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YVONNE WOLFMAYR-SCHNITZER

ECONOMIC INTEGRATION, SPECIALISATION AND THE LOCATION OF INDUSTRIES

A SURVEY OF THE THEORETICAL LITERATURE

1. Introduction

Since the second half of the eighties, international trade and above all foreign investment flows have surged as have other new forms of international co-operation agreements between firms. All these facets of internationalisation are inherent to the globalisation process and are driven by lower trade barriers, reduced restrictions on FDI and improvements in transport and communication which facilitate the dispersion of activities, accelerate the dissipation of knowledge and technology and enhance world-wide economic integration. The emergence of Asian competitors and the opening and re-orientation of Eastern Europe have further accelerated this process while the European integration process completely abolished trade barriers between member states, created a single market and in its final stage a single currency.

Both, the process of European integration and globalisation have dramatically changed the competitive environment for European manufacturing. Not only the scope of competition has changed, but also its nature: exclusive focus on low production (labour) costs is becoming increasingly difficult and the pressure to produce and sell high quality with attractive prices forces firms to focus on continuous quality upgrading, innovation and outsourcing. Locational decisions of firms become more and more driven by motives related to the external environment of the firm and economies of scale which may enhance locational concentration. Spill-overs, the availability of good transportation and communication infrastructure, close, co-ordinated relationships with customers and suppliers, the presence of a highly skilled and specialised labour force, the reliability of supporting companies are only a few factors. Agglomeration economies that are economies arising from the proximity

associated with the clustering of firms, workers and consumers have come to the fore as typical explanations for geographic clustering and concentration of industrial activities. From a regional policy point of view the danger and concern lies in the fact that these agglomeration forces may strengthen the imbalance between a rich core and a poor periphery as innovative industries are more likely to agglomerate in the core areas of the EU, with better market access and structures and disadvantage peripheral regions even more.

Another possible consequence of the European integration and the global competition is an increased specialisation of European regions given that technologies and/or endowments and factor inputs differ across countries. FDI might reinforce the patterns of specialisation, especially, if access to technology is a more important determinant of FDI than access to markets. From a European perspective specialisation according to comparative advantage and the deeper division of labour will enhance efficiency and competitiveness and therefore be beneficial. On the other hand, specialisation in narrow product groups may increase the demand risk for individual countries and especially increase the vulnerability for lagging regions when firms are unable to adopt and move on to more promising market segments in a time of increasingly shorter product cycles.

While the effects of globalisation and the European integration on welfare of the member states and income convergence/divergence have been of major interest, another important (related) question of policy concern is that of the possible impact of these ongoing processes on industrial structures and the dispersion of industrial activities within Europe. What are the predictions on this issue from economic theory? Can we expect integration and global competition to make industrial structures across European countries more similar or to induce a trend towards higher specialisation? What are the conditions under which we can expect a movement of industries toward the core, and when will industries disperse over all regions? Which are the industries to be affected most? This paper gives a survey on relevant theoretical models and their predictions on these issues.¹⁾

¹⁾ An overview on the existing empirical literature on these questions can be found in: Aiginger, 1999. For recent empirical results on the convergence of European industrial structures see Aiginger et.al., 1999.

Integration theory, directly analyses the economic consequences of tariff mechanisms and other trade policies. Its starting point was Viner's (1950) analysis of the economic consequences of customs unions. This theory's major focus has been on the determination of two opposing forces: trade creation between the members of the customs union and trade diversion stemming from the exclusions of non-members and their effects on welfare for the whole integration area. As to the question of the distribution of welfare effects within the customs union, the arguments are taken to a large part from basic international trade models predicting income convergence between member states which in turn increases intra-industry specialisation (Verdoorn, 1960). Arguments are also taken from regional and development economics postulating divergence of incomes and structures between peripheral and core regions within the integration area.

The survey thus starts with a review of traditional comparative advantage models of trade as well as models from the new trade theory literature giving predictions on specialisation patterns across countries in interindustry trade and intraindustry trade, respectively. The bow is then bend further to economic geography models which give insights on the location of industries, in particular how core-periphery patters can arise endogenously in equilibrium. Economic geography models so far mainly worked with single location firms. So we continue by an overview on the theory of the multinational firms based on a proximity/plant size trade off. Here insights can be gained on how multi-location firms organise their activities across space which in turn can have important impacts on trade specialisation and the "geography" of economic activities. Throughout the theoretical models the processes of integration and globalisation are modelled as a decrease in "transportation costs" or "transaction costs" subsuming all sorts of possible costs that arise in international transactions, from tariffs, quotas, transportation to information costs (national regulations, culture, language) and exchange-rate risks, etc..

2. Traditional (static) international trade theory models

Traditional trade theory explains trade specialisation patterns by concentrating on the unique characteristics of each country, which in turn give rise to relative cost differences, called "comparative advantages". **Ricardo (1817)** assumed international differences in the productivity of labour to be the sole reason for cross-country differences in comparative production costs. The "**Heckscher-Ohlin theory of trade**"

(factor-proportions theory) on the other hand assumes, that technologies are the same across countries and comparative advantages are entirely due to differences in factor endowments or the relative abundance of factors of production. In the two-factor economy of the HO-world then, countries will tend to specialise in the export of goods whose production is intensive in factors with which they are abundantly endowed.

Although the HO-model has long occupied a central place in trade theory, no empirical tests have so far supported the hypothesis in its pure form, assuming that technology is freely available and ubiquitous across countries (Leamer-Levinsohn, 1995). The inclusion of additional factors of production beyond just capital and labour, most importantly human capital and other knowledge-related variables like labour skills, R&D expenditure, employment of scientists and engineers (generalised factor proportions theory), variables closely linked to differences in countries' technological capabilities moved the theory much closer to reality. This is also suggested by some recent interesting empirical works on comparative advantage. The work include that of Trefler 1993, 1995, Harrigan 1997, Davis and Weinstein, et al. 1997 which all suggest that with some quite simple deviations from the original format of the theory (inclusion of Ricardian technical differences, consideration of cross-country differences in demand patterns), the HO-model seems to work quite well. There were also numerous attempts to introduce technological change into an otherwise Heckscher-Ohlin model (Finlay-Grubert, 1959), nevertheless, the HO-theory remained an essentially static theory for a long time.

3. "Man-made" comparative advantage, technological change and product cycles

The first major step towards technology-oriented theories of trade emphasising technological change and the resulting pattern of trade in new products was **Posner's (1961) "technology-gap-model"**. Posner explicitly added technological progress as an independent determinant for international specialisation in trade beyond factor intensities and endowments (HO-model) and given technological differences (Ricardo) of the traditional trade models. Innovations continuously alter the list of products or processes on which innovating countries build temporary comparative advantages. International trade specialisation then depends on the speed of innovations in one country and how fast they are imitated in other countries ("imitation gap"). Most importantly, in contrast to the generalised HO-model, technology is no longer

regarded as an endowment, but seen as the outcome of processes of innovation, discovery, learning, and imitation ("man-made").

The technology-gap-model was an important precursor of the product-cycle theories which incorporate the idea that products go through a "life-cycle" of systematic changes in technology so that different national competitive advantages are decisive at different stages in the product life cycle: skilled labour for production and development of new products; capital intensive production techniques in "growing stage" of products; low wage, less skilled labour when the product has become mature and standardised.

Hirsch (1967) essentially sees factor proportions (extended HO-model) as determining the location of production over a product's life cycle. Accordingly, developed countries will be exporters of new products because the technology for producing new products is intensive in the use of skilled labour with which developed countries are abundantly endowed.

Vernon (1966) on the other hand clearly departs from the assumption of traditional trade theories and emphasises that innovations are demand driven, following the main arguments of Linder (1961), who stresses specific demand structures, the ease of communication and the proximity to the customers as the main determinants for innovation and trade patterns. New products will be first produced in and then exported from the country where they are first demanded and where new needs and wants are first perceptible. This will be in industrialised countries where new products or processes are needed to satisfy the wants of high-income customers, or where there is more need to cut labour costs.

The concept of the product cycle was then formalised by **Krugman (1979a)**. His starting point is a world of two countries (North and South), two goods (old, mature goods and new goods) and only one factor of production - labour. With only one factor of production, the countries' factor endowments are bound to be identical. In addition it is assumed that cost functions are the same for all countries, ruling out comparative cost advantages as an (Ricardian) explanation of trade. The only source of comparative advantage of the North then lies in its special ability to produce new goods. That is, the pattern of trade is solely determined by a continuing process of innovation and technology transfer to the South.

The ability of the advanced North to develop and immediately produce new goods (for reasons given by Vernon (1966) and others within the concept of the product cycle) becomes a source of comparative advantage. The non-innovating South adopts and learns the new methods of production only with a lag. And this "adoption lag" in the South gives rise to trade. By the time the South is able to produce the goods, the products have become mature and standardised and the production technology has become common property so that the production of the "old" goods tends to shift to the low-wage South. One of the major implication of Krugman's product cycle-model is that "the decline of industries in developed countries will be a recurrent event ...and that developed countries must continually innovate, not just to grow, but even to maintain their real incomes (Krugman, 1990, p. 150)".

While technological change has a central role to play in determining world trade specialisation and changes in that pattern of trade over time, Vernon's and Krugman's model of the product cycle are essentially concerned with the effects of innovations and technology transfer and not their causes. The process of innovation and diffusion and the rates at which they occur are taken as exogenous.

Grossman - Helpman (1991a, 1991b, 1991c) constructed a whole range of North-South trade models with endogenous innovation and endogenous technology transfer and quality competition. The theory is based on the models of endogenous technical change by Romer (1990) and Aghion - Howitt (1990) and interprets product and process innovation as the result of deliberate, purposeful R&D by profit-seeking enterprises. In a Schumpeterian framework, the firms' incentive to invest in R&D and innovate depends on the expectations that the innovation will generate (at least temporary) monopoly profits until the new technology becomes public knowledge. Sustainable growth is made feasible by the assumption of some kind of technological externality; that is, the creation of knowledge through private R&D yields positive external effects. The new knowledge thus adds to the public stock of technological knowledge and is accessible to all firms doing R&D themselves. Without the assumption of technological externalities innovators would be in a position to establish permanent monopolies without any further R&D effort.

Equating innovation with the development of new products that are of higher quality than similar products on the market, the authors introduced the notion of the "quality ladder" into the literature. The model then becomes very similar to Krugman's (1979a)

and in a process of ongoing product upgrading and imitation the North and South are consecutively climbing up the quality ladder.

From the trade theory literature reviewed so far the major prediction is that for given differences in technology and/or endowments, the processes of European integration and globalisation lead to a higher degree of specialisation according to comparative advantage. In the limit, assuming transportation costs are incurred in shipping goods, nonincreasing economies of scale and a uniform distribution of resources across space, each location would become a base for autarkic economy where goods are produced at a very small scale, with each individual producing for his own consumption. (This has in literature often been referred to as a Robinson Crusoe type economy or “backyard capitalism”). These models can best explain trade between countries at different stages of development, with different factor endowments or production technologies, trade that is characterised by an exchange of goods from different industries (interindustry trade). High income countries are predicted to specialise in capital intensive, technology, skill and research intensive industries with high levels of product and process innovations, driven by forces on the demand side and the supply side (innovation rents, capacity to make use of technological opportunities). In industries where product differentiation is important, countries specialise in products on the upper quality segment.

4. New trade theory and intraindustry trade (IIT)

Comparative advantage, while relevant, is insufficient as the only explanation of specialisation, as often very similar regions exhibit very different production structures and the bulk of trade takes place among industrialised countries despite the fact that these countries share similar factor endowments and production technologies. Most of this trade between industrialised countries takes the form of intraindustry trade (IIT), that is, an exchange of differentiated goods that fall into the same product category. As a result various theories have been developed to supplement traditional theories or to some extent even replace them to explain the phenomenon of IIT.²⁾

²⁾ Greenaway-Milner (1986) provide a comprehensive discussion of intraindustry trade.

Basically, scale economies, product differentiation (preference variety) and imperfect competition are the fundamental “ingredients” of new trade theory models and intra-industry trade between identical countries or countries that differ only in size.

First attempts to introduce increasing returns to scale to models of trade maintained the assumption of perfect competition by relying on the concept of Marshallian external economies. In the external economy model costs depend on the location: *ceteris paribus*, the larger is the size of the local industry, the lower costs. While each firm behaves as though it is subject to constant return to scale, scale economies become effective at the industry (branch) level and build the basis for regional concentration of industries. Some of the more recent contributions to this literature include Panagarija (1980, 1981, 1986), Markusen and Melvin (1981) and Ethier (1982a).

A second category of new trade models is based on economies of scale that are internal to the firms and allow for monopolistic competition. The most influential approach to modelling monopolistic competition is based on the work of Dixit and Stiglitz (1977) and has been introduced in international trade by Krugman (1979b).³⁾ The key assumptions in such a framework are: a perfect symmetry across varieties in production as well as consumption; each consumer derives utility from product variety and for a given income, utility increases with the number of varieties (“love of variety” approach); the production of each variety is subject to internal economies of scale; free entry/exit of firms drives profits to zero.

In the **Krugman (1979b)** model then, trade becomes a way of extending the market and of allowing the exploitation of scale economies and intraindustry trade is the natural outcome independent from international differences in technologies, factor endowments, or tastes. Furthermore, although the model is able to predict the volume of trade the direction of trade and the production structure is indeterminate as long as there is free trade (no transportation costs) and as long as there is no factor endowment or technology basis for trade. Only small differences in factor endowments across countries, for example will tend to create a pattern of specialisation according to the Heckscher-Ohlin theory of trade (Krugman 1987). Alternatively,

³⁾ Another approach draws on the work of Lancaster (1979, 1980) and is developed by Helpman (1981). It is based on a „most preferred variety“ utility function. See also Helpman, Krugman (1985).

given identical endowments and technologies of trading countries the presence of transport costs makes it more profitable to locate increasing return activities in the location with the larger market. This is an argument which is similar to Linder (1961) who hypothesised that countries are likely to export goods that are in greater demand at home. In the more recent literature this has been dubbed as the “home market effect” or “home market bias in exports” (Krugman 1980, Helpman Krugman 1985). A strong example of home market effects is given by Krugman (1980) himself by combining increasing returns with (iceberg) transportation costs. Note that it is the presence of transport costs that plays the most crucial role in obtaining home market effects. At the same time the 1980 model is an interesting initial application of the Krugman (1979b) model in the area of economic geography and we will come back to this model later in the chapter.

Ethier (1982b) takes a quite different approach from Krugman (1979b). He applies the Dixit-Stiglitz framework to explain the impact of (internal) scale economies and product differentiation at the intermediate input level and thus explains IIT in inputs rather than final products. His model involves two goods, one which is produced under constant returns (agriculture) and the other under increasing returns (manufactures). The output of the manufactured good is modelled to involve two stages and each stage is characterised by two distinct forms of economies of scale. First, primary resources are used to produce differentiated intermediate inputs (components) under internal economies of scale which Ethier terms “national returns”. Then the differentiated components are combined to produce the final manufactured good under external economies of scale. More specifically, the production function for finished manufactured goods displays constant returns to scale for a given number of varieties, but increasing returns in the number of inputs. A larger variety of components reflects a greater division of labour and greater economies of specialisation à la Adam Smith. The greater the number of varieties in inputs the lower the cost of production of the final product. As trade gives each country access to the other’s components external economies of scale are international in scope. To take account of this international aspect Ethier calls them “international returns to scale”.

Modelling the interaction of national scale economies with international returns to scale and relative factor endowment differences of countries, Ethier is able to show that for trade in final products, the Heckscher-Ohlin pattern of interindustry trade holds. If tastes are identical across countries, each country is a net exporter of the

sector intensive to its relatively abundant factor. Intraindustry trade occurs in trade with intermediate inputs and here Ethier shows IIT to have a factor endowment basis and that IIT is complementary to international factor movements ("complementarity theorem"). Given world endowments, a movement of factors such that relative endowments become more similar, promotes IIT. If factor endowments become more dissimilar IIT diminishes as it expands the scope for interindustry trade.

In fact one of the major general conclusions that can be drawn from the new trade theory literature is that the share of IIT in total trade as opposed to the share of interindustry trade is positively related to the similarities of demand and production characteristics.

However, one of the most important distinctions made in the various models explaining IIT is that between horizontal and vertical product differentiation.⁴⁾ The distinction is important because different country and industry characteristics are associated with the two types of product differentiation.

Models of horizontal product differentiation predict that dissimilarities of demand and per capita incomes between countries are a deterrent to horizontal specialisation and further, that the greater the differences in initial factor endowments of countries, the less important will intra-industry trade be and, the greater the market sizes of the countries (the greater the potential to reap economies of scale), the greater will be the amount of intra-industry trade. As noted in Greenaway - Hine - Milner (1995), horizontal product differentiation is much more related to the modern theories of trade, preference diversity and economies of scale than vertical product differentiation.

The **Falvey (1981)** model as well as the **Falvey - Kierzkowski (1985)** model of vertical product differentiation on the other hand provide an explanation of IIT in a quasi Heckscher - Ohlin setting. The central assumption of the respective models is that a higher capital/labour ratio results in the production of higher quality. From this follows that capital-abundant, rich countries export relatively high quality products, while less developed, labour-abundant countries export relatively low quality products.

⁴⁾ Horizontal differentiation refers to different varieties of a product that are of similar quality (different colour and design of shoes of similar quality). Vertical differentiation refers to different varieties that are of different qualities (leather shoes, plastic shoes).

The implications of models of vertical product differentiation are quite different from the models incorporating horizontal product differentiation as they predict a positive relationship between the difference in factor endowments and vertical IIT, as well as a positive correlation between the difference in countries' per capita incomes and demand and vertical IIT.

Models of trade with imperfect competition allowing for oligopoly behaviour (as opposed to monopolistic competition) give yet another reason for intraindustry trade independent from scale economies and differences in demand and supply conditions across countries. Models such as developed by **Brander (1981)**, **Brander and Krugman (1983)** show that IIT can arise due to market segmentation or "reciprocal dumping". In the simplest setting of "reciprocal dumping models" there are two firms, one in each country, producing a homogenous product. Transport costs are incurred in exporting goods. In autarky, each firm is a monopolist in its country, and chooses an output level at which prices lie above marginal costs and profits are maximised. Increasing the output level would have a negative effect on price and profits. On the other hand selling in the segmented foreign market brings further earning without negative price effects in the monopolist's home market. Thus, starting from autarky each monopolist sees a residual demand curve in the foreign market (market demand less the autarky output level of the monopolist) and enters, trade opens and firms compete in a Cournot fashion. The key assumption in the model however is that the two markets are segmented so that each firm chooses the profit-maximising quantity for each country separately. There are no cost or variety gains obtained in this kind of model, and no prediction about specialisation. The gains from trade stem solely from a pro-competitive effect. The net gain is positive or negative however, as the pro-competitive effect has to be opposed to the waste of resources due to transport costs.

5. Economic geography

So far we have reviewed two classes of trade models, models based on comparative advantage and constant returns to scale and models based on increasing returns. Economic geography models build a third class whose most distinctive element is the interaction of increasing returns with transport costs across countries (or regions). In such a world increasing return activities are predicted to locate in the larger market, giving rise to a "home-market effect". Market size then becomes the basis for trade and differences in the production structure. Note that without transport costs in an

increasing returns model specialisation patterns would still be indeterminate as in the new trade theory models reviewed before. It is the presence of trading costs that plays a crucial role in obtaining home-market effects.

Home market effects also produce results that are in fundamental contrast to models of comparative advantage. In a comparative advantage model, *ceteris paribus*, unusually strong demand for a class of goods will turn those goods into importables. Transport costs may diminish the trade volume, but never lead the good to be exported as in a world of increasing returns to scale (Davis, Weinstein 1996).

A very common feature of economic geography models is the assumption that transportation of the differentiated goods across countries involves the very specific form of iceberg-type transportation costs. With iceberg-type transportation costs the assumption is that only a fraction of the good shipped arrives with part of it melting away in transit – usually at a constant rate per distance covered. Transport costs are thus incurred in the good itself and this modelling trick helps to circumvent the need to separately model transportation.

Also, economic geography literature up to this date, has analysed the predictions of the models mostly in the form of numerical simulations and examples rather than analytical solutions. Hence, the “stories” told are valid for only certain parameter values of the model.

In what follows we will review some of the most influencing models in economic geography in more detail.

Combining increasing returns with iceberg-transportation costs in a model with two differentiated sectors **Krugman (1980)** provides a first initial application of the framework given in Krugman (1979a) in the area of economic geography. Production technologies are assumed to be the same not only across varieties within each sector but also across sectors. He models two countries which are of equal size and equally endowed with the single factor labour. However, consumers in each country have different tastes with respect to the two groups of products, but one country is the mirror image of the other.

Krugman then derives the following results: First, if countries are identical in all respects except size, the country which has the larger domestic market will have a higher wage. Secondly, under autarky, the country with the larger home market for

one product will produce a larger variety of this product and will be a net exporter of that product when trade opens (home market bias in exports). Krugman also shows that if two countries have sufficiently dissimilar tastes each will completely specialise in the industry of home demand bias. Also, if the assumption of equal country size is removed and consumption patterns across countries were the same, the larger country will be the net exporter of products whose production involves economies of scale.

The Krugman (1980) framework represents one of the early economic geography models in which location patterns emerging in a process of economic integration are driven by exogenous differences in markets size (see also Helpman-Krugman 1985, Krugman-Venables 1990). Within this framework it is not possible to explain why countries that are a priori very similar also with respect to their size (or market access) can diverge in production structures. More recent advances in economic geography have combined these models' outcome with "cumulative or circular causation in location decisions of firms and consumers/workers" and formalised forward-backward linkage mechanisms giving rise to agglomeration economies: the concentration of economic activity in one place itself creates a favourable economic environment that supports further concentration and spatial concentration becomes a self-reinforcing process.

This cumulative process builds on the existence of externalities, which according to Marshall (1920) can arise because of three forces: knowledge spillovers (technological spillovers), availability of specialised skills, and forward and backward linkages associated with large markets. While all three are important, the new economic geography models explicitly focus on the third, linkages. Krugman (1991a,b) provided the basic framework and economic geography models following his line have mainly concentrated on the monopolistic competition model a la Spence-Dixit-Stiglitz, an approach that singles out pecuniary externalities associated with forward and backward linkages.⁵⁾

⁵⁾ In the literature pecuniary externalities are contrasted to technological externalities. Pecuniary externalities describe benefits of economic interactions through the market place while technological externalities, subsume effects of non-market interactions (information spill overs) which arise in some invisible form.

On the other hand, dispersion forces are essential to any model of economic geography. Various sources of dispersion forces have been used in the literature: geographical dispersion of demand from immobile agricultural workers (Krugman 1991a, 1991b), from immobile consumers (Krugman, Venables 1995, 1996); non-traded goods (Helpman 1997); congestion externalities (Ricci 1999), land rent (Elizondo, Krugman 1996); local public expenditure (Trifonetti 1997).

The basic framework however was provided by **Krugman (1991a,b)**. The set up in Krugman (1991a, 1991b) differs from the model in Krugman (1980) in two important aspects: first, the two regions are a priori identical in every respect. Second, Krugman adds international labour mobility to the story becoming an important driving force for agglomeration in interaction with increasing returns and trade costs: Locations close to large markets pay higher real wages and consequently attract more labour. This enlarges the market further and causes positive demand effects and backward linkages as a greater number of consumers makes the core even more attractive for firms and causes a concentration of economic activity. Scale economies at the individual firm level are transformed into increasing returns at the level of the region as a whole. Labour mobility makes the size of the market at different locations endogenous. There is no intersectoral mobility of factors in Krugman model and only the labour used in industry is mobile between regions while agricultural workers do not move. The immobility of agricultural workers is the centrifugal force in the model.

Krugman shows that in this setting the interplay between increasing returns, transport costs and interregional migration of industrial labour can endogenously give rise to a core-periphery pattern. The critical question Krugman then asks is when a situation in which all industry and industrial workers are concentrated in one region becomes a sustainable equilibrium. The location forces depend on the strength of two opposing effects on real wages of the two regions:

The competition effect which arises when an additional firm locates in a region and thereby increases competition for the local market and lowers the wage rate which firms can pay without making losses. This will drive workers out of that region. The other is the “home-market” effect or linkage effect which arises when additional workers move into the region, thereby increasing local expenditure on manufactures and enabling firms to pay higher wages. This, in turn makes the location more

attractive for still other workers and firms.⁶⁾ The relative strength of these forces is affected by transport costs, the degree of economies of scale and the share of manufactured goods in consumer expenditure.

Given the other parameters of the model, under autarky, or very high trade costs, the competition effect dominates and industry is equally divided between two (identical) regions. With further reductions in trade costs product market competition becomes less important in firms' decisions as they start more and more to compete in distant markets even without producing locally and thus relocations of firms do not change the competitive environment anymore. Thus at some critical level of transport costs they start to agglomerate to exploit demand linkages while more and more workers move in because of higher real wages and an increased variety of products. There is a range of transport costs for which agglomeration forces are still too weak to destabilise the symmetric equilibrium (is still locally stable), but they are strong enough to ensure that if all firms were concentrated in one region this would be a locally stable equilibrium too (agglomeration becomes sustainable). At sufficiently low transportation costs though, symmetric equilibrium is destabilised, forward and backward linkages take over and the industrial structures of the two regions diverge.

The other parameters in the model then influence the critical values of transport cost for which agglomeration becomes sustainable. The critical value is higher, that is agglomeration takes place earlier in a process of regional integration,

- the lower the elasticity of substitution across varieties in consumer preferences as this in turn increases the importance for consumers to have a large variety of products available locally. This, in turn, lowers monopoly power of firms over their own varieties, weakens local competition and favours agglomeration.
- the larger the share of manufactures in expenditure: augments impact of migration on demand for industrial goods and thus region's market; increases weight of prices of industrial goods in real wages, nominal wages then do not have to rise by that much to attract workers to region.

⁶⁾ There is an additional „price index“ effect that helps raise the real wage in the core. The proportion of locally produced varieties, which are priced lower than „imported“ varieties due to transport costs, rises. This lowers the price index in the core.

Puga (1998) adopts the basic framework from Krugman (1991a,b), but additionally assumes that the two sectors in the economy no longer use specific factors and move between sectors. The critical values for transportation costs then also include the elasticity of labour supply from agriculture to manufacturing. Agglomeration gets an extra kick from intersectoral labour mobility, but even without it, the opportunity for firms to attract workers from other regions is enough to ensure agglomeration at some point in the integration process. Adding intersectoral migration to Krugman (1991a,b) thus helps to understand determinants of economic agglomeration, but does not change the relationship between integration and industrial location derived in Krugman.

The u-shaped relation between integration and geographical concentration

However, if the interaction between product markets and factor markets are properly modelled, and possible general equilibrium effects causing changes in factor prices and costs are taken into account, so that relative factor prices between regions may diverge, it can be shown that there is a u-shaped relationship between the level of transportation costs and the degree of geographical concentration of production: very high and very low transportation costs would favour dispersion, intermediate levels, a concentration of activities. Intuitively, when trade barriers are initially very high and then reduced, production will first move to the larger country because of cost advantages in the production of the increasing returns product in the larger market in the presence of transportation costs. As the size of the industry in core increases, this will give rise to regional wage differentials because factor market competition takes over (upward sloping labour supply schedules), but – as to real wages – partly also because of differences in price indices as transportation costs have to be incurred in a different amount of goods in the two locations. The smaller (peripheral) country will then have lower wages. If factors are mobile between countries, this accompanying rise in factor prices would simply give an additional impulse to a concentration of industry in the larger market by inducing immigration. If instead there are some immobile factors which are important for production, or non-tradable goods that are particularly important for consumption (e.g. housing) they will act as dispersion forces and bring regional convergence in terms of production structures as integration goes far enough.

Krugman-Venables (1990) directly examine the effects that economic integration has on the location of production in a framework similar to Krugman (1980) and arrive at the u-shaped impact of trade liberalisation on the size of the manufacturing sector in the peripheral region. The critical assumption for this relationship is that relative factor prices diverge, anything that impedes such differences to emerge (for example: internationally mobile labour or capital), will reinforce the tendency to concentrate production in the core. Any forces which tend to equalise factor prices across countries will increase the importance of market access considerations in determining the location of manufacturing. Labour mobility for example would reinforce centripetal tendencies associated with integration, because it reduces the magnitude of wage differentials and as more labour migrates to the core, by accentuating market size differences between the centre and the periphery.

As Krugman-Venables (1990), also Venables (1996), Krugman-Venables (1995) and Puga (1999) predict the same u-shaped impact of trade liberalisation on the size of the industry in the periphery if there is any lack of interregional labour mobility. However, while in Krugman-Venables (1990) differences in market size are exogenously given, the market size is endogenously determined in the latter and the u-shape even occurs between a priori identical countries. But the latter models are important in another respect too, as they show that vertical linkages of industries can play a similar role as labour mobility in Krugman (1991a,b) in leading to an agglomeration of industry when trade costs fall below some critical level.⁷⁾

Vertically linked industries

Venables (1996) models three sectors, one of which is perfectly competitive producing a costlessly tradable good. The two others are monopolistically competitive and vertically linked. The upstream industry is providing an intermediate good to the downstream firm which in turn supplies consumption. There is a single primary (homogenous) factor at each location, labour. The upstream firm uses labour alone, while the downstream industry uses labour and differentiated intermediate inputs as in

⁷⁾ For vertical linkages to create agglomeration forces, it is important that both industries, upstream and downstream firms use an increasing returns technology. If an upstream firm producing the intermediate output were perfectly competitive, then, without IRS, part of the industry would always locate wherever there are downstream firms and the downstream firms would only use local suppliers.

Ethier's (1982b) model. Both upstream and downstream firms produce under increasing returns to scale. The two locations in the model are identical in all respects.

Vertical linkages of industries give rise to cost and demand linkages. The downstream firm forms the market for the upstream firm and with transport costs, market access considerations draw the upstream firm to locations where there are many downstream firms. This gives rise to a demand linkage (demand came only from consumers in Krugman). On the other hand, with transportation costs incurred in shipping goods, downstream costs depend on the location of upstream firms. The closer a downstream firm locates to the market where there are many upstream firms, the more it saves in transport costs. Demand and cost linkages of vertically integrated firms thus constitute the driving force for the agglomeration of activities. Working in the opposite direction are the location of any immobile factor of production and the location of final consumer demand.

Another application in this area with similar predictions comes from **Krugman and Venables (1995)** in which they explain how globalisation resulting from a decline in transport costs can give rise to different effects on incomes and productions patterns in the North and South at different levels of transportation costs.

Finally, **Puga (1999)** carefully studies the impact of international labour mobility on the relationship between the degree of regional integration and regional differences in production structures (integration and agglomeration). He sets up a more general framework combining the basic Krugman model (1991a,b) focusing on interregional mobility of labour with input/output linkages of industries à la Venables (1996) and Krugman-Venables (1995) and also endogenizes the distribution of labour across sectors as in Puga (1998a).

Puga then derives the following results which also give a good summary on the main predictions of economic geography models: If workers move across regions, adding input-output linkages and intersectoral migration to the Krugman (1991a,b) model helps to understand the determinants of economic agglomeration, but does not change the relationship between integration and industrial location derived in that paper. A lack of interregional labour mobility postpones agglomeration in a process of regional integration and weakens it when it happens. A lack of migration (and a flexible response of wages to changes in industrial employment) makes the relationship between integration and agglomeration non-monotonic (u-shaped) as

firms start moving to the lower wage region bringing about convergence in production patterns as well as real wages as trade barriers become low enough. For intermediate stages of integration there will be large disparities. If wage differences are not eliminated by migration, this acts as a centrifugal force, which can moderate agglomeration and sustain non-extreme equilibria with partial agglomeration in one region. The evolution of industrial location is then characterised by a gradual rather than a discontinuous changes.

Agglomeration economies and the regional pattern of specialisation

Most of the models reviewed so far ignore the possibility of regional specialisation in different increasing returns to scale (IRS) sectors and thus say little about how agglomeration in one region affects the degree of specialisation of regions in different sectors subject to agglomeration effects (the IRS industries). As it comes to specialisation, the usual prediction out of most models of economic geography is that due to agglomeration forces the core region specialises in the IRS activity while the constant returns to scale (CRS) activity moves to the periphery, nothing is said about specialisation across regions within the IRS industry. If differences in factor endowments of countries are taken into account as done by e.g. Krugman, Venables (1990) these models based on one CRS activity and one IRS activity predict that if the large country also happens to have a comparative advantage in the IRS-industry, the centripetal forces in the model would be reinforced. If the small country happens to have a comparative advantage in producing differentiated goods, in early stages of trade liberalisation, firms will start to relocate to the larger market even though this goes against the direction of trade predicted on the basis of relative factor endowments. However, due to lower wages in the peripheral country, at sufficiently low trade barriers, manufacturing output in the periphery will continuously rise.

But, if the European integration induces agglomeration which activities within the IRS industry would the core attract more, or which activity would the periphery loose more? Only some papers have attempted to integrate economic geography models with traditional trade theory based on comparative advantage and investigated the relation between agglomeration and specialisation *within* the IRS activity.

Amiti (1998) introduces a model which is an interesting variety of the Krugman (1980) model and combines traditional theory with economic geography to show how country size alone can influence specialisation patterns when industries are allowed to

differ in terms of factor intensities, trade costs and demand elasticities. The results depends on the relative strength of a market access effect attracting IRS firms to the large country in the presence of transport costs, and a production cost effect, attracting firms to the smaller market because of lower wages.

She shows that if the labour intensive industry is assumed to be subject to higher transport costs (due for instance to a strong union resisting trade liberalisation), then the large country is a net exporter of labour intensive goods at high levels of trade costs (market access effect dominates) and become net exporters of capital intensive goods at low levels of trade costs (production cost effect stronger). Since workers are immobile and firms do not use intermediate inputs Amiti's model does not take into account endogenous agglomeration effects. Therefore this framework does not allow to investigate the relationship between agglomeration and specialisation within the IRS sector.

Krugman-Venables (1996) introduce a model that can show how specialisation can be induced by sector specific agglomeration forces. The most crucial assumption made is that input-output linkages within industries are stronger than between industries, that is, firms in each sector sell and buy a higher proportion of intermediates to and from firms in the same sector than to and from firms of the other sector. Vertical linkages create demand and cost linkages, and with stronger intra-industry input-output linkages than inter-industry linkages, may cause industrial agglomeration to occur with each of the (symmetric) countries specialising in a single industry.⁸⁾

Venables (1998) takes over the basic framework in Krugman-Venables (1996) but extends it by not only considering two industries, but a continuum of industries which differ in relative productivities due to Ricardian technical differences between countries. The authors show that the resulting division is not unique and not necessarily in line with comparative advantage. This contrasts to Dornbusch, Fisher, Samuelson (1977) who found that comparative advantage in a Ricardian model with a continuum of products induces a unique division of industries between countries.

⁸⁾ If instead it is assumed that inter-industry linkages are more important, each location will always have some of each industry, as firms always derive more advantages from proximity to firms in the other industry.

Ricci (1999) develops a two-country, three-sector and one (internationally mobile) factor model with Ricardian productivity differentials across regions and across sectors. The model includes a CRS activity producing a homogenous commodity that can be freely traded, and an IRS industry composed of two sectors which are directly subject to agglomeration forces, monopolistic competition and iceberg transportation costs. The dispersion force in the model comes from a congestion externality: as the location becomes more crowded, the utility of its consumers decreases by a congestion factor, directly influencing migration decisions.

In this framework, the author then studies the impacts of an increase in country size and an increase in comparative advantage, respectively.

- An increase in country size will induce agglomeration and reduce the specialisation of that country in the comparative advantage sector within the IRS industry. A relative enlargement of one country attracts firms of all IRS sectors, and proportionately more from the one sector in which the country has comparative disadvantage because it is already more specialised in the other. So agglomeration in the large country will reduce specialisation within the IRS sector, it will increase specialisation in IRS versus CRS industry.
- While each country will always remain specialised in the good in which it has a comparative advantage, an increase in comparative advantage (one country gets still more productive in comparative advantage sector) is not necessarily associated with an increase in specialisation (within the IRS sector). An increase in comparative advantage in one country has two effects on specialisation. One is the direct positive effect of inducing firms of that sector to move to that country, the other is an indirect negative effect on specialisation that stems from the subsequent agglomeration of all firms in that country if the country expands as a consequence of the relative productivity changes. Agglomeration comes about as an increase in number of firms producing in the country with increased comparative advantage induces workers to migrate, increasing the size of the location and attracting more firms from both sectors (backward linkage). In turn, the increase in number of firms attracts even more workers. This circular chain induces agglomeration. The overall effect then is uncertain. The positive effect for specialisation will be lower, and “perverse relation” between comparative advantage and specialisation within the IRS sector more likely when the country is small and highly specialised since the

direct positive effect for specialisation will be quite small and the agglomeration effect large.

Finally **Brülhart (1995)** takes up the Krugman (1980) model with two IRS industries, adds factor mobility (localised external scale economies) and comparative advantages and investigates the relative importance of intra-industry trade (IIT) and interindustry trade in such a framework. For a given level of trade barriers one can expect high locational concentration and low IIT in industries subject to high scale economies. IIT falls with progressing integration among countries as agglomeration forces eventually push integrating countries towards sectoral specialisation. The expansion of trade resulting from liberalisation is therefore strictly inter-industry in nature. If there is a time lag between the liberalisation of trade and the re-location of production there will be an initial surge of IIT followed by a decline, when the forces for industrial agglomeration come into full effect. Where factor endowments favour the location of an industry in the larger country, the decline of IIT is accelerated as liberalisation proceeds. Where relative factor endowments favour production in the smaller country IIT is likely to rise, or at least to remain high, as economic integration proceeds.

The author then also considers a specification of input requirements of the increasing-returns industry such that fixed and marginal costs do not have the same factor ratios and the relative importance of fixed and variable costs determines factor requirements. A specification that has been used by Lawrence and Spiller (1983) from which Brülhart derives an interesting hypothesis which serves as a link to the theory of innovation and the product cycle. From the premise that technologically advanced, new products involve high fixed costs (high R&D costs but small market demand) and labour is the most important source in variable costs one comes to the prediction that countries whose factor endowment is most beneficial for the fixed costs component in firms' production function (skilled labour, capital) will attract the production of innovative, new products. Standardised, "old" goods will be concentrated in countries whose factor endowment ratio matches best the sector's ratio influencing variable costs (low skill labour). From the product cycle theories, the more mature the product, greater the scale of production, the less important are fixed costs.

6. Foreign Direct Investment, economic geography and trade

The trade theory models as well as the economic geography literature reviewed so far ignore the existence of multinational firms. It is clear, however, that the way how multi-location firms organise their activities can have important impacts on the geography of economic activities and the specialisation of regions and countries. The literature distinguishes between two polar cases of multinational activity: horizontal or vertical investments. Horizontal MNCs are firms which produce roughly the same product or service in multiple locations, vertical MNCs in contrast are firms which geographically fragment the production process by stages with the aim of internalising the comparative advantages of particular sites. Of course this classification is a conceptual one, most MNCs are both vertically and horizontally integrated across borders. Economic models of FDI and trade are overwhelmingly based on the trade-off between transportation costs, scale economies and proximity/size of local markets which is likely to influence the horizontal pattern of multinational activity. Relative comparative advantages of countries are likely to govern the vertical pattern of multinational activity.

A good summary of the existing literature on multinational firms in the framework of Dunning's OLI (ownership, location, internalisation) paradigm is given by Markusen (1995). Among others, Brainard (1993), Pfaffermayr (1997), Markusen, Venables (1996, 1998) and Markusen (1998a,b) provide detailed theoretical models on FDI and trade. Note that FDI and trade are both treated endogenously depending on common exogenous determinants (e.g. transportation cost, plant economies of scale, factor endowments, etc.). Thus the impact of FDI on trade (volume and specialisation) has to be analysed with respect to these parameters.

The key premise of the theory of multinational firms is that firms incur significant costs of doing business abroad relative to domestic firms in those countries. Therefore, for a firm to become multinational, it must have offsetting advantages which are usually referred to as ownership advantages or firm specific assets. In Dunning's OLI paradigm, which is taken as the organising framework, besides ownership advantages there two other conditions for firms preferring FDI over exports or contractual arrangements with foreign firms: location advantage, internalisation advantage (FDI or licensing). See the box for more details.

Box: Dunning's OLI-paradigm

Ownership advantages:

The ownership advantage confers some intangible asset or cost advantage to the firm sufficient to outweigh the disadvantages of doing business abroad. These include management, engineering, marketing, and financial services, many of which are based on human capital. They also include the "services" of patents and trademarks, which are other knowledge based assets. Subsidiaries import these services in exchange for repatriated profits, royalties, fees, or output.

Knowledge based assets are more likely to give rise to direct foreign investment than physical capital assets. They can be easily transferred back and forth across space. Knowledge also often has the character of a public good within the firm, and this means that it can be supplied to additional production facilities at very low costs. All this also gives rise to **economies of multiplant production** because of a cost efficiency of multinationals over two independent single-plant firms. A multi-plant firm only needs to make a single investment for R&D for example.

Location advantages:

For horizontal firms, producing same goods and services in each of several locations sources of location advantages are transport costs (more generally proximity advantages), access to a large market in potential host countries (if market very small it will not pay to establish firm there). Both sources follow from existence of plant-level scale economies. Low production costs likewise favour foreign production. For FDI being attractive all these cost advantages have to outweigh additional fixed set-up cost for the foreign plant. So in essence a horizontal integrated MNC is trading off lower marginal costs against higher fixed costs as compared to the export option.

Vertical multinationals are encouraged by low rather than high trade costs. They arise when stages of production have different factor intensities and countries have different relative factor endowments. So vertically integrated MNCs are likely to locate different stages of the value added chain according to comparative advantage of the host countries. Note that investments in sales outlets (distribution and service) also form an important form of vertical integration across borders.

Internalisation advantages

This third component of the OLI-Paradigm gives the conditions which favour production within the firm against contracts with foreign firms for serving foreign markets. So it asks for the boundaries of multinational firms. Specifically, internalisation advantages explain how agency problems might be better solved within a firm than through an arm's length arrangement with a licensee or contractor. According to Markusen (1998) these advantages arise from the same joint-input, public goods property of knowledge that create ownership advantages or firm specific assets.

The models consider both, vertical and horizontal MNCs as well as national firms. There are two countries, two factors (unskilled and skilled labour) and two goods. One of the goods is produced by unskilled labour under constant returns to scale, the other by skilled labour and under increasing returns to scale. Headquarters and plants may be geographically separated. The distinguishing feature of horizontal multinationals is that they have one plant in each country, vertical MNCs have the headquarter in one country and one plant in the other.

As to the production regime for high to moderate transportation costs the above framework shows that horizontal MNCs are dominant when countries are similar in both size and relative endowments. National firms (located in the larger country) prevail when the countries are very different in size, especially when the larger country is also skilled labour abundant. Finally, vertical MNCs dominate when the countries are similar in size but very different in relative endowments.

The specific production regime effects the direction of trade. Basically, when transport costs are important there are two determinants for the direction of trade, relative factor endowments (the skilled labour abundant country has an advantage in the production of the IRS good) and relative country size (due to plant economies of scale the large country has an advantage in IRS production). When a country is therefore large and skilled labour abundant (a condition that favours production regime with national firms) the two determinants of comparative advantage work in same direction and that country then exports the IRS product. When a country is skill abundant, but small (here vertical MNCs dominate) that country would import the IRS good and export managerial services, headquarter services. Factor endowments and country size pull in opposite directions. Production in this situation is pulled to the larger country, this

lowers demand for skilled labour in the small country and leads to lower wages. This in turn gives an incentive for vertical MNCs to set up headquarters in the small country and plants in the large country.

For very low to zero transport costs horizontal MNCs will not exist as in the presence of plant level scale economies, no firm will want to set up a second plant when trade is basically costless. As long as factor price equalisation (FPE) holds, there is also no incentive for vertical MNCs to enter. Outside the FPE set, vertical MNCs come to exist when countries are very different in size and in factor endowments.

As to the pattern of trade in the presence of very low transportation cost, the first result is that country size is no longer an advantage. Within the FPE set, there is intra-industry trade in the IRS good when the countries are similar in relative endowments, and the skill abundant country is the a net exporter. Outside FPE set, factor prices are different and this stimulates vertical MNCs to enter the picture. Still as long as factor endowment differences are not too extreme national firms stay to exploit the skilled labour abundance and countries will then export both the IRS good and headquarter services. As factor endowment differences become too extreme though the pattern of trade in goods reverses, headquarter services become concentrated in the skilled labour abundant country, production of the IRS good in the other country. (Investment liberalisation thus may lead the skilled labour abundant country to import instead of export skill-intensive good.)

Markusen, Venables (1996) make the first attempt to bring multinational corporations into the economic geography models. They provide a full general equilibrium model combining HO-theory with monopolistic competition, transport costs and horizontal MNCs. The authors thereby adopt the Helpman-Krugman (1985) model, but extend it to allocations outside the FPE-set and include positive transportation cost. Their first important result refers to trade volumes in the presence of (horizontal) multinationals. Since multinational production substitutes for trade when countries are similar in size and in relative endowments, a convergence in country size and factor endowments of countries may not be associated with growing volumes of intraindustry trade. In the presence of comparative advantages, but similar country size, intra-firm trade induced by vertical MNCs may however partly compensate the substitution effect (Helpman 1994, Pfaffermayr 1997). The second result is that horizontal multinational activity (at intermediate levels of transportation costs) dampen agglomeration tendencies and thereby contribute to the dispersion of economic

activity. In economic geography models without multinational production the IRS sector production would be concentrated in the larger country. These models have also shown to generate “perverse” responses of factor prices to factor movements (as more factors move to a region their real rewards are increased) and hence foster spatial agglomeration of activity. Thus the larger country has both, higher real wages and a higher real return to capital. When multinationals enter, they establish plants in both countries. This increases demand for capital and therefore the return to capital in that country too. That reduces factor price differences of countries and therefore the tendency towards agglomeration.

7. Summary

What are now the key insights from the reviewed theory?

For given endowment and/or productivity differences across member countries, intensified integration and global competition is predicted to increase specialisation according to comparative advantage. The higher income countries are predicted to specialise in capital intensive, technology, skill and research intensive industries. If endowments and productivities converge – as is a natural prediction for a single market with perfect factor mobility – and industries are characterised by constant returns to scale, specialisation is forecast to decrease.

High-income countries will concentrate on industries with high levels of product and process innovations, driven by forces on the demand side (new products and greater variety are demanded) and the supply side (innovation rents and the capacity to make use of technological opportunities). In industries where product differentiation is important, countries specialise in products on the upper quality segment. Countries with similar incomes, endowments and technologies engage in intraindustry trade.

Economic geography models focus on the forces of agglomeration and dispersion. Economies of scale are as essential to these models as are transport costs. Their main focus is on regions or locations, not countries, on the share of production, not trade and finally, differences in market size and demand structures. Economic geography highlights the possibility that locations and countries with optimal market access may profit first and stronger from economic integration. In the presence of transport costs, industries for which increasing returns to scale are important locate near the largest

market. These are likely to be technologically advanced, innovative, new products which involve a high share of fixed costs due e.g., to R&D investments. Through agglomeration economies, the spatial concentration of economic activity then can become a self-reinforcing process. The periphery specialises in low wage industries and mature products, in industries with less product differentiation and limited spillovers. Eventually this process of agglomeration is forecast to reverse, however, if factor prices rise faster in the centre, if diseconomies of agglomeration emerge and if economic integration reaches a low enough level that makes a given cost difference between the core and the periphery more decisive.

Finally, the models of FDI and trade offer several predictions on the effect of deeper integration on the behaviour of multinational firms and the consequences for specialisation. The first implication of lowering transport costs could be that horizontal multinationals concentrate their activities since market proximity loses its importance, and decisions regarding plant size and location are then more based on low costs and the exploitation of economies of scale. This process should lead to more specialisation within Europe. A counteracting force, however, is that integration is likely to decrease the fixed costs of setting up plants, since for example, legislation is more harmonised and currency risks disappear, and thus would intensify the expansion of horizontal investments.

Vertical FDI on the other hand is predicted to rise. Lower transport costs induce endowment based intra-firm trade. The countries well endowed with skilled labour export skill-intensive intermediates and headquarter services. Particularly when there is no factor-price equalisation despite decreasing transportation costs, intra-firm specialisation becomes more pronounced (headquarters in skill abundant countries, labour-intensive production in labour abundant countries).

At an intermediate stage with medium transportation costs, horizontally integrated MNEs may dampen agglomeration tendencies. This is highlighted by the Markusen, Venables (1998) model, in which multinationals establish plants in both large and small countries, thereby increasing demand and the returns to capital in the smaller country, as well. This reduces factor price differences between the countries and dampens the tendency towards agglomeration. The same dampening effect on agglomeration forces could also be exerted by vertically integrated MNEs, as they establish the production of labour-intensive intermediates in low-wage peripheral regions.

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