EU Integration and Outsiders

A simulation study of industrial location.

Richard E. Baldwin [♥]
Graduate Institute of International Studies (GIIS) and CEPR

Rikard Forslid [♦]
Stockholm University and CEPR

Jan I. Haaland [♣]
Norwegian School of Economics and Business Administration and CEPR

Karen Helene Midelfart Knarvik [♣]
Norwegian School of Economics and Business Administration and CEPR

ABSTRACT: This paper focuses on the location effects of preferential trade areas (PTA) on non-members. More specifically, using a CGE model calibrated to real data, it focuses on the impact of tighter European integration on outsider regions. We argue that because theoretical models analysing PTAs have very few contact points with reality, further research is needed to evaluate whether the effects highlighted by these models – catastrophic agglomeration and non-monotonic relocation, for example – are theoretical aberrations of highly specific models, or important effects that help us explain real world events. In our 14-sector, 10-region model, we find broad confirmation for the theoretical PTA models, and in particular for the Puga-Venables effects. We find that tighter European integration has a significant impact on Central and Eastern European countries, but the impact on the other regions of the world is rather small. Our findings do however, suggest that the simple models of economic geography analysing PTAs miss important elements. The most important of these are comparative advantage and real trade costs.

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[♥] Graduate Institute of International Studies, 11a Ave de la Paix, CH-1211, Switzerland. Baldwin@hei.unige.ch
[♦] Department of Economics, Stockholm University, S-106 91 Stockholm, Sweden. Phone: +46 8 16 30 96, fax: +46 8 15 94 82, e-mail: rikard.forslid@ne.su.se
[♣] Centre for International Economics and Shipping, Norwegian School of Economics and Business Administration, Helleveien 30, 5045 Bergen, Norway. Phone: +47 55 95 92 55 (Haaland), +47 55 95 95 10 (Knarvik); fax: + 47 55 95 93 50, e-mails: jan.haaland@nhh.no and karenhelene.knarvik@snf.no

1. Introduction

Europe's political leaders have, since 1957, chosen ever-tighter economic integration as a means of promoting an ever-closer union among the peoples of Europe. This integration has had, and will continue to have, important effects on the location of industry. The location effects of this integration have traditionally played only a minor role in formal economic analysis of European integration. This has recently changed. Economists in Europe and elsewhere have returned to location issues with new 'breakthrough' modelling tools and fresh excitement. This area, sometimes called the new economic geography, enjoys the happy conflux of new data, new theory and pressing policy relevance. Researchers all across Europe are working on this topic. See, for instance, the 1999 special issue of the *European Economic Review* edited by Elhanan Helpman and Jacques Thisse. Much less attention, however, has been devoted to the location effects on those outside the main European integration initiatives such as the Single European Act.

The focus of this paper is on the location effects of preferential trade arrangements on non-members, i.e. outsiders. The main theory piece on this topic is Puga and Venables (1997). Using a very simple two-sector, three-nation model, Puga and Venables predict that agglomeration forces may foster regional disparity within the preferential trading bloc. In particular, production in both members will rise with the margin of preference, but only up to a point. Beyond this point, the so-called break point, industry in the bloc agglomerates mainly or entirely in one of the two member nations. This catastrophic agglomeration initially harms the outsiders, but further raising the preference margin actually increases outsider's production before decreasing it again.

Simple theoretical models, such as Krugman and Venables (1995) and Puga and Venables (1997), are useful for illustrating novel theoretical effects in an intellectually uncluttered setting. These models, however, have very few contact points with reality, so further research is needed to evaluate whether the effects highlighted by these models – catastrophic agglomeration and non-monotonic location effect, for example – are theoretical aberrations of highly specific models, or important effects that help us explain real world events. One way forward would be to empirically estimate the impact of agglomeration forces, as in Midelfart Knarvik and Steen (1999) and Amiti (1997). An alternate route, the one pursued in this paper, is to theoretically investigate the main results in a more realistic model, namely a CGE model calibrated to real data. While the former approach checks the empirical validity of the agglomeration forces within certain industries, our approach focuses on how robust the predictions from simple, symmetric two-goods models are in a more realistic, many-goods, many-countries setting.[2]

Our experiment consists of successive lowering or trade costs within the EEA. While this paper focus on the effects on outsiders, the location effects on the inside countries have been analysed by Forslid, Haaland and Midelfart Knarvik (1999). We therefore here only give a shorter presentation of the within EEA impact.

The plan of the paper is to start with a review of the theoretical literature, in section 2 and to introduce our simulation model, which is an exact replica of Forslid, Haaland and Midelfart

[2] Several studies using CGE-models, e.g. Haaland and Norman (1992, 1995) and Baldwin, Forslid and Haaland (1996), have also studied effects for outsiders in a European economic integration framework. This study differs from previous work because agglomeration forces and locational effects are more pronounced in the present model, and because the model experiment of succesive lowering of trade costs is explicitly directed towards checking the theoretical predictions of economic geography models.

Knarvik (1999), in section 3. We discuss our simulation results in section 4 and provide a summary of our findings and some concluding remarks in section 5.

2. Theory

The vast literature on regional integration agreements (RIA) focuses on the integrating countries since the main line of inquiry revolves around the merits of RIA membership. The main qualitative lesson, i.e. that preferential liberalisation has ambiguous welfare effects on members, has been well known since Viner (1950). However, the impact of RIAs on non-member nations has been subject to much less formal study, as can be seen from a perusal of Pomfret (1997) and Bhagwati, Krishna and Panagariya (1999). The main result here is that an RIA is typically unfavourable for non-member nations. In traditional neoclassical models, the harm to outside nations stems from lower terms of trade and lower export volumes (see Baldwin and Venables, 1995).

In the context of models that allow for agglomeration effects, i.e. models that seem naturally adapted to the European trade situation, the major contributions are Krugman (1993) and Puga and Venables (1997). The Krugman paper focuses on the so-called "hub" effect. That is, he considers what happens to industrial production patterns in a three-nation model when one nation has lower trade cost with the other two nations. Puga and Venables also consider this experiment, but more importantly, they study the production shifting effects of the more classical policy experiment, namely customs union formation. For this reason we focus on the Puga-Venables model.

2.1 The Puga-Venables Customs Union Model

The Puga and Venables (1997) paper, which is theoretical, works with an extremely simple economic geography model of the Venables (1996) type. Specifically, the authors assume two sectors in each nation, one representing a Dixit-Stiglitz sector with monopolistic competition, increasing returns, intra-industry linkages and iceberg trade costs. The other sector is a consumer commodity marked by perfect competition, constant returns to scale and zero trade costs. This sector is used as numeraire. There is only one factor of production (labour), and three countries (home, partner and RoW). The representative consumer in each country has Cobb-Douglas preferences over the commodity and a CES aggregate of the industrial goods. The same CES aggregate enters industrial firms' technology. Instead of modelling explicitly an upstream and a downstream sector, firms in the industry sector are both upstream suppliers of intermediates to other firms as well as downstream producers for consumer demand. These are all standard assumptions in the new economic geography literature (see Fujita, Krugman and Venables 1999).

In the Puga-Venables paper, four forces determine the equilibrium location of firms. First there are two dispersion forces stemming from product-market and labour-market competition. That is, all else equal, firms would rather be in a market with few competitors (both for labour and for customers) and this encourages geographical dispersion of industry. Counteracting these there are two agglomeration forces, forward (i.e. cost-related) linkages and backward (i.e. demand-related) linkages. Specifically, industrial firms use output from other industrial firms as intermediate inputs, so a larger number of locally produced varieties imply, everything else being equal, a lower cost of intermediates. This in turn reduces variable and fixed costs of production in the particular region and thus attracts firms. This is the cost-linked agglomeration force. Of course, firms are buyers of intermediates as well as sellers, so a larger number of local firms expands the market size and this also attracts more firms. This is the demand-linked agglomeration force.

Note that a reduction in the level of trade costs weakens both the dispersion and the agglomeration forces. However, in this model the dispersion forces erode more rapidly, so a steady decline in trade costs might for a certain range of parameter values eventually lead to a breakdown in the symmetric distribution of industry. In particular, at least one region will then become fully specialised in industry.

2.2 The Thought Experiment and Results with the Simple Model

Using this simple set-up, Puga and Venables consider how the location of production is affected by geographically discriminatory trade policies. Their focus is on a couple of key issues related to implications of RIAs for outsiders. Does the RIA formation lead to what Baldwin and Venables (1995) refer to as 'production shifting', as industry is drawn from countries outside the preferential trade area (PTA) to countries inside the PTA? How does the existence of industrial input-output linkages affect the magnitude of production shifting? What are the welfare implications?

The point of departure is a stable symmetric equilibrium with industrial production in all three countries. Ex ante the countries are identical in all respects; however, since this model allows for the possibility of a core-periphery outcome (i.e. all industry is agglomerated in one nation), the initial trade barriers must be assumed to be sufficiently high to ensure that the symmetric outcome is locally stable.

The policy experiment is that of the classic preferential liberalisation: a progressive lowering of trade barriers between two of the countries (home and partner) with no change in the trade barriers between RoW and either home or partner. Assuming for the moment a fixed number of firms in reach region, the model acts very much in a classical fashion. RoW firms face reduced competitiveness in both of their export markets as inside firms get an advantage. Hence, they export less, and there is no offsetting change in competitiveness in their own local market, so output of RoW-firms falls. Since operating profit is proportional to sales under Dixit-Stiglitz monopolistic competition, the preferential liberalisation lowers the profitability of RoW firms. For inside firms, the liberalisation boosts operating profit, although the effects are slightly involved. The two-way preferential barrier reduction exposes them to more competition in their local market, but boosts their competitiveness in the foreign market. These effects tend to offset each other however, so each inside firm gains competitiveness relative to RoW firms in both markets.

Now allowing for free entry and exit, it is clear that firms will relocate from RoW to countries in the RIA, i.e. production shifting occurs, and this process continues until zero profits are restored. The magnitude of the production shifting depends upon the strength of the input-output linkages – the stronger these linkages the larger the production shifting from outsiders to insiders.

These results hold for small margins of preference. When trade costs between home and partner get low enough, a very non-classical event can occur. Lowering home-to-partner trade costs and vice versa weakens the agglomeration and dispersion forces operating in the two markets. That is, as trade costs come down local presence of supplies provides less of an edge and the presence of competitors in the local (as opposed to foreign) market matters less. In the

Puga-Venables model – as is the case in all the standard economic geography models – the agglomeration forces erode more slowly. Consequently, at some level of home-partner preferences, the agglomeration forces outstrip the dispersion forces. The result is agglomeration of industry in one of the RIA nations.

This catastrophic agglomeration is not new (indeed it is the hallmark of an economic geography model). What is new is the implications of this for the RoW-based firms. The within-RIA agglomeration increases the degree of competition faced by RoW firms in the RIA-member that receives the extra firms (call this the 'core' for brevity). However, RoW firms now face a sharp drop in competition in the periphery member of the RIA. In other words, the typical RoW-based firm will now see a more fragmented RIA. This fragmentation may raise or lower RoW-profits. An interesting case is when it raises profits because in this case, the internal RIA catastrophic agglomeration actually raises the production in the RoW. That is, as RoW firms get more profitable, more RoW firms enter until profits are restored to zero.

[FIGURE 1]

Figure 1 illustrates the main Puga-Venables results. The first result is that progressive elimination of barriers between two of the three nations produces regional disparities within the RIA. To see this, focus on the solid lines in the diagram. For trade cost reductions between the origin (which represents infinite trade costs) and the "break point", the preferential liberalisation has neoclassical effects. That is, both customs union (CU) members gain industry share at the expense of the RoW. Since the two CU members are initially symmetric, the gain is apportioned equally among them. However, for trade cost reduction greater than this, industry within the RIA tends to agglomerate in one of the two initially symmetric regions. In this model, the concentration within the CU takes the spectacular form of catastrophic agglomeration, as shown by the jump up in the CU "core" share to the flat line and the jump of the CU "periphery" share down to the bowl-shaped curve. The bowl-shaped curve for CU periphery indicates that deeper preferential liberalisation beyond the break point at first exacerbates this intra-CU disparity, but then mitigates it.

As far as the non-member nation is concerned, the catastrophic agglomeration increases the delocation experienced by the non-member nation (as shown by the jump down to the dashed, mound-shaped curve). Further discriminatory liberalisation has a very non-monotonic impact on industry in the non-member nation. At first, the loss of industry is reduced and later it is increased.

We can characterise the Puga and Venables (1997) as making five predictions:

- CU formation might increase regional disparities within the CU.
- The loss of industry for the CU periphery region could be non-monotonically related to the level of trade costs and it could be roughly convex.
- The gain of industry for the CU core could be non-monotonically related to the level of trade costs and it could take the form of a catastrophic agglomeration.
- CU formation should reduce the industry share of non-members.
- The loss of industry for non-members could be non-monotonically related to the level of trade costs and could be roughly concave.

As for welfare effects, these seem to be closely correlated with the location of industry. Hence, the core gains steadily while the inside periphery may lose from integration; the overall effect for the integrating region is, however, a welfare gain. The outside region loses, although the welfare development may be non-monotonous in the same way as it is for industrial production in the outside region.

Before turning to a more realistic model, namely a CGE model of global trade calibrated to a base year, it should be noted that the catastrophic agglomeration is perhaps the most spectacular of the theoretical predictions of this genre of simple theory models. It is also, however, one of the most fragile results. Even quite slight modifications of the model – including allowing for asymmetric regions and/or addition dispersion forces – can rule out catastrophic agglomeration.

2.3 Extending the Puga-Venables framework

The model sketched above gives strong results regarding location and welfare effects for both insiders and outsiders. Some of these are "neoclassical" and hence robust in the sense that the results from Puga-Venables model are similar to well-known effects from standard customs-union theory. However, the dispersion and non-monotonicity results are not of this kind; these are new results in the literature on new economic geography and agglomeration. As noted above, the effects for insiders have been studied in some detail in this literature, and while some of the results are fragile – like the catastrophic agglomerations – others seem to be more robust. Non-monotonic relationships between trade costs and industry location do for example occur under a wider range of assumptions than in the restrictive Puga-Venables model.

In the present paper we focus on the effects for outsiders, to which much less attention has been paid. The fact that outsiders lose from a production shifting effect is well known. However, the possibility of a non-monotonic relationship with a range of preferential trade costs for which the outsider will actually increase its share of manufacturing, is a new and surprising result. An interesting question is then how robust this result is. No formal analysis exists to help us answer this question. However, by considering the importance of the key assumptions behind the result, we may get an impression of the robustness. In the Puga-Venables model countries are assumed to be identical at the outset, and initial trade costs are such that the inside countries are symmetric and experience the same increase in the share of industry for a range of preferential liberalisation. But when the break point is reached, the situation changes dramatically. The core becomes completely specialised and the periphery's industrial production is suddenly less than in any of the other countries, including the RoW. This internal agglomeration thus gives the outsiders (RoW) a market size advantage relative to the inside periphery and this acts as a counterweight to the trade costs disadvantage faced by RoW. As intra-CU trade costs drop further, the trade-off at first favours RoW production and then it disfavours RoW production. The result is a non-monotonic relationship between RoW production and intra-CU trade costs.

How would initial asymmetries affect this? The countries could differ in size or in the pattern of production and trade, and both may be important for the results. Consider first a situation where the outside country's industrial production is small relative to the insiders; in such a case, the outsider may never get a size advantage but will always face a trade costs disadvantage. Hence, we should expect a monotonously decreasing industry sector in the outside country, possibly with a sudden jump down when the break point is reached.

Secondly, let us consider a case with asymmetric inside countries. In such a case, preferential liberalisation would eventually imply a growth in industrial production in the large inside country matched by a decline in the small one. The core country may, however, still be diversified. In this situation, the outsider nation will always be disadvantaged relative to the core and continued intra-CU liberalisation reinforces this disadvantage. Consequently, the decline in periphery production may not boost outsider's production at all.

Thirdly, differences in the pattern of specialisation and trade may yield similar effects to the ones just discussed. If the outsider trades more with one of the insiders than with the other one in a particular industry or in general, then the important thing is what happens to industrial production in the country that is the more important trading partner. If it happens to trade much with the core country, it will definitely lose industrial production due to the preferential liberalisation. If the periphery is the most important partner, then the picture is more complex; the outsider may probably gain industrial production for certain ranges of trade costs in this case.

Finally, the Puga-Venables prediction of non-monotonic effects on outsiders assumes that initial trade costs are high enough to ensure a diversified and symmetric initial equilibrium. When confronted with real data, as in the CGE-model applied below, we should remember that we don't know where we are at the outset in Figure 1. Since there may already be elements of a core-periphery pattern in the initial data, the expected effects of further regional integration should be adjusted accordingly.

To sum up this section, some of the strong results from Puga-Venables model are likely to be modified in more realistic settings. In particular that seems to be true for the predicted non-monotonic relationship between preferential trade costs and industrial production in the outside region. The negative effects for outsiders, on the other hand, seem to be robust results. And it should be clear that the expected negative effects are stronger the more important the core of the regional integration area is as a trading partner for the outsider.

3. Simulation Model

The Puga-Venables paper is useful to illustrate the basic effects; however, extensions are called for. In particular, it does not tell us what the impact of regional integration is when there are several factors of production, a number of industrial sectors, and not just one outsider country. Which industries will typically be drawn into the integrating countries? What outside countries will be most affected by the RIA – in terms of production, factor prices and welfare? This section uses a medium-size CGE model to analyse the production shifting effects of a RIA in a more realistic framework.

The discussion shall be organised around the five main Puga-Venables predictions. We start, however, with a description of the CGE model employed.

3.1 Features of the CGE Model

The model employed is an exact replica of Forslid, Haaland and Midelfart Knarvik (1999). Thus the model is in the line of CGE models introduced by Haaland and Norman (1992) and, Smith and Venables (1991, 1992) and extended by Baldwin, Forslid and Haaland (1996), Allen, Gasiorek and Smith (1998), and Keuschnigg and Kohler (1996). The main modification of the Haaland-Norman structure is that our model adopts large-group rather than small-group monopolistic competition. This change implies that firm scale is invariant to changes in trade barriers (Helpman and Krugman 1985). Furthermore, the model allows for region-specific input-output linkages and highlights the role of non-traded producer services. Finally, the model allows for import duties, export subsidies and real trade costs.

The model has ten regions, of which four are Western European. These together constitute the European Economic Area (EEA) plus Switzerland, which we refer to as the EEA for brevity's sake. The regional split is based on geography rather than economic criteria. The two other European regions are Central and Eastern Europe and the former Soviet Republics. The remaining regions are North America, South East Asia, China & South Asia and the Rest of the World (see Table 1).

Table 1: Regions

Regions	Description
Europe Central (EC)	Austria, Denmark, Germany, Switzerland
Europe North (EN)	Finland, Iceland, Norway, Sweden
Europe South (ES)	Greece, Italy, Portugal, Spain
Europe West (EW)	BeNeLux, Ireland, France, UK
Europe East (EE)	Czech Rep., Slovak Rep., Hungary, Poland, Bulgaria, Romania, Slovenia
"EEA"	EC+EN+ES+EW
Former Soviet Union (FS)	Former Soviet Republics including Estonia, Lithuania, Latvia
USA&Canada (UC)	USA and Canada
South East Asia (SEA)	South East Asia including Japan
China & South Asia (CSA)	China, India, Bangladesh, Bhutan, Maldives, Nepal, Pakistan, Sri Lanka
Rest of World (RoW)	Other nations not elsewhere included

Source: CGE Model Definitions.

The model disaggregates activity into 14 sectors. The key feature of a Venables-style geography model is the input-output linkages among sectors. This is captured in the model via a complete input-output structure, i.e. all linkages across the 14 sectors.

Two of the 14 sectors are perfectly competitive. The others are marked by monopolistic competition of the Dixit-Stiglitz variety. Two of these imperfectly competitive sectors are non-traded services sectors; the others are traded manufacturing sectors. The basic industrial structure of the model is shown in Table 2.

Table 2: Industries, Trade Costs and Market Structure

Industry	Description
Public Services, Private Services	Non-traded monopolistically competitive sector linked to all other sectors through the input-output structure
Agriculture, Energy	Traded perfect competitive sectors without trade costs. Each sector has a specific factor, which creates an element of decreasing returns to scale.
Textiles, Leather Products, Wood Products, Metals, Minerals, Chemicals, Food Products, Transport Equipment, Machinery, Other Manufacturing	Traded sectors with monopolistic competition. Transport costs of iceberg type, plus tariffs and export taxes or subsidies. Linked to all other sectors through the input-output structure.

Source: CGE Model Definitions.

The model allows for 3 intersectorally mobile factors of production, namely unskilled labour, skilled labour and physical capital, in addition to the specific factors in the energy and agriculture sectors. Factor supplies are assumed to be fixed in this version of the model.

3.2 Basic model equations

Representative consumers in each region have Cobb-Douglas preferences across sector aggregates. This implies the standard, upper-tier demand functions:

$$C_{im} = \alpha_{im} \frac{Y_m}{PI_{im}} \tag{1}$$

where C is the sector consumption composite, α is the expenditure share, Y is the income level, and PI_{im} is the usual CES price index for all differentiated goods in sector "i", namely:

$$PI_{im} = \left(\sum_{j=1}^{10} N_{ij} a_{ijm} P_{ijm}^{(1-\sigma_i)} \right)^{\frac{1}{1-\sigma_i}} \tag{2}$$

where P_{ijm} is the consumer price of good "i" made in region "j" and sold in market "m", the parameters σ_i and a_{ijm} are the product-specific demand elasticity and the region-specific and product-specific biases, respectively (for non-traded goods $a_{ijm}=0$ for all $m \neq j$), and N_{ij} is the number of varieties of good i from region j sold in market m (there are 10 regions and thus 10 markets). Note that income and prices indices are region-specific.

The demand function for individual varieties of an imperfectly competitive sector "i" in region "m" is:

$$X_{ijm} = a_{ijm}\left(\frac{P_{ijm}}{PI_{im}}\right)^{-\sigma_i} C_{im} \qquad \textbf{(3)}$$

Producer prices in the imperfectly competitive sectors are set by the usual mark-up pricing first order conditions, namely:

$$PP_{ij} = \frac{\sigma_i}{\sigma_i - 1} MC_{ij} \qquad \textbf{(4)}$$

where PP_{ij} is the producer price of good i produced in region j, and MC_{ij} are region-specific and product-specific marginal costs. Note that the usual mill-pricing behaviour of Dixit-Stiglitz monopolistic competitors means the producer prices are not destination-specific.

For perfectly competitive sectors, firms perceive demand to be perfectly elastic and so set consumer prices equal to marginal cost.

Consumer prices (P_{ijm}) differ from producer prices due to three types of trade costs: export taxes (EXTAX), transport costs (TRANS), and tariff equivalents of import barriers (TAREQ). The transport costs are of the iceberg type, while export taxes and import tariffs are transfers (to the representative consumer). Thus:

$$P_{ijm} = PP_{ij}\left(1 + EXTAX_{ijm}\right)\left(1 + TRANS_{ijm}\right)\left(1 + TAREQ_{ijm}\right) \qquad \textbf{(5)}$$

where the trade costs are region-specific, product-specific and destination-specific. Observe that for locally sold differentiated goods (this includes non-traded differentiated goods), producer and consumer prices are identical since $EXTAX_{ijm}$=$TRANS_{ijm}$=$EXTAX_{ijm}$=0 for j=m.

Marginal cost curves are assumed to be flat (i.e. invariant to firm-level output) with the form of the marginal cost function being a nested CES-function. In particular, primary inputs, differentiated intermediates, and homogenous intermediates are nested in a top-level CES function with "S_{top}" as the top-level elasticity of substitution. Thus, the marginal cost function for industry i in region j is:

$$M\mathrm{C}_{\mathrm{ij}} = \left[BV_{ij}\left(QV_{ij}\right)^{1-S_{top_i}} + BZ_{ij}\left(Q_{ij}\right)^{1-S_{top_i}} + BZPC_{ij}\left(QPC_{ij}\right)^{1-S_{top_i}}\right]^{\frac{1}{1-S_{top_i}}} \qquad \textbf{(6)}$$

where the B's are region-specific and industry-specific cost parameters, and the Q's are price indices. Namely,

$$Q_{hm} = \left(\sum_{i=1}^{12} g_{ihm} PI_{im}^{(1-sq)}\right)^{\frac{1}{1-sq}} \qquad \textbf{(7)}$$

is the price index for differentiated intermediate goods; this is specific to each purchasing region and purchasing sector. Here "sq" is the elasticity of substitution among imperfectly competitive goods used as intermediates; in general each purchasing sector uses inputs from each of the 12 sectors, although in practice some of the "g" constant terms may be close to zero. Observe that this formulation assumes that firms and consumers in a region face the same price indices, PI_{im}. This implies that industries and consumers have identical expenditure shares, as in the Puga-Venables model.

The price indices for perfectly competitive goods (the set PC) as intermediates are constructed in the same way, i.e.:

$$QPC_{hm} = \left(\sum_{\forall i \in PC} g_{ihm} PC_i^{(1-sq)} \right)^{\frac{1}{1-sq}} \quad \textbf{(8)}$$

where PC_i is the world market price of perfectly competitive good i. Lastly, QV_{ij} is a price aggregate for the three primary factors used in the production in sector i in region j, namely

$$PV_{ij} = \left(\sum_{k=1}^{3} b_{ijk} W_{jk}^{1-s_i} \right)^{\frac{1}{1-s_i}} \quad \textbf{(9)}$$

where s_i is the elasticity of substitution among factors, and the b's are region-specific and industry-specific cost parameters.

In the monopolistically competitive sectors, firms face fixed costs as well as marginal costs. The fixed costs are assumed to require inputs in exactly the same proportion as marginal costs. In other words, the cost functions are homothetic. The number of firms in each sector in each region adjusts to eliminate pure profits. Given the homotheticity of costs, this implies that firm size never varies with trade costs. The use of intermediates from own as well as other industries implies the existence of inter- and intra-industry cost linkages. The presence of these linkages, together with trade costs, means that the number of firms producing in the region affects each firm's costs. This creates cost-linkage agglomeration forces since firms located in a region with a large number of suppliers of important intermediates, will be relatively more competitive and this competitiveness will attract many firms. Agglomeration forces do not directly affect the perfectly competitive sectors, but these sectors are linked to other sectors via factor-market competition with the other sectors. The decreasing returns in these sectors (due to a specific factor) act to dampen the expansion of the other sectors.

3.3 Data

A detailed description of the data and data sources can be found in Forslid, Haaland, Mæstad and Midelfart Knarvik (1999), but the main sources are EUROSTAT (input-output tables for Europe), GTAP and NBER World Trade Flows. Forslid et al (1999) also provides a descriptive analysis of the data material, focusing on the distribution of production across regions, trade flows and trade volume, differences in technology and factor use across industries.

4. Simulation results

Using the model described above, we study the effects of a preferential trade cost reduction on industrial location. More specifically, we study the impact of European integration on the regions outside the EEA area. The idea of this exercise is to judge which aspects of the economic geography based predictions, and in particular of the Puga-Venables predictions, carry through in a more realistic model. The approach therefore follows the lines of Forslid, Haaland and Midelfart Knarvik (1999). The main difference is that we focus primarily on the impact on nations outside of the integrating area.

4.1 The Simulation Experiment

The simulation experiment consists of step-wise changes (both increases and decreases) in the trade costs among the four Western European regions, i.e. Europe Central (EC), Europe North (EN), Europe West (EW) and Europe South (ES). All other trade costs are unchanged so this is a preferential liberalisation. The changes involve all three types of trade costs (transport costs, tariffs and export taxes) with all costs changed in proportion. The step size is 10% per step and we consider three 10% rises and eight 10% decreases starting from the benchmark 1992-data (this benchmark corresponds to 1.0 in the figures).

Table 3 shows the base case trade costs for sales from the regions listed across the top of the table to the EEA region. The numbers are a straight average over the trade costs into EC, EN, ES and EW region. For example, the sixth column shows that Europe East (EE) textiles producers face a 29.3% trade cost in the EEA markets (the 29.3% figure is an average of the four actual trade costs between EE and the four EEA regions). The first four columns show the intra-EEA regional trade costs. Columns five and twelve show the average of the intra-EEA costs and the extra-EEA costs. The contrast between these two columns shows the deep level that European preferential liberalisation had attained by the base year, 1992. It also indicates that our simulation experiments are a long way from most of the CU exercises like that of Puga-Venables, which take all barriers to be initially identical.

Table 3: Trade Costs into EEA area, by Exporting Region and Sector
(% of producer price, averaged over the four EEA regions)

	EC	EN	ES	EW	Avg of 4	EE	FS	CSA	SEA	UC	RoW	Avg of 6
Textiles	3.7	6.5	4.2	4.2	4.7	29.3	27.3	50.2	38.0	12.0	24.9	30.3
Leather	3.4	3.8	3.6	3.9	3.7	10.8	9.6	11.4	10.3	9.5	12.3	10.7
Woodprod	3.2	-8.2	3.7	3.5	0.6	6.5	15.6	7.5	10.5	6.4	11.5	9.7
Metals	3.5	6.6	3.9	4.0	4.5	11.4	8.5	9.1	9.2	6.6	10.8	9.3
Minerals	8.0	6.0	7.6	6.3	7.0	16.7	82.2	9.2	9.4	8.9	13.0	23.2
Chemicals	4.2	11.8	5.0	5.1	6.5	20.6	23.4	25.5	25.7	21.7	23.2	23.4
Foodprod	12.5	23.0	12.5	12.4	15.1	46.7	44.4	22.7	25.3	21.0	37.8	33.0
Transeq	1.9	3.0	2.2	2.2	2.3	9.3	10.5	7.7	19.3	4.7	7.2	9.8
Machines	2.3	2.4	2.9	2.9	2.6	6.1	6.7	7.1	30.4	5.6	8.1	10.7
Other man	3.1	2.8	3.2	3.3	3.1	6.3	6.2	9.3	12.6	5.5	6.3	7.7
Average	4.6	5.8	4.9	4.8	5.0	16.4	23.4	16.0	19.1	10.2	15.5	16.8

Notes: a. EEA includes Switzerland in the model.
b. See **Table 1** for regional abbreviations.
c. For EC, EN, ES and EW, the numbers indicate costs within the EEA area. For other regions, the cost shows the trade cost of selling the specific product to the EEA area (using average cost of selling to EC, EN, ES and EW).

4.2 Intra-CU Regional Disparity Results

The five Puga-Venables results discussed above can be grouped into two categories. Results concerning predictions about intra-CU disparities and results concerning the impact on non-members. The first thing to focus on is intra-CU disparities. Since Forslid, Haaland and Midelfart Knarvik (1999) studies these aspects at length, we provide only a limited discussion of these effects. The three internal Puga-Venables predictions are:

- CU formation might increase regional disparities within the CU.
- The loss of industry for the CU periphery region could be non-monotonically related to the level of trade costs and it could be roughly convex.
- The gain of industry for the CU core could be non-monotonically related to the level of trade costs and it could take the form of a catastrophic agglomeration.

In studying the results of the simulation, we focus on the imperfectly competitive, traded goods sectors since these are the sectors most influenced by the economic geography type agglomeration forces, explicitly considered here. Figure 6 shows the impact on production volumes in the four EEA regions. Each line in each diagram represents the change in one of the relevant region's ten sectors that are traded and imperfectly competitive. The numbers have been converted to indices in order to facilitate comparison across the sectors and regions; 100 equals production at the highest trade costs, namely 1.3 times the base case costs. In all four regions, the figures suggest that preferential trade-cost reductions increase regional specialisation within Western Europe; see Forslid, Haaland and Midelfart Knarvik (1999) for a more detailed discussion.

This finding confirms that the first prediction carries through in a model that is more realistic than the theoretical economic geography models (see e.g. Krugman and Venables, 1995, and Puga and Venables, 1997).

[FIGURE 2]

Given the range of sectors considered in our model, we can push the prediction further. The core logic of the economic geography finding of heightened regional disparity rests on agglomeration forces. This is easily seen since the two CU nations in the theoretical economic geography models, referred to above, are absolutely symmetric ex ante. Thus there are no endowment-driven or technology-driven comparative advantages to explain the regional disparities that appear. Given this, we can extend well known results from theoretical economic geography analyses to suggest that if agglomeration is the main force driving the regional disparities, we should observe the largest disparities in sectors marked by the strongest agglomeration forces. As discussed above, agglomeration forces in our model and Puga-Venables type models are strengthened by a high share of intermediate usage and strong scale economies. For the 10 sectors, these facts are listed in Table 4. Note that machinery, transport equipment, chemicals and metals have above average scale elasticities. As for intermediate input shares, it is the wood products, metals, chemicals and textile sectors that are above average. Taking these together, we should expect strong agglomeration effects at least in the chemicals and metals sectors.

Table 4: **Sectoral Indicators of Agglomeration Forces**

	Scale Elasticity*	Intermediates Input Share**	Trade Costs***
Textile	0.06	0.29	4.70
Leather	0.06	0.19	3.70
Wood Products	0.12	0.27	0.60
Metals	0.16	0.37	4.50
Minerals	0.10	0.13	7.00
Chemicals	0.24	0.30	6.50
Food Products	0.08	0.16	15.10
Transport Eq.	0.26	0.15	2.30
Machinery	0.20	0.17	2.60
Oth.Manuf.	0.08	0.03	3.10
Mean	0.14	0.20	5.00

*) Percent reduction in average cost (AC) with a one-percent increase in output.
**) Includes intermediates from own sector only.
***) As a percent of producer prices; unweighted average over all CU regions.

Figure 2 also clearly shows that the sectors experience quite different effects. Textiles, leather, wood products and food products experience large shifts, while metals, chemical and machinery experience very small production effects. However, one should note that the latter sectors are relatively concentrated in Europe Central originally – and obviously – remain so as trade is liberalised (see Forslid, Haaland and Midelfart Knarvik 1999 for further analysis on this point). Comparing these findings to Table 4, we see that three of the four sectors that show a very strong tendency towards regional concentration have average or above average intermediate usage. Intermediate usage here refers to use of intermediates from own sector. The food products sector does not have a high intermediate usage cost share, but it does start with very high trade costs so the proportional cuts in our simulations imply massive liberalisation. Further evidence for agglomeration effects can be found in the results for the textile sectors. This sector is marked by something that resembles a catastrophic agglomeration when trade costs are lowered from 40% to 30% of the base-case level. This is a very non-neoclassical result and thus seems to indicate that agglomeration forces are important in this sector. It also confirms the economic geography based predictions on non-monotonicity and catastrophes, at least for one sector.

There are, however, some sectors that might seem to defy the economic geography based prediction, namely chemicals and metals. In these sectors we should expect strong agglomeration forces since they have both above average scale economies and above average intermediate use. Yet these sectors experience a small tendency towards regional dispersion. However, as noted above, these are also sectors that originally were relatively concentrated. Hence, we cannot discard the importance of agglomeration forces for the localisation of these industries; but the results indicates that in the interaction with comparative advantage effects, they are losing in significance as the trade liberalisation process proceeds. As demonstrated by Forslid, Haaland and Midelfart Knarvik (1999), these high scale industries actually display a weak non-monotone localisation pattern with maximal concentration for trade costs around the middle of our range.

Our model includes many more location forces than does Puga and Venables (1997). For instance, we include a sector with diminishing returns to scale, which tends to dampen agglomeration, but we have input-output links with the non-traded service sectors, which should foster agglomeration along the lines of Faini (1984). We turn now to the impact of such forces. For low trade costs, agglomeration forces become weak, so comparative advantage forces will tend to dominate the location of industries. Given that industries have different relative factor intensities, and regions have different relative endowments, we should observe location effects corresponding to comparative advantage. Value added shares and factor intensities ratios are shown in Table 5 (the rankings of different sectors are similar across the EEA, so only the EEA average is shown). Note that chemicals, transport equipment and machinery are skill-intensive sectors, while textiles and leather are relatively unskilled labour intensive. Food products and minerals are relatively capital intensive.

Table 5: **Value added shares and factor intensity ratios (European averages).**

	Unskilled labour	Skilled labour	Capital	Unskilled /skilled ratio	Labour /capital Ratio
Textiles	0.595	0.175	0.235	3.40	3.28
Leather and Products	0.603	0.175	0.225	3.44	3.46
Wood Products	0.530	0.245	0.228	2.16	3.41
Metals	0.565	0.233	0.203	2.43	3.94
Minerals	0.455	0.195	0.353	2.33	1.84
Chemicals	0.438	0.278	0.285	1.58	2.51
Food Products	0.450	0.185	0.365	2.43	1.74
Transport Equipment	0.540	0.268	0.198	2.02	4.09
Machinery	0.478	0.313	0.210	1.53	3.76
Other Manufacturing	0.553	0.240	0.205	2.30	3.87
MEAN	0.521	0.231	0.251	2.36	3.19

Comparative advantage also depends upon relative factor endowments and these are displayed in Table 6, columns 1 and 2. The table shows that Europe South is relatively abundantly endowed with unskilled labour, while Europe North is relatively abundant in skilled labour. Europe Central and Europe North are relatively more capital abundant than Europe South and Europe West.

Table 6: Relative Factor Endowments and relative size

	Unskilled/Skilled labour force	Labour/Capital stock	Share of European GDP *)
Europe Central	4.02	0.019	34.5 %
Europe North	1.69	0.017	5.8 %
Europe South	7.41	0.038	24.3 %
Europe West	2.77	0.037	35.5 %
MEAN	2.99	0.028	

*) Base case (1992) model data.

Using these facts to interpret the Figure 2 results, we see that comparative advantage does seem to play an important role in explaining the rise in regional disparity. For instance, production of unskilled-labour intensive leather and textile sectors shift to the unskilled-labour abundant Europe South. Food products, which are relatively capital intensive, move sharply to capital-rich Europe North. The big move in wood products is due to the removal of a significant export subsidy initially paid in Europe North (see Table 3).

What all this suggests is that, as Forslid, Haaland and Midelfart Knarvik (1999) point out, regional disparity are related to agglomeration forces as well as neoclassical forces. Which type of forces dominate will depend on industry characteristics. For instance, in the cases of textile, leather and food products, its seems that lowering intra-CU trade costs produces disparities that corresponds to a heightened exploitation of comparative advantages. However, the effects are reinforced by agglomeration forces.

4.3 Impact on Outsiders

The second category of Puga-Venables predictions concerns the impact on nations that are not members of the CU. Here there are two Puga-Venables predictions. The first of these comes from both economic geography and neoclassical CU analyses (see Baldwin and Venables , 1995):

- CU formation should reduce the industry share of non-members.
- The loss of industry for non-members could be non-monotonically related to the level of trade costs and could be roughly concave.

[FIGURE 3]

Figure 3 shows the production volume indices by region for the four non-Eurasian regions (all graphed to the same scale). From this figure we see that Europe's preferential liberalisation clearly has very little impact on production in South East Asia and RoW (basically Africa, South America, and the Middle East). A glance at Table 7 shows that the Western European markets (EEA) account for only a minor part of Asian and RoW manufacture sales, namely 3.2 % in both cases. Moreover, as Table 3 shows, the initial level of intra-EEA barriers is quite low, so the increase in the margin of preference in our simulations is quite modest. Finally, observe that while all of these production effects on South East Asia and RoW are small, they are all negative as is predicted by the Puga-Venables paper and standard neoclassical analysis.

Table 7: Regional distribution of total manufacture sales *(percent of total sales from the regions in the left-hand column to the regions across the top row)*

	EW	EC	ES	EN	EEA	EE	FS	CSA	SEA	UC	ROW
EW	69.3	11.2	6.9	1.4	88.8	0.5	0.3	0.5	2.5	3.6	3.7
EC	11.9	71.3	5.5	1.9	90.6	1.4	0.6	0.4	2.4	2.5	1.9
ES	8.1	7.0	78.0	0.6	93.7	0.6	0.4	0.2	1.3	1.8	2.1
EN	8.6	7.9	2.7	73.5	92.7	0.5	0.5	0.4	1.8	2.6	1.4
EE	3.6	10.5	3.6	1.0	18.7	74.8	1.2	0.6	0.9	0.8	3.1
FS	0.7	0.9	0.5	0.4	2.5	0.5	94.3	1.3	0.7	0.3	0.5
CSA	1.1	0.9	0.5	0.1	2.6	0.1	0.6	82.0	7.2	4.7	2.9
SEA	1.3	1.2	0.5	0.2	3.2	0.1	0.1	1.6	87.5	5.3	2.3
UC	1.8	0.9	0.5	0.2	3.4	0.1	0.1	0.4	3.1	89.4	3.5
ROW	1.4	0.9	0.8	0.1	3.2	0.2	0.1	0.5	2.2	4.1	89.8

Source: CGE model. See **Table 1** for regional abbreviations.

The figure also shows the production effects on China and South Asia (CSA), and the US and Canada (UC). Putting the leather sector to the side for a moment, the figure shows that CSA and UC production display slightly negative production effects or no effects at all. Again this is in line with the fact that the EEA market accounts for less than 4% of UC sales and less than 3% of CSA sales. It is not, therefore, surprising that changes within the EEA have only a minor impact on UC and CSA industry.

Figures 2 and 3 also reveal unexpected developments in the leather sector. The dominant impact in this sector is a spectacular rise in Europe South's production and an important drop in the leather output of Europe Central and Europe West. The impacts on the non-member regions are all much milder, including the unexpected rise in North American production. The big shifts in leather production are somewhat curious at first sight, but they follow from the peculiar nature of the sector. Three features act in concert to encourage large production shifts in the leather sector. The sector is quite competitive (since it has close to constant returns to scale) yet trade costs are quite low (a third of those in textiles) and intermediate inputs are quite important. These factors combine to amplify even the small changes in competitiveness caused by the discriminatory trade cost reductions in Europe.

[FIGURE 4]

Figures 4 and 5 show the impact of our simulated change in intra-EEA trade costs on the two regions – namely Europe East (EE) and the Former Soviet Republics (FS) – that would be most likely to be affected, given their geographic proximity. What we see from Figure 4 is that the impact on the Former Soviet Republics is quite limited, apart from the idiosyncratic leather sector. The reason again follows from the Table 7 sales shares. For the most part FS industry sells in the FS, so the EEA's internal trade cost adjustments have little impact on FS output.

The one region that is significantly affected is Central and Eastern Europe (EE), as Figure 5 shows. Again, this result follows naturally from the fact that EE industry depends heavily on the West European markets for exports. From Table 7 we see that almost a fifth of EE manufactured goods are sold in the EEA markets, with Europe Central (EC) being a particularly important customer. Plainly, the EE volume of production drops in every sector. Moreover, the drop is largest in transport equipment, a sector marked by both a high intermediate input share and significant scale economies.

[FIGURE 5]

It is also noteworthy that the textile sector displays very non-monotonic behaviour. More precisely, EE textile production generally falls as EEA discriminatory liberalisation proceeds (as expected), however when the trade costs move from 40% of the base case level to 30%, EE experiences a large increase in textile production. This increase can be thought of as the external "echo" of the internal catastrophic collapse of textile production in Europe Central (see Figure 2). As textile production in Europe Central – EE’s major Western European trading partner – declines, Europe East producers suddenly find themselves faced with many fewer competitors in the Europe Central market. Since Europe Central accounts for more than a third of the EEA GDP (see Table 6) this significantly benefits production in nearby East European producers. This finding broadly confirms the Puga-Venables emphasis on agglomeration effects. It illustrates how an agglomeration process causing regional disparity and catastrophic agglomeration within a CU, might lead to gains for outsiders.

4.4 Welfare and factor price effects for outsiders

A commonly expressed fear is that closer EU integration will harm outside countries, especially those that are heavily dependent upon EU markets, such as Norway and Switzerland. This is indeed a prediction of neoclassical customs union theory and of the new economic geography theory. The basic story is that outsiders will lose competitiveness relative to insiders, and to compensate for that, factor prices are forced down.

[FIGURE 6]

Our simulations confirm these predictions. Figure 6 shows the real GDP effects for all the outside regions, as well as the average for the insiders (called EEA). The figure clearly reveals that insiders gain and outsiders lose. However, the loss is only significant for Central and Eastern Europe (EE), as we should expect, based on the analysis above. Indeed, the percentage loss in GDP is approximately of the same magnitude as the gain to the EEA, namely almost 2% in each case.

[FIGURE 7]

Figure 7 shows the real factor price effects for the Europe East region. It is interesting to note that although all real factor prices decline, the loss is less for unskilled labour than for the other factors. There is also an interesting element of non-monotonicity, coinciding with the range of trade costs where the catastrophic agglomeration in the textiles industry inside the EEA – and the accompanying growth in textiles in Eastern Europe – takes place.

5. Conclusions

The theoretical economic geography literature is useful for illustrating novel theoretical effects in an intellectually uncluttered setting. These models, however, have very few contact points with reality, so further research is needed to evaluate whether the effects highlighted by these model--catastrophic agglomeration and non-monotonic location effect, for example--are theoretical aberrations of highly specific models, or important effects that help us explain real world events. One way forward would be to empirically estimate the impact of agglomeration forces, as in Midelfart Knarvik and Steen (1999) and Amiti (1997). An alternate route, the one pursued in this paper, is to theoretically investigate the main results in a more realistic model, namely a CGE model calibrated to real data.

The focus of this paper is on the location effects of preferential trade arrangements on non-members, i.e. outsiders, and as such it is best seen as a complement to the earlier work by Forslid, Haaland and Midelfart Knarvik (1999). The main theory piece on this topic is Puga and Venables (1997). Using a very simple two-sector, three-nation model, Puga and Venables is one of the economic geography models that predict that agglomeration forces might foster regional disparity within the preferential trading bloc. In particular, production in both members will rise with the margin of preference, but only up to a point. Beyond this point, the so-called break point, industry in the bloc agglomerates mainly or entirely in one of the two member nations. This catastrophic agglomeration initially harms the outsiders, but further raising the preference margin actually increases outsider's production before decreasing it again.

In our 14-sector, 10-region model, we do find broad confirmation for the Puga-Venables effects when we simulate changes in the degree of preferential liberalisation among EEA members. For instance, three of the four sectors that are marked by very strong region agglomeration also have average or above average usage of intermediate inputs. We also find a catastrophic collapse in one sector (textiles) that is marked by strong input-output linkages. Moreover, this collapse within the bloc has important ramifications for production in one outside region, namely the Central and Eastern European countries (EE). Interestingly, we find that the collapse within the EEA is good for EE textile production. The reason is that our model has a more realistic trade cost structure and the collapse moves EEA textile production out of Europe Central and to Europe South. Since the EEs are very close to Europe Central (Austria, Denmark, Germany, and Switzerland) and this market is very large, the collapse actually boosts the competitiveness of EE textile firms.

Overall our findings suggest that the simple models of the economic geography literature miss important elements. The most important of these is comparative advantage and real trade costs differences. In the simplest economic geography models, regions are ex ante symmetric so comparative advantage never appears. In the real world nations and sectors are marked by important differences in factor intensity and factor endowments. As trade costs come down, these neoclassical forces take over.

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Figure 1: Simulations with the Puga-Venables Model

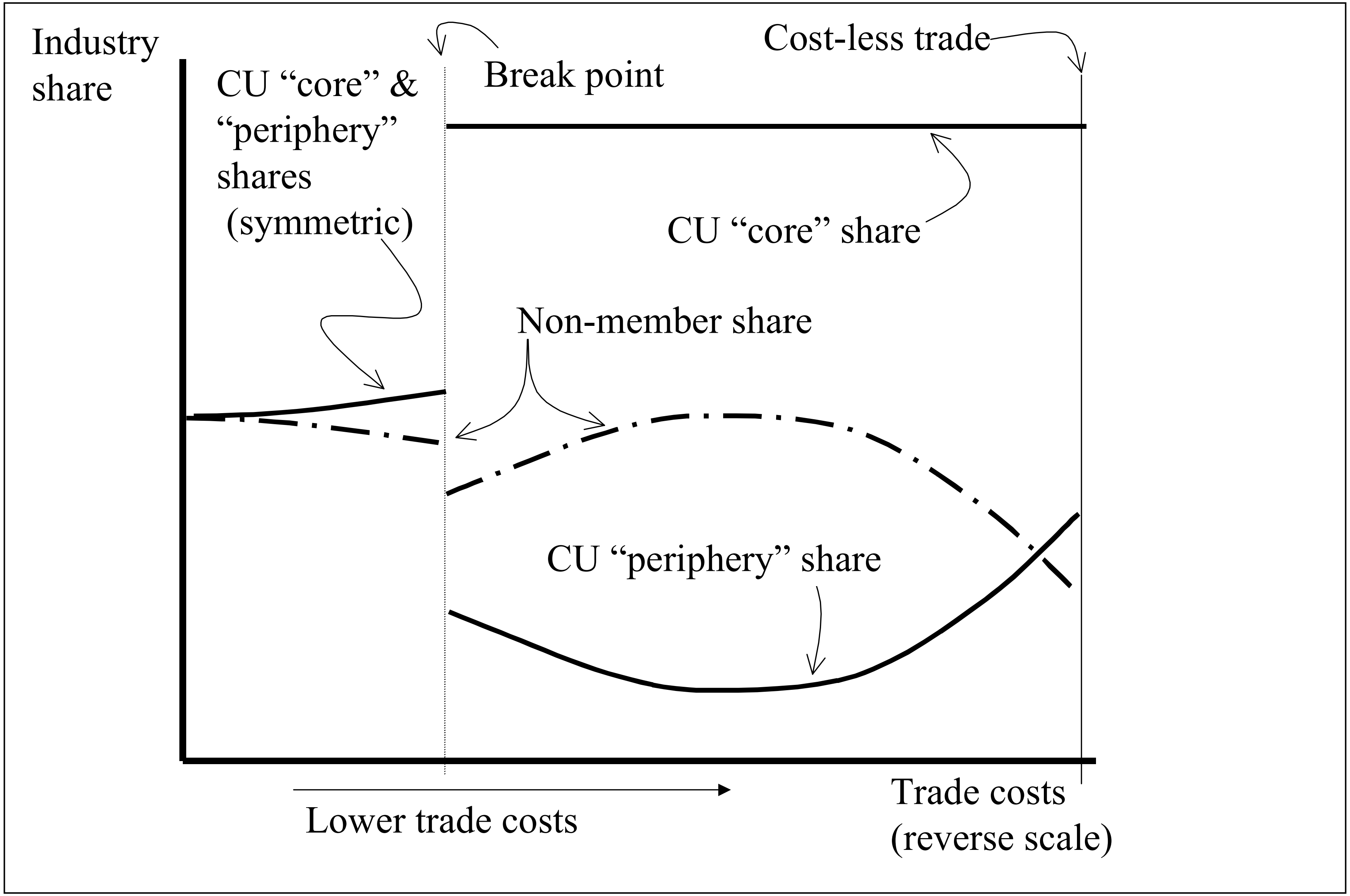

Figure 2: Production Volume Indices by Region and Sector

(ES= Europe South, EW= Europe West, EC= Europe Central, EN= Europe North)

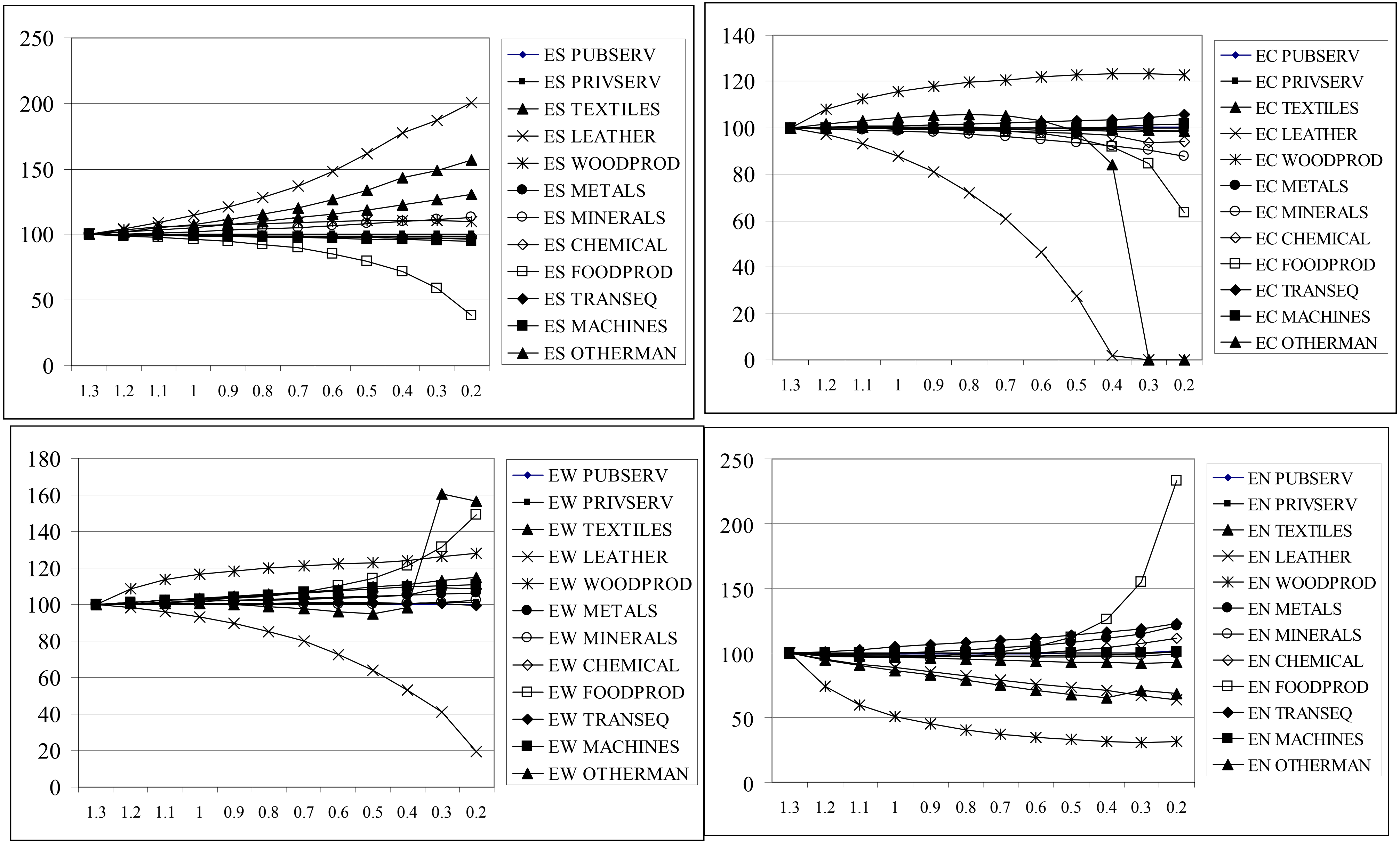

Figure 3: Production Volume Indices by Region and Sector
(SEA= South East Asia, CSA= Central and South America, ROW= Rest of World, CU= Canada and US)

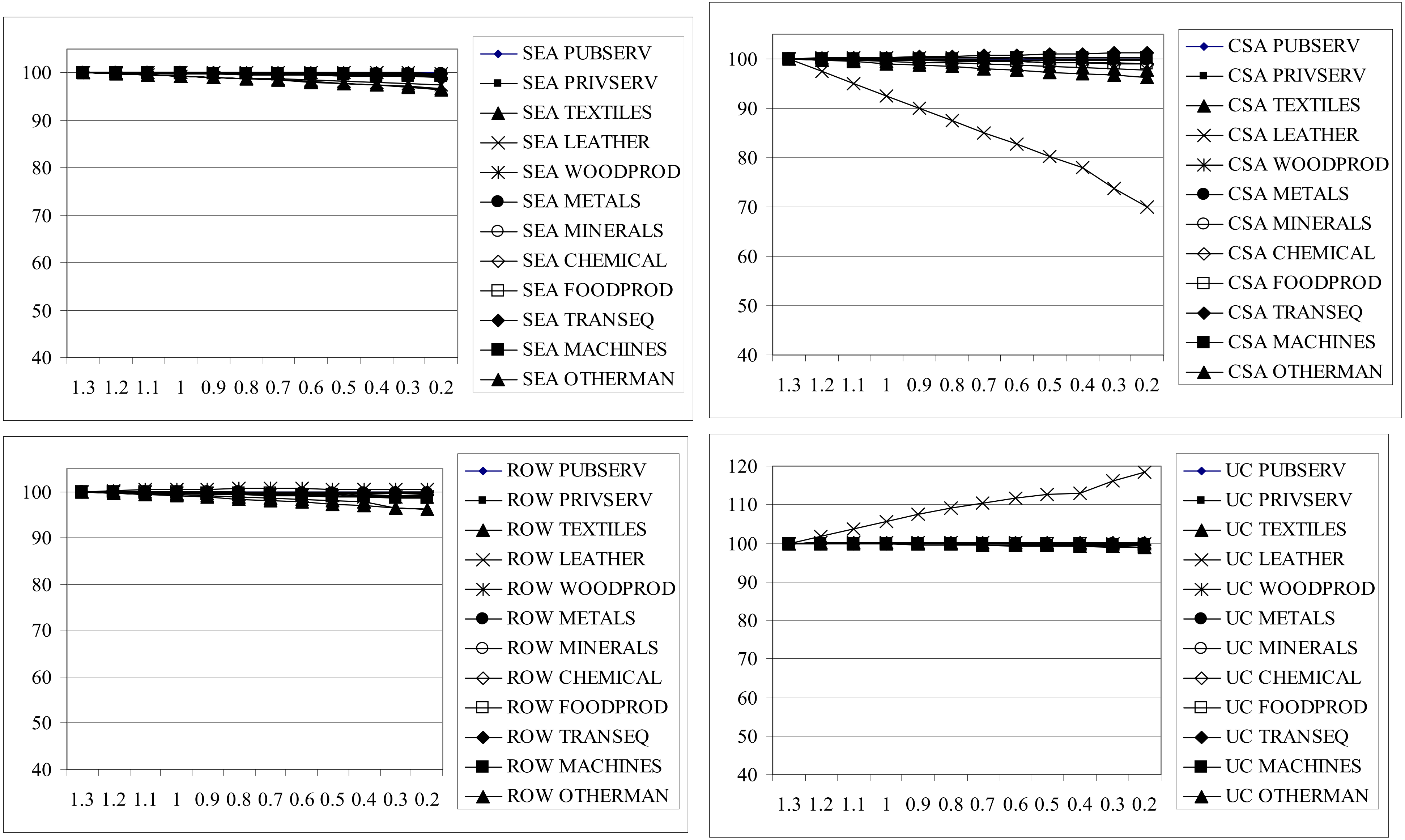

Figure 4: Production Volume Indices by Region and Sector (FS= Former Soviet)

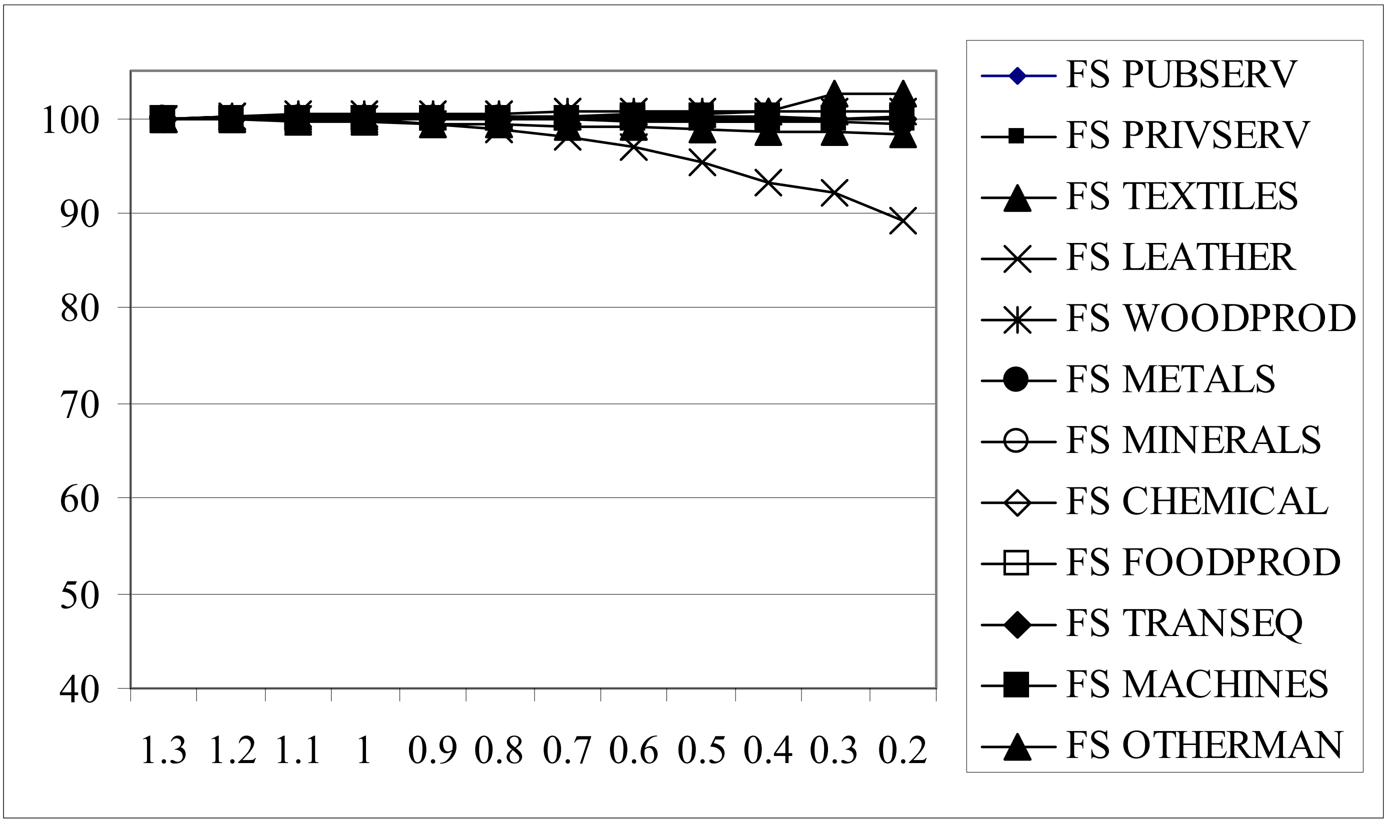

Figure 5: Production Volume Indices by Region and Sector (EE= Europe East)

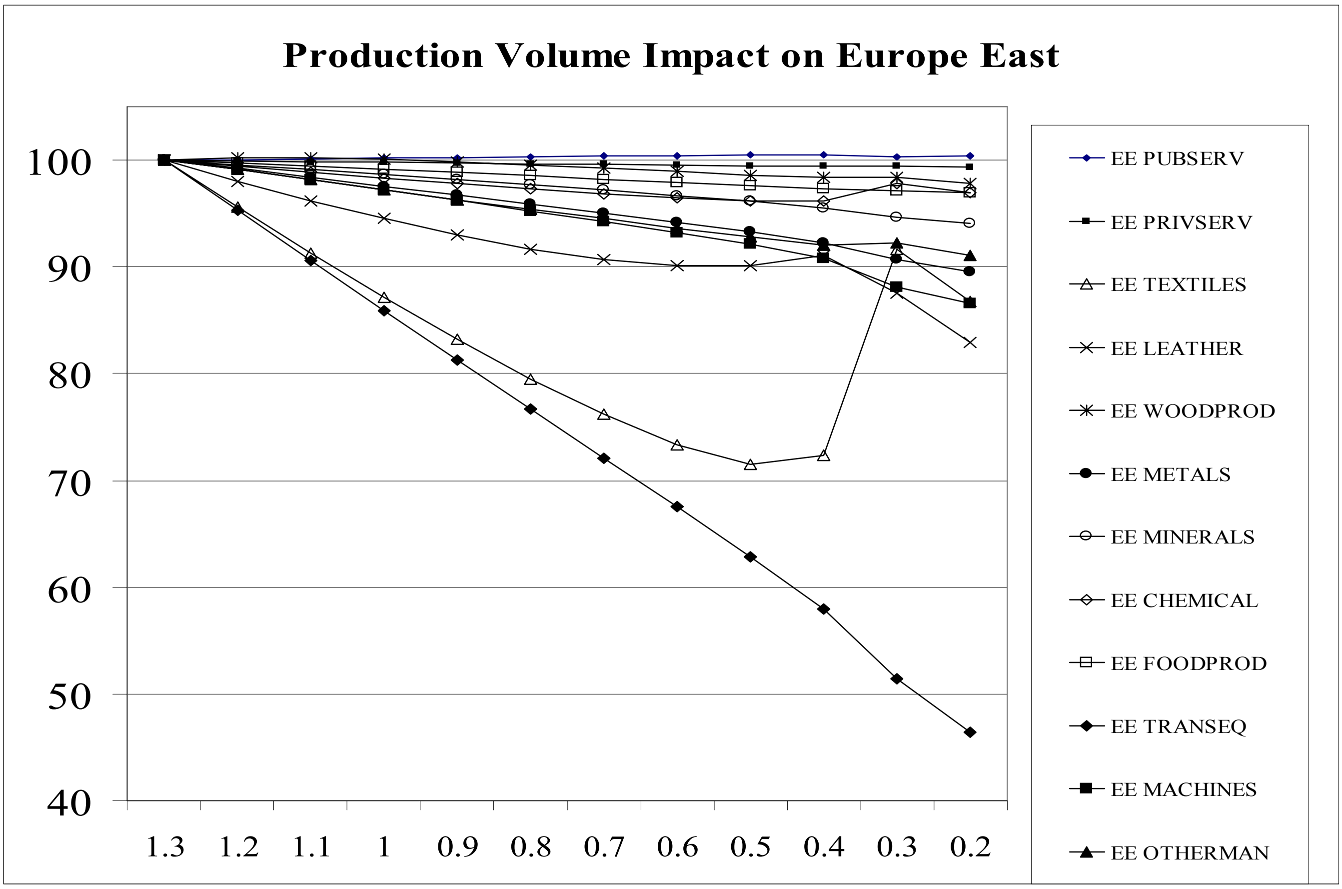

Figure 6. Welfare effects.

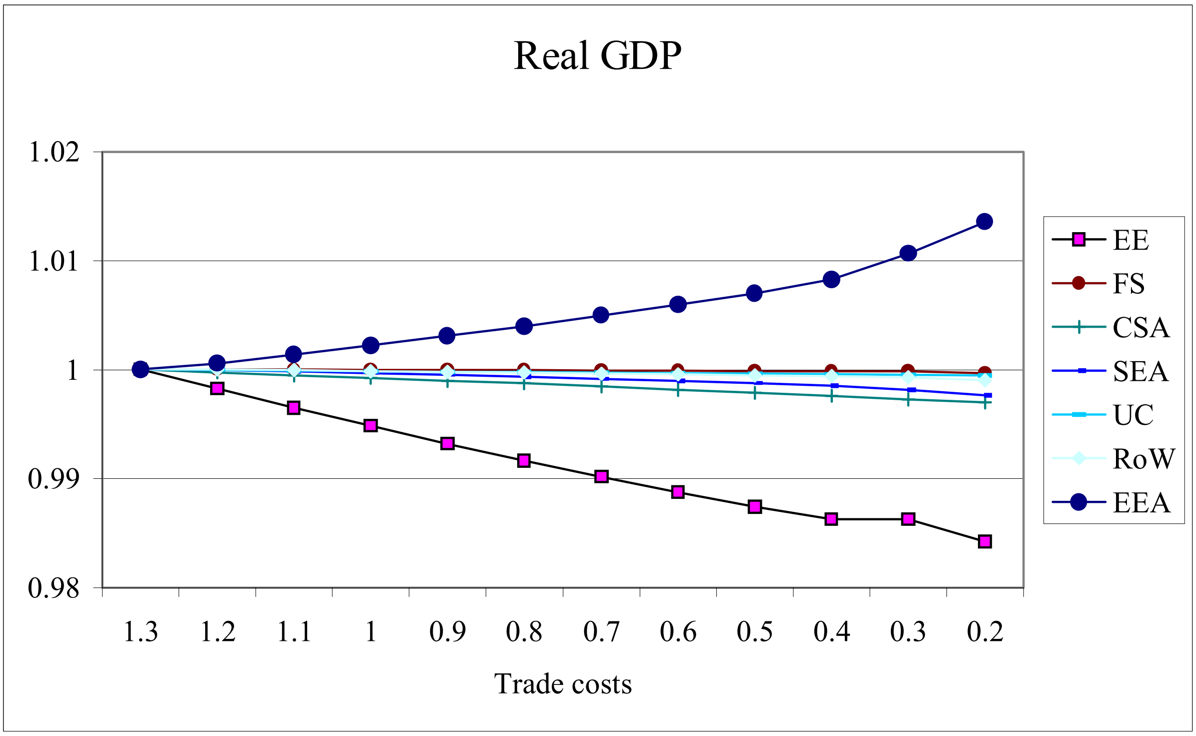

Figure 7. Real factor prices changes in Eastern Europe (EE)