%). Coefficients obtained by means of the GLS estimator look stable, thus results can be considered rather robust. In this case, fragmentation of production plays a relevant role also in the other high-tech industry (Telecommunication Eq.), and comparative advantages strengthen their effect in the Motor Vehicles Industry. Again market potential is not at work as a determinant of industrial localisation. The slightly better performance of the model under random effects may be credited to the fact that over such a short period of time (5 years) it is difficult to observe much within variation among individual countries and sectors.

A way to get more information about the possible different role played by each regressor in the determination of localisation of industries is to impose linear restrictions over sectoral coefficients and test their significance. This would reveal which variable plays a similar role regardless of specific sectoral characteristics. I present the results of these tests in Table 2.

[19] For simplicity's sake I rename the size variable in the following way $lnNE(i) = \log\left(\frac{N_{it}^j}{S_t^j S_{it}}\right)$, where $i = 1, 2, 3, 4$ indexes sectors (1 = Furniture, 2 = Motor Vehicles, 3 = Office Machinery, 4 = Telecommunication Equipment). I index other regressors in the same way.

Table 1: Overall Estimates

Panel of Annual Data from 1995 to 1999 7 Countries - 4 Industries Dependent Variable: $\log h_{it}^{j}$		
Estimation Technique:	Fixed Effects with Specific Time Eff.	Random Effects with Specific Time Eff.
lnNE1	-0.366	0.389
	(-0.80)	(1.83)
lnNE2	0.996**	0.915**
	(6.46)	(7.42)
lnNE3	0.299*	0.342**
	(2.48)	(3.35)
lnNE4	0.875**	0.606**
	(4.16)	(3.52)
lnMI1	0.138	0.198
	(0.62)	(1.29)
lnMI2	0.028	0.111
	(0.13)	(0.64)
lnMI3	0.400*	0.434**
	(2.24)	(2.70)
lnMI4	0.250	0.448**
	(1.30)	(2.77)
lnCA1	0.242	0.453
	(0.74)	(1.60)
lnCA2	0.406*	0.561**
	(2.20)	(3.48)
lnCA3	0.002	-0.060
	(0.03)	(-0.68)
lnCA4	0.086	0.104
	(0.61)	(1.02)
lnMP1	-1.401	0.247
	(-0.54)	(0.66)
lnMP2	1.381	-0.207
	(0.96)	(-0.57)
lnMP3	-1.977	0.197
	(-1.58)	(0.52)
lnMP4	1.351	-0.128
	(1.72)	(-0.37)
No. of Obs	178	178
R-sq within	0.58	0.51
R-sq between	0.02	0.81
R-sq overall	0.01	0.75
NOTE:	t-stat. in parenthesis. * = Sign. 5%; ** = Sign. 1%. Time dummies and constant not reported.	

Table 2: Tests of linearrestrictions over sectoral coefficients

Coefficients from **fixed effects** estimates

Linear restriction imposed	Test Results	H_0
lnNE1 = lnNE2 = lnNE3 = lnNE4	F(3,122) = 6.35 Prob > F = 0.0005	rejected
lnMI1 = lnMI2 = lnMI3 = lnMI4	F(3,122) = 0.65 Prob > F = 0.5829	accepted
lnCA1 = lnCA2 = lnCA3 = lnCA4	F(3,122) = 1.33 Prob > F = 0.2665	accepted
lnMP1 = lnMP2 = lnMP3 = lnMP4	F(3,122) = 2.84 Prob > F = 0.0410	rejected

Coefficients from **random effects** estimates

Linear restriction imposed	Test Results	H_0
lnNE1 = lnNE2 = lnNE3 = lnNE4	F(3,122) = 15.02 Prob > F = 0.0018	rejected
lnMI1 = lnMI2 = lnMI3 = lnMI4	F(3,122) = 3.26 Prob > F = 0.3529	accepted
lnCA1 = lnCA2 = lnCA3 = lnCA4	F(3,122) = 13.41 Prob > F = 0.0038	rejected
lnMP1 = lnMP2 = lnMP3 = lnMP4	F(3,122) = 4.72 Prob > F = 0.1936	accepted

On the basis of these results one cannot exclude that, under fixed effects, fragmentation of production has the same impact in the determination of localisation of each industry and thus on country specialisation. The same can be said of comparative advantages, but not of the size variable and of the market potential. Under random effects considerations about fragmentation of production can be confirmed but the equality assumption does not hold anymore for comparative advantages. Restriction over market potential coefficients can be accepted while the one over size variable coefficients is rejected again.

In Table 3 I report results obtained running a regression where all acceptable restrictions under fixed effects are imposed. I observe that the number of varieties (size variable) preserve its industry specific importance. Fragmentation of production has now the same significant and positive impact on the concentration of activities in a certain location for all industries thus affecting specialisation patterns of countries. Comparative advantages loose their marginal importance but the market potential seems to play a new a significant role at least in the Telecommunication Equipment sector.

I give account of results obtained imposing linear restriction under random effects in Table 4. Previous patterns are confirmed and strengthened, with fragmentation of production presenting the same positive and very significant effect in all sectors and market potential preserving its relative unimportance in the determination of industries localisation.

The bottom line is that market potential looses its importance in determining the localisation of industrial activities and the pattern of specialisation of a country when trade in parts and components is explicitly taken into account. Furthermore, while economies of scale associated with a growing size of the industry affacts positively (even if with different scopes across sectors) the concentration of activities, comparative advantages might have at most a certain importance in one sector (Motor Vehicles) but their general relevance seems very limited

Table 3: Estimates with Fixed Effects imposing linear restrictions

Panel of Annual Data from 1995 to 1999	
7 Countries - 4 Industries	
Dependent Variable: $\log h_{it}^{j}$	
Estimation Technique:	Fixed Effects with Specific Time Eff.
lnNE1	-0.446
	(-1.00)
lnNE2	0.999**
	(6.71)
lnNE3	0.294*
	(2.46)
lnNE4	0.864**
	(4.24)
lnMI	0.251*
	(2.57)
lnCA	0.101
	(1.48)
lnMP1	-1.006
	(-0.46)
lnMP2	1.676
	(1.51)
lnMP3	-1.900
	(-1.88)
lnMP4	1.455*
	(2.03)
No of Obs	178
R-sq within	0.57
R-sq between	0.02
R-sq overall	0.01
NOTE:	t-statistics in parenthesis. * = Sign. 5%; ** = Sign. 1%. Time dummies and constant not reported.

Table 4: Estimates with Random Effects imposing linear restrictions

Panel of Annual Data from 1995 to 1999	
7 Countries - 4 Industries	
Dependent Variable: $\log h_{it}^{j}$	
Estimation Technique:	Random Effects with Specific Time Eff.
lnNE1	0.491**
	(6.55)
lnNE2	0.499**
	(6.67)
lnNE3	0.537**
	(6.10)
lnNE4	0.497**
	(6.57)
lnMI	0.296**
	(3.57)
lnCA1	0.318
	(1.28)
lnCA2	0.428**
	(3.82)
lnCA3	0.018
	(0.26)
lnCA4	0.176
	(1.77)
lnMP	-0.293
	(-0.91)
No of Obs	178
R-sq within	0.46
R-sq between	0.76
R-sq overall	0.70
NOTE:	t-statistics in parenthesis. * = Sign. 5%; ** = Sign. 1%. Time dummies and constant not reported.

6 Concluding remarks

Last decade of the XX century has been crucial for Central Eastern European Countries. Their transition to the market economy has produced huge changes in their economic structures with harsh readjustments of their trade patterns. The increasing participation of CEECs firms in the International Production Networks set by EU principals encouraged the reorientation of trade flows. Focusing on the four sector in which most of the trade in parts and components with EU-15 is concentrated, I observe considerable changes in both specialisation dynamics and relocation of activities across CEECs. Market potential changed accordingly suggesting a redesign of economic geography of the whole area.

I define a framework in which market structure, fragmentation of production, comparative advantages and market potential are considered all together as possible determinants of localisation and specialisation. The empirical analysis seems to reveal that New Trade Theory arguments (market structure, economies of scale, etc.) and fragmentation of production may be seen as relevant reasons for activities to relocate and countries to change specialisation patterns. But while the impact of the size component differ across industries, the role played by vertical specialization is significant and common over all sectors. Old frameworks' reasons for trade (comparative advantages) have some influence in determining the shape of industrial location just in the Motor Vehicles industry. Market potential seem not to be able to determine any of the observed trends a part from the Telecommunication Equipment industry where it may have a large positive impact, but this last result does not appear very robust. Severe data constraints do not allow me to consider this evidence as conclusive, but just as a first step in the attempt to improve our knowledge of the phenomenon.

A Concordance table

ISIC rev.3	361 Furniture	
	Parts	**Components**
SITC rev.3	821	
ISIC rev.3	34 Motor vehicles, trailers and semi-trailers	
	Parts	**Components**
SITC rev.3	7139	7132
SITC rev.3	784	778832
SITC rev.3	74419	71623
ISIC rev.3	30 Office, accounting and computing machinery	
	Parts	**Components**
SITC rev.3	7591	
SITC rev.3	7599	
ISICs rev.3	32 Radio, television & communication equipment & apparatus	
	Parts	**Components**
SITC rev.3	76491	7641
SITC rev.3	76492	7642
SITC rev.3	76493	
SITC rev.3	76499	
SITC rev.3	77689	7761-4
SITC rev.3		7768

REFERENCES

Amiti M., 1998, New Trade Theories and Industrial Location in the EU: a Survey of Evidence, *Oxford Review of Economic Policy*, 14 (2), 45-53

Balassa B., 1965, Trade Liberalization and "Revealed" Comparative Advantage, *The Manchester School of Economic and Political Studies*, 33(2), 99-123

Brülhart M., Crozet M. and Koenig P., 2004, Enlargement and the EU Periphery: The Impact of Changing Market Potential, *The World Economy*, forthcoming

Carstensen K. and Toubal F., 2004, Foreign Direct Investment in Central Eastern European Countries: A Dynamic Panel Analysis, *Journal of Comparative Economics*, 32, 3-22

Chiarlone S., 2002, Country specialisation and Trade Overlap: Whome Are the Central Eastern European Countries Competing with, in Baldone S., Sdogati F., and Tajoli L. (eds.), *EU Enlargement to the CEECs: Trade Competition, Delocalisation of Production, and Effects on the Economies of the Union*, Franco Angeli

Choudhri E.U. and Hakura D.S., 2001, International Trade in Manufactured Products: a Ricardo-Heckscher-Ohlin Explanation with Monopolistic Competition, *IMF Working Paper No. 41*

De Simone G., 2004, The Effects of International Fragmentation of Production on Trade Patterns: an Empirical Assessment, *SNF Working Paper 17/04*, Bergen

Graziani, Giovanni, 1995, Threats and Opportunities for West European Industry Deriving from Trade Liberalization with Central and Eastern Europe, in Dobrinsky R. and Landesmann M. (eds.), *Transforming Economies and European Integration*, Edward Elgar, Aldershot, UK and Brookefield, US

Graziani, Giovanni, 1998, Globalization of Production in the Textile and Clothing Industries: The Case of Italian Foreign Direct Investment and Outward Processing in Eastern Europe, in Zysman J.and Schwartz A. (eds.), *Enlarging Europe: The Industrial Foundations of a New Political Reality*, University of California at Berkeley

Harris C., 1954, The market as a factor in the localisation of industry in the United States, *Annals of the Association of American Geographers*, 64, 315-48

Hoekman B. and Djankov S., 1997, Determinants of the Export Structure of Countries in Central and Eastern Europe, *World Bank Economic Review*, 11, 471-487

Jones R., Kierzkowski H. and Lurong C., 2005, What Does Evidence Tell Us About Fragmentation and Outsourcing?, *International Review of Economics and Finance*, 14(3)

Kaminski B. and Ng F., 2001, Trade and Production Fragmentation: Central European Economies in EU Networks of Production and Marketing, *Policy Research Working Paper Series no. 2611*, World Bank

Midelfart-Knarvik K.H., Overman H.G., Venables A.J., 2000, Comparative advantage and economic geography: estimating the location of production in the EU, *CEPR Discussion Paper No. 2618*

Overman H., Redding S., Venables A.J., 2003, The Economic Geography of Trade, Production and Income: a Survey of Empirics, in Harrigan J. and Choi K. (eds.), *Handbook of International Trade*, Blackwell

Redding S. and Venables A., 2004, Economic Geography and International Inequality, *Journal of International Economics*, 62(1), 53-82

Sass M., 2004, FDI in Hungary - The First Mover Advantage and Disadvantage, *EIB Papers*, 9(2), 63-90

Wolf N., 2004, Endowments, Market Potential and Industrial Location: Evidence from Interwar Poland (1918-1939), *CEP Discussion Paper No. 609*, London School of Economics

Yeats, Alexander J., 1998, Just How Big Is Global Production Sharing?, *Policy ResearchWorking Paper 1871*, The World Bank, Development Research Group, Washington D.C.