

Agglomeration in the global economy: A survey of the 'new economic geography'^{*}

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ABSTRACT: This review of recent contributions reveals common conclusions about the effects of integration on location. For high trade costs, the need to supply markets locally encourages firms to spread across different regions. Integration weakens the incentives for self-sufficiency and for intermediate values of trade costs pecuniary externalities induce firms and workers to cluster together, turning location into a self-reinforcing process. However, agglomeration raises the price of immobile local factors and goods, so for low transport costs firms may spread to regions where those prices are lower.

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1. Introduction

Economic activities are unevenly distributed across space. The determinants of spatial differences in the patterns of production have traditionally been presented in terms of differences in endowments, technologies, or policy regimes. Such explanations, while relevant, fail to explain why even a priori similar regions can develop very different production structures. They also stand in sharp contrast with the changing pattern of comparative advantage of regions and countries undergoing rapid development. Recent contributions to the so-called 'new economic geography' have developed a novel approach to the way we think about location; one in which firms tend to cluster together, and regions with similar – or even identical – underlying characteristics can turn out to be very different. Much of that work focuses on how the propensity of firms and workers to agglomerate in space changes as regions become more integrated. This paper reviews that line of work, with the aim of uncovering the common picture emerging from what is sometimes critically described as a collection of special cases.

Economic agglomeration can be considered at different levels of aggregation. Starting from the bottom, there are small scale agglomerations of finely defined sectors. Amongst the best known examples of such highly specialised industrial districts are US carpet production industry in the Georgian city of Dalton (Krugman (1991*a*)) and the Italian textile industry in the city of Prato (Pyke, Becattini, and Sengenberger (1990), Porter (1990)). At the other end, there are large scale agglomerations that cut across state and country boundaries. These include the US 'Manufacturing Belt' (approximately contained in the parallelogram Green Bay-Saint Louis-Baltimore-Portland) and the European 'Hot Banana' (the area between Milan and London, containing Northern Italy, Southern Germany, South East France, the Ruhr area, the Ile de France, Belgium, the Netherlands, and South East England).

Arguably, from the possible explanations of why firms tend to cluster together, technological externalities arising from personal interactions matter most for small scale agglomerations. To explain large scale agglomerations, however, we must either look at other technological externalities whose effectiveness does not decrease as sharply with distance, or turn to pecuniary externalities, which are mediated by markets (the distinction between technological and pecuniary externalities is due to Scitovsky

(1954)). Hanson (1997*b*, 1998) interprets the empirically observed gradients in the spatial distribution of factor returns, decreasing gradually from industry centres all the way to country borders (which he estimates for Mexico) as evidence of the underlying action of pecuniary externalities.

In this paper we are concerned with understanding large scale agglomerations, creating differences between entire regions. What is at the origin of such inequalities? How will the spatial distribution of economic activities change as countries and regions become more integrated? Will economic integration lead to a higher or lower degree of spatial agglomeration? And are all activities likely to evolve similarly, or will integration have a different impact on different sectors?

This paper reviews recent papers addressing those questions with a common set of tools, involving a combination of monopolistic competition *à la* Spence (1976) and Dixit and Stiglitz (1977) and 'iceberg' trade costs *à la* Samuelson (1954). These tools, while peculiar, are the best available for dealing with increasing returns, trade costs, migration, and input-output linkages between firms in an analytically tractable general equilibrium framework. An excellent recent survey of how this approach relates to work based on either technological externalities or spatial competition is provided by Fujita and Thisse (1996).

While this research leads naturally to policy analysis, little work has been done so far in this direction. Similarly, although early empirical tests seem to support its implications, work in the area has been mostly theoretical. The focus of this review on theory is therefore a reflection of the current state of this literature rather than a personal choice.

The remainder of the paper is organised as follows. The next section focuses on comparative advantage and market access considerations, highlighted respectively by traditional and more recent trade theory. Section 3 describes how pecuniary externalities can create a cumulative causation process that leads to the agglomeration of industry as regions integrate. Section 4 incorporates congestion effects caused by higher prices for non-tradeable factors and goods. It shows that the same forces that explain the agglomeration of industry at early stages of integration can explain the spread of industry to less developed regions when integration goes far enough. A final

section summarises the main conclusions, reviews the first empirical papers in the area, and suggests some directions for future research.

2. The point of view of traditional and 'new' trade theory

Comparative advantage

Economic theory has traditionally explained differences in production structures mainly through differences in underlying characteristics (geography, endowments, technology), which make space itself uneven. In this framework, economic integration leads regions to specialise according to their comparative advantage (see, e.g., Jones (1965)).

Absent underlying differences between regions, models of trade with constant returns to scale and perfect competition predict that economic activities will be evenly distributed across space. Imagine a world in which there are *non*-increasing returns to scale, transporting goods across space is costly, and differences in underlying characteristics are small. Then firms producing in regions with relatively many other firms face stronger competition in product and factor markets. This tends to lower their profitability relative to firms facing fewer local competitors and generates an outcome in which firms are spatially dispersed (in the limit, such an economy is characterised by a sort of 'backyard capitalism': each consumer becomes a Robinson Crusoe producing for his own consumption).

Product and factor market competition provide reasons for firms to locate far from each other, but these must be set against those forces which tend to pull firms together. Comparative advantage, while relevant, provides a weak explanation for the remarkable spatial concentration of activity – often very similar regions have very different production structures. Furthermore, when more things are mobile than not, traditional trade theory fails to give clear-cut predictions of the patterns of specialisation and trade (see, e.g., Meade (1950)).

Market access

Increasing returns to scale turn out to be essential for explaining the uneven geographical distribution of economic activity (Scotchmer and Thisse (1992) call this the 'folk theorem of spatial economics'). Models of trade with increasing returns and imperfect competition (see, e.g., Helpman and Krugman (1985)) explain why countries without significant comparative advantage with respect to each other can develop different production structures on the basis of their different access to markets.

The implications of these models for location, and the effects that economic integration has on it, are formalised by Krugman and Venables (1990). They start by assuming that the world is divided into two regions: a large 'core' country and a small 'peripheral' country. The core country has larger factor endowments than the peripheral country, although both have the same relative endowments (hence there is no comparative advantage in the traditional sense). This difference in endowments is meant to reflect better access to markets from the core region than from the peripheral region rather than differences in actual size. This distinction is particularly important when trying to assess the empirical relevance of market access effects (Davis and Weinstein (1996, 1998) find no evidence of market access effects for OCDE countries on the basis of each country's own size, but find evidence of strong market access effects on the basis of each country's access to markets).

Krugman and Venables (1990) model two production sectors. One of these sectors is perfectly competitive and produces a freely tradeable homogenous commodity under constant returns to scale. The other sector is monopolistically competitive and has firms producing differentiated manufactures under increasing returns to scale.

It is hardly surprising that at equilibrium the core has more imperfectly competitive firms than the periphery. The interesting finding is that, for finite positive trade costs, the core's share of world industry is larger than its share of world endowments. It is therefore a net exporter of manufactures. Furthermore, the difference between the two shares changes non-monotonically with economic integration.

Scale economies induce firms to locate in few places (in fact, in their model, as in most formalisations of monopolistic competition, each variety is produced in just one

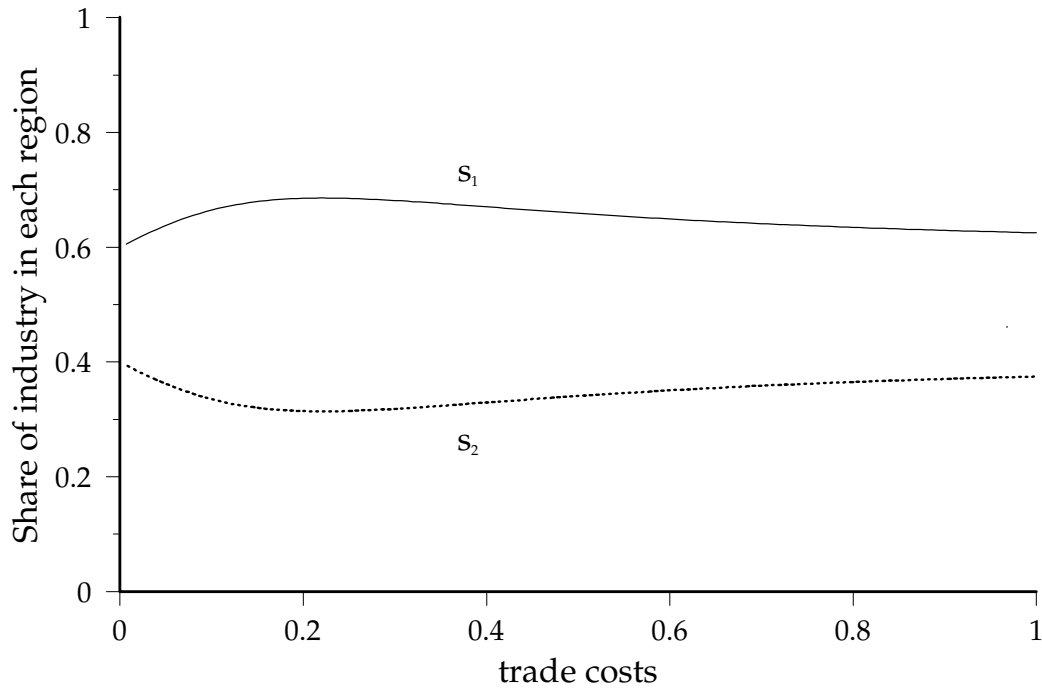


FIGURE 1
Integration and location in Krugman and Venables (1990)

place). And if there are some trade or transport costs for industrial goods, more firms set up production in the country with the larger market to avoid trade costs in a larger fraction of their sales. What Krugman and Venables (1990) show is that the tendency to locate in the larger market is stronger for values of trade costs that are neither too high nor too low. When trade costs are high, location is mainly determined by one of the two forces we have described as ‘traditional’: product market competition. When trade costs are low, the other ‘traditional’ force, factor market competition, takes over.

This is best seen by considering a process of gradual integration from autarchy to free trade between the two countries, as depicted in figure 1. The vertical axis is the share of industry in each country, and the horizontal axis plots trade costs (zero represents free trade, one represents trade costs equal to the producer price of the product). In this example country 1 (the core country) is assumed to have 60% of world endowments of the two factors. Under autarchy, each country’s share of industry would equal its share of world endowments. With high but finite trade costs, firms sell mainly — but not only

– in their local market. Then if a country had many more firms relative to its market size than the other, stronger product market competition would lead some local firms to exit reducing such differences.

Economic integration increases the share of sales that each firm makes in the other country, thereby weakening the effect of more local firms on competition. Yet increasing returns imply that the larger sales of firms producing in the core give them higher profits. As more firms enter in response to those profits, the size of industry in the core rises above its share of world endowments.

However, as the size of industry in the core increases so does demand for local factors. At some point, rising factor prices start driving some firms out of the core, so further integration starts reducing its share of industry. As the two countries approach a free trade regime it is increasingly factor price differences that determine location, so differences in both nominal and real wages between them tend to disappear, while each country's share of industry tends to go back to its share of world endowments.

Models of trade with imperfect competition highlight the fundamental ambiguity of the effects of economic integration on the relative competitiveness of core and peripheral regions. However, this approach still has important shortcomings.

First, new trade theory – like traditional theory – explains differences in production structures through differences in underlying characteristics. It starts by assuming that there are countries with large and small markets, but does nothing to explain why this division arises, and particularly why countries that are a priori very similar can develop very different production structures.

Second, it does not explain why firms in particular sectors tend to locate close to each other, leading to regional specialisation.

Third, it presents industrial development as taking place gradually and simultaneously in all developing countries, while in practice industrialisation often takes the form of waves of rapid industrialisation in which industry spreads successively from country to country.

These are the kind of issues that the 'new economic geography' has come to address. The remainder of the paper focuses on them.

3. Endogenous core-periphery patterns

Models of trade with imperfect competition predict that, in the presence of increasing returns and trade costs, firms and workers tend to locate close to large markets. Development economists in the 1950's were keen to emphasise that large markets are in turn those where more firms and workers locate (there is a variety of concepts related to this argument, such as Perroux's (1955) 'growth poles', Myrdal's (1957) 'circular and cumulative causation', or Hirshman's (1958) 'forward and backward linkages', although its application to regional growth is usually associated with Pred (1966)). New economic geography formalises this kind of cumulative causation mechanisms, to show that regions which are similar, or even identical, in underlying structure can endogenously differentiate into rich 'core' regions and poor 'peripheral' regions.

There are several mechanisms through which such cumulative causation may arise. Krugman (1991*b*) shows that the interaction of labour migration across regions with increasing returns and trade costs creates a tendency for firms and workers to cluster together as regions integrate. While relevant for studying agglomeration within national boundaries, in an international context high barriers to migration may limit the role of labour mobility as a force driving agglomeration. Venables (1996) addresses this issue by showing that vertical linkages between upstream and downstream industries, when both of them are imperfectly competitive, can play a role equivalent to that of labour migration in endogenously determining the size of the market in different regions. Linking with 'new growth theory', Baldwin (1997) shows that factor accumulation can also sustain agglomerations, while Martin and Ottaviano (1996*a*) look at the intertemporal component of input-output linkages.

Migration-induced demand linkages

The main point of Krugman (1991*b*) is that, if some factors are mobile between countries, then the pressure put on those factors by the concentration of economic activities will be eased. Factor mobility will make the supply of factors sufficiently elastic that small differences in the size of industry across regions can build up. Even

if regions are a priori identical, they can become endogenously differentiated into an industrialised core and a deindustrialised periphery.

Krugman's (1991*b*) model has much in common with the economy of Krugman and Venables (1990) (some of the aspects of his paper were anticipated in earlier work by Faini (1984), Fujita (1988), and Rivera-Batiz (1988)): two regions and two sectors, one monopolistically competitive (industry) the other perfectly competitive (agriculture). But there are three main differences. First, each of the two sectors uses a specific factor, so there is no intersectoral reallocation of factors (as we discuss below, this element is not essential to the story). Second, only the factor used by industry (workers) is mobile between regions, while the factor used by agriculture (farmers in Krugman's paper, although we find it useful to think of this factor as land) is not. Finally, the two regions are a priori identical in every respect, including their endowment of immobile factors.

To understand the forces at work it is useful to consider the following thought experiment. Suppose that for some reason one firm decides to move production from one region to the other. How does this affect firms' profitability? The presence of one more firm will increase competition in the product and labour markets of the region receiving the firm, thus tending to reduce local profits and to make relocation unprofitable. If there was no migration, this would be the end of the story and regions would remain identical. However, the rise in the number of local varieties and the rise in labour demand and wages tend to attract more workers. This increases local expenditure (a demand linkage) and eases competition in the labour market, so tends to increase local profits and to attract more firms.

Whether the overall effect of entry is to increase the profitability of local firms (encouraging further entry), or to lower that profitability (leading to exit), depends on parameters of the model, and in particular on how integrated regions are. Figure 2 plots the share of industry in each region during a process of gradual integration. Without differences in endowments, in the framework of Krugman and Venables (1990) nothing would happen. Here, the same is true initially. Under autarky industry is equally split between the two identical countries (without trade, production must mirror sales). And initial reductions in trade costs do not change this, since with high trade costs the

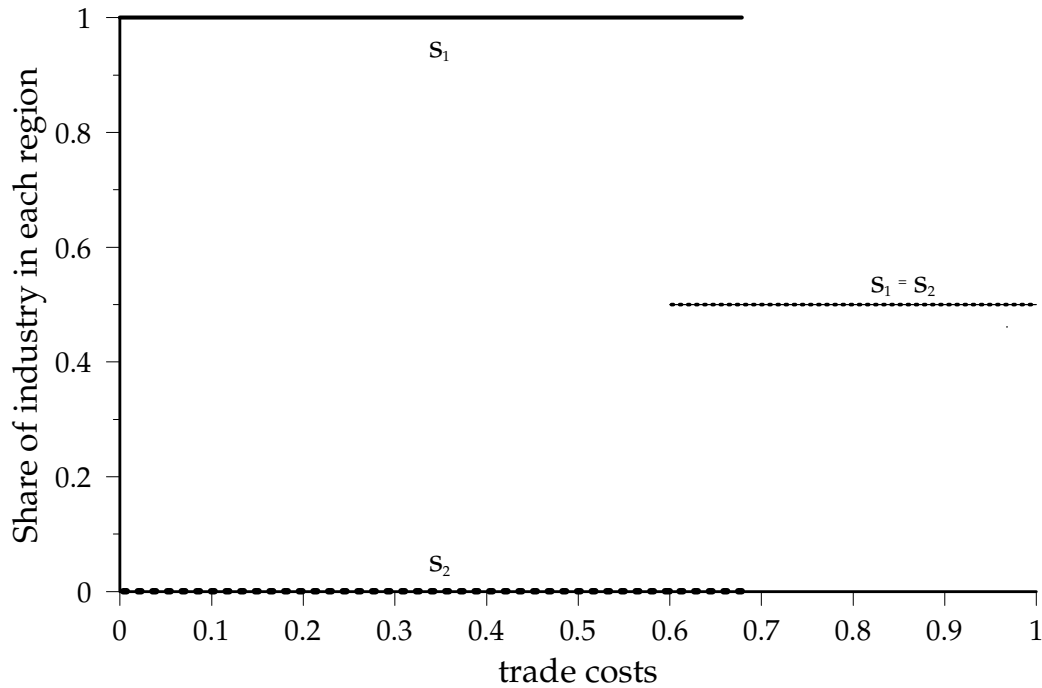


FIGURE 2
Integration and location in Krugman (1991b)

stronger product market competition associated with more firms dominates the location decisions of firms, so these remain split across regions to meet final demand locally.

However, further reductions in trade costs allow firms to cluster together to exploit demand linkages to each others workers, while still being able to compete in distant markets. There is a range of trade costs for which agglomeration forces are too weak to destabilise the symmetric equilibrium, but they are strong enough to ensure that if all firms were concentrated in one region this would be a locally stable equilibrium as well. And when trade costs fall enough, a (hypothetical) small firm relocation from, say, region 1 to region 2 raises profits of firms in 2 and reduces profits of firms in 1. The industrial structures of the two regions must then diverge, and this is what we observe happening for low trade costs in the figure: the two regions become differentiated into an industrialised core and a deindustrialised periphery.

Agglomeration takes place earlier during a process of regional integration the stronger the preference for variety, and the larger the share of manufactures in

expenditure. This is because a lower elasticity of substitution across varieties in consumers' preferences increases the importance of having a large variety of products available locally. By reinforcing the monopoly power of firms over their own varieties, this weakens local competition and favours agglomeration. A larger share of manufactures in consumer expenditures also favours agglomeration, because it augments the impact of immigration on the size of the local market for manufactures. In addition, it increases the weight of the prices of manufactures in real wages, thus enabling firms located in regions with more industry to attract workers without having to pay high nominal wages.

By introducing intersectoral mobility in Krugman's (1991*b*) model, Puga (1998*a*) highlights the important role played by the elasticity of labour supply. No matter how strong are the incentives for the agglomeration of industry, this can only take place if firms in a region can draw workers from elsewhere. A higher elasticity of labour supply from agriculture to manufacturing allows firms to attract workers from the agricultural sector in their own region with smaller wage increases, and thus favours agglomeration. Development economists (e.g., Rosenstein-Rodan (1943), Lewis (1954)) have long stressed that the elasticity of labour supply is much higher in LDCs than in more developed countries. This could help explain why primate cities dominate in LDCs, while a comparatively small share of urban population lives in Europe's largest cities.

Input-output cost and demand linkages

The cumulative causation mechanism modelled by Krugman (1991*b*) relies on the assumption that, when a region does relatively badly in terms of non-agricultural employment, workers move to regions that are doing relatively better, and this tends to eliminate interregional real wage differentials. Blanchard and Katz (1992) show that in the US there is such an adjustment process working through regional migration. In Europe, however, such an adjustment process is absent (Decressin and Fatàs (1995)). There is very little migration across European countries despite large intercountry wage differences (only about 1.5% of EU citizens live in a Member State different from where they were born). Even within European countries, migration across regions remains

small. Eichengreen (1993) estimates that the elasticity of interregional migration with respect to the ratio of local wages to the national average is 25 times higher in the US than in Britain. The difference with respect to Italy is even larger. More generally, barriers to international migration make worker mobility a more suitable explanation for agglomeration in a regional than in an international context.

Venables (1996) addresses this issue by arguing that firms like to be close to each other not only because of linkages working through the supply of labour and demand for goods from each others workers, but also because of direct input-output linkages amongst themselves. This amounts to a formalisation of Hirschman-type (1958) 'forward' and 'backward' linkages between industrial firms in the economy. The formal modelling of such linkages highlights that they only give rise to pecuniary externalities if there are increasing returns to scale. For a downstream industry to bestow a backward linkage on an upstream industry it is not enough that there is a buyer-supplier relationship between the two; it must be the case that an increase in the output of the downstream industry, by enlarging the market for the intermediates it uses, induces the upstream industry to produce at a more efficient scale. Similarly, a downstream industry enjoys a forward linkage only insofar an increase in the output of an upstream sector allows downstream firms to produce more efficiently.

To study the implications of this phenomenon, Venables (1996) considers an economy with two countries and internationally immobile labour. Besides a perfectly competitive sector, he models an upstream and a downstream imperfectly competitive industries, where the goods produced by upstream firms are inputs to downstream firms. Krugman and Venables (1995) make the model closer in structure to Krugman (1991*b*), by collapsing the upstream and downstream industries to a single imperfectly competitive sector in which the output of each firm is sold both as a final good to consumers and as an intermediate input to all other firms.

The effects of globalisation on agglomeration in this framework depend on whether differences across regions in industrial employment levels are accompanied by differences in wages or not. Here we look at the case in which agglomeration does not open interregional wage gaps (which in the context of Krugman and Venables (1995) simply requires that at equilibrium all countries keep some agricultural production). In

the next section we look at the differences introduced by interregional wage inequalities.

The relationship between integration and industrial location is identical to that represented in figure 2 for Krugman's (1991*b*) model (in a qualitative sense, but if the share of intermediates in firms costs is the same as the share of manufactures in consumer expenditure also in a quantitative sense; see Puga (1998*b*) for details). Regions have the same underlying characteristics, and for high values of trade costs they also have the same production structures. Falls in trade costs first make agglomeration sustainable, and then destabilise the symmetric equilibrium, leading regions to endogenously differentiate into an industrialised core and a deindustrialised periphery.

However, the linkages driving agglomeration are different from those in Krugman (1991*b*). In Krugman (1991*b*) model an increase in the number of firms in a location increases demand for the output of local firms through the expenditure of the workers attracted from other regions. In Krugman and Venables (1995) there is no interregional mobility, so workers must be drawn from other sectors instead, and the higher demand comes from expenditure on intermediates by the newly arrived firms. Additionally, in Krugman and Venables (1995) there is a cost linkage arising from the saving in trade costs on a larger fraction of their intermediate inputs by firms in the larger market.

Endogenous growth, factor accumulation and intertemporal linkages

Baldwin (1997) suggests an alternative way in which agglomeration may occur without factor migration. He shows that factor accumulation can play the same role as migration in fostering agglomeration through demand linkages. The structure of his model is similar to that of Krugman and Venables (1990) with the addition of a Research and Development (R&D) activity that uses labour to invent and patent new manufactures. The differentiated manufactures are produced using labour and patents as an additional factor. Patents last forever and are non-tradable, so that production occurs where invention takes place.

Decreasing returns to patent accumulation imply that the economy eventually reaches an equilibrium where no more innovation takes place. What is then the spatial

distribution of firms at this equilibrium? The answer depends on whether profits accruing to new patents increase or decrease with the number of firms. These profits are determined by the balance between the attractiveness of the larger market in the presence of increasing returns and its unattractiveness arising from product and factor market competition. If the former dominates, invention in the larger market pays more and endogenous accumulation prevents an even distribution of firms. As in Krugman (1991*b*) this happens for low trade costs, a large share of expenditures devoted to the differentiated manufactures, and low elasticity of substitution between them.

Baldwin (1997) argues that, even if static, the previous models can be interpreted as describing the spatial distribution of economic activities in the long run, when all resources in the economy grow at some constant rate, which does not depend on the spatial distribution of firms. Indeed this appears to be the interpretation favoured by the authors. The main problem with this point of view is that the distribution of economic activities and the long run rate of growth of the economy cannot be considered as independent. This point is made Walz (1996*a,b*) and Martin and Ottaviano (1996*a*, 1998) who model economic growth as ongoing invention of new differentiated products in the wake of Romer (1990) and Grossman and Helpman (1991).

Walz (1996*a,b*), develops a model where migration and aggregate increasing returns to scale at the local level can trigger agglomeration and faster growth. Martin and Ottaviano (1996*a*, 1998) consider instead increasing returns at the firm level. Martin and Ottaviano (1998) show that local technological externalities in factor accumulation reinforce the incentives towards agglomeration stemming from local pecuniary externalities in production. Martin and Ottaviano (1996*a*) introduce an intertemporal version of forward and backward linkages. They model two countries and the two usual sectors: one perfectly competitive and one monopolistically competitive. In addition, there is an R&D sector, which is perfectly competitive and uses differentiated specialised producer services as only inputs for the invention of new industrial varieties. Unlike in Baldwin (1997) constant returns to patent accumulation yield ongoing growth even in the long run. Moreover, once invented, a new variety can be

produced anywhere by using local labour, while the royalties for the related patent are repatriated to the location where it was invented in the first place.

The benefit obtained by the R&D labs from input differentiation plays a role in Martin and Ottaviano (1998) equivalent to that of labour mobility in Krugman (1991*b*) and that of input-output linkages in Venables (1996) and Krugman and Venables (1995). The way in which the model generates circular causation between concentration and growth can be seen by considering the usual firm relocation starting from an even spatial distribution of firms and labs. The presence of one more firm gives labs access to a wider range of services without any additional trade cost. This makes innovation cheaper. Local labs innovate at a faster rate and some labs relocate from the other country. Faster innovation and more labs in turn increase the local demand for intermediates and therefore attract more industrial firms. So labs follow firms and firms follow labs.

One can think of this framework as introducing an intertemporal linkage by which the existing industrial firms are connected to the future generations of industrial firms. As with static linkages, the end result is agglomeration: one location specialises in innovation and industry, the other in the traditional production. However, an additional implication arises in this context, as agglomeration increases the rate of growth. The relationship between integration and agglomeration is also similar to what we have seen so far: reductions in trade costs can trigger agglomeration and faster growth.

Where does agglomeration take place?

We have investigated several cumulative mechanisms through which economic activities can agglomerate, and discussed under what conditions integration can be expected to cause agglomeration. Treating agglomeration as a self-reinforcing process raises the possibility of several feasible spatial configurations. How can one select amongst them? Having abstracted from differences in underlying characteristics to illustrate the self-reinforcing nature of agglomeration, there is little in these models to tell us where industry goes. Nevertheless, the papers surveyed so far provide one

possible answer. A small initial asymmetry can be amplified by cumulative causation and give rise to large differences between regions. Historical accident can therefore determine location. Krugman (1993a) cites an example from Cronon (1991): Chicago became the central city of the American heartland without any distinctive advantage to Chicago's site.

Another way to explain why certain activities cluster in particular locations is to introduce more structure into these models by bringing in elements from traditional and new trade theory. Thus, agglomeration could amplify comparative advantage (although it could also work against it). Or agglomeration could respond to market access considerations arising from geography. Krugman (1993a) looks at the latter possibility by studying the equilibrium location of manufacturing on a disc-shaped region. He develops a measure of 'market potential' in the tradition of Harris (1954), with microfoundations built on a model like that in Krugman (1991b) but with a continuum of locations. Given the location of a single manufacturing concentration, he can calculate the maximum real wage that a firm in any alternative location could pay (these market potential indices are extended to a more general setting by Fujita and Krugman (1995) and Fujita, Krugman, and Mori (1995)). If the wage gradient or market potential curve is downward sloping from the concentration of manufacturing then no firm is able to attract workers to alternative locations, so such concentration is an equilibrium.

Krugman (1993a) shows that, if there is just one manufacturing concentration, this tends not too far off the centre, as firms need good access to the whole region. However, it need not be precisely at the centre, because the location of the city itself can shift the economic centre of the market away from the geographical centre. As in the example of Chicago, second nature can make up for the advantages that first nature failed to provide a location with. Krugman (1993b) shows that hubs in transportation networks enjoy a similar advantage to central places. Fujita and Mori (1996) argue that these may help explain why so many large cities are port cities.

While, in the presence of agglomeration economies, historical accidents can trigger self-reinforcing agglomeration processes, agglomeration could start even in the absence of any historical accident. Agglomeration could take place in a certain location just

because everyone expects this to happen, and precisely this shared belief would be responsible of the cumulative causation that would eventually confirm it.

Matsuyama (1991) and Krugman (1991c) relate the relative importance of history versus expectations to the strength of technological externalities. When an existing agglomeration unravels giving rise to a new one, the process is not instantaneous and carries costs and benefits. The costs are due to the fact that agglomeration economies are lost in the transition and the adjustment is often slow and painful. The benefits come from the future agglomeration economies that the new spatial distribution will deliver. As a matter of fact, costs come before benefits. Therefore expectations will be able to revert the situation inherited by history only if the present discounted value of future benefits offsets the present costs. Intuitively, this will happen if adjustment costs are low and if people are patient.

The analysis in terms of technological externalities is not able to address the question of what are the relevant microeconomic factors that affect the balance between history and expectations. Ottaviano (1996a, 1997) studies the problem in terms of pecuniary externalities by constructing a dynamic model in the spirit of Krugman (1991b). What he shows is that the same forces that make the tendency of firms to cluster together stronger (namely low trade costs and large economies of scale), also make expectations more important.

4. Globalisation and the spread of industry

Labour immobility as a dispersion force

So far we assumed that agglomeration does not increase wages and prices of non-tradeable goods in regions where more firms and workers cluster together. This assumption is clearly counterfactual, and in this section we explore the consequences of relaxing it.

That is the main purpose of Puga (1998b), who develops a unified framework that captures several of the models discussed in section 2 (Krugman (1991b), Krugman and

Venables (1995), and Puga (1998a)). His model is very close to those reviewed so far, but considers both interregional migration and input-output linkages as forces which may drive agglomeration; it also takes a closer look at the interaction between constant and increasing returns activities in labour markets. In the process of solving the model, a methodology is developed for deriving analytical results in this kind of framework, while taking into account factor price effects. Four main conclusions can be drawn from that analysis.

First, comparison of the outcomes with and without interregional migration shows that agglomeration gets an extra kick from the relocation of workers towards locations with higher real wages. Thus the lack of interregional mobility both postpones agglomeration in a process of regional integration and weakens it when it happens (this suggests that the unwillingness of European workers to migrate can play an important part in explaining why non-agricultural employment is less geographically concentrated in Europe than in the United States but income disparities are wider across EU regions than across US States).

Second, if equilibrium wage differences are not eliminated by migration, they act as a dispersion force by increasing production costs for firms producing in locations with relatively many other firms.

Third, this dispersion force can moderate agglomeration and sustain non-extreme equilibria in which all regions have industry, even if in different proportions.

Fourth, firms find higher local wages increasingly discouraging as regions become more integrated, so for low trade costs it is the price of non-tradeable factors that determines location. Venables (1996) points out that with zero trade costs each firm finds no advantage in locating close to the rest of industry and locates in the region with lowest wages; therefore, if wages are increasing in industrial employment, for trade costs sufficiently close to zero agglomeration in one region cannot be an equilibrium. Krugman and Venables (1995) illustrate this with examples in which for low trade costs some firms relocate from the industrial agglomeration to regions with lower wages, but not to the extent of allowing full convergence between a priori identical regions.

Puga (1998b) shows that with a more general modelling of the interaction between increasing returns and constant return activities in factor markets the relationship

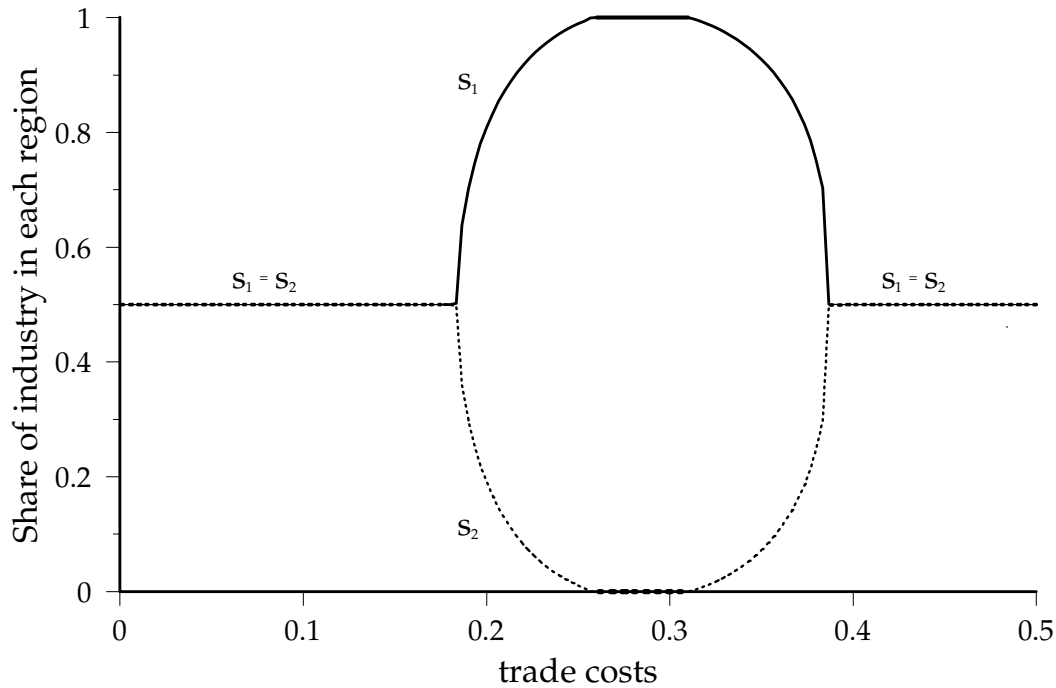


FIGURE 3
Integration and location in Puga (1998b)

between economic integration and location is as depicted in figure 3. For high trade costs firms are split between the identically endowed regions to meet final demand. For intermediate trade costs regional disparities open up as some regions attract more industry than others – but not to the extent of becoming fully specialised. For low trade costs agglomeration unravels as the share of industry in regions with lower wages increases gradually (early entrants look for lower prices of immobile factors relative to more industrialised regions; later, as a critical mass of firms is created in some sectors, more firms move in to exploit forward and backward linkages).

By comparing figures 1 and 3 we can see how this inverted U-shaped relationship between integration and agglomeration differs from that found by Krugman and Venables (1990). In Krugman and Venables (1990) there is no cumulative causation so the evolution of industrial location during a process of economic integration is driven by exogenous differences in market size. If both countries were of the same size industry would be split half and half between them for any level of trade costs. As

already noted, the main addition of new economic geography to such models is to make market size endogenous so regional inequalities first rise and then fall during a process of regional integration, even between identical countries.

By introducing more than two regions one can observe a more complex picture in which, starting from the agglomeration of industry in a subset of regions, industrialisation spreads in a series of waves from country to country. According to this view economic development is not a smooth process of many countries catching up with the rich. It is instead the coexistence of a rich and a poor group of nations, but with possible mechanisms causing poor countries to join the rich club. Two such mechanisms are the expansion of manufacturing relative to other tradeable sectors in the world as a whole, and changes in trade policy (Puga and Venables (1996, 1997b)). Consider the expansion of manufacturing. This initially accentuates wage differences between industrialised and non-industrialised countries. At some point this wage gap becomes unsustainable, and industry starts to spill over to low wage economies. As this process continues so relocating firms begin to benefit from the forward and backward linkages to other firms, and a 'critical mass' is reached by some country. At this point that country undergoes rapid industrialisation, accompanied by an increase in wages. Further growth causes the process to repeat itself, so industry spills over, in a series of waves, from one country to another. This provides a useful way to think about the westwards spread of industry from Japan to its East Asian neighbours as manufacturing production has grown in the region. Integration starting from the concentration of industry in few places produces similar patterns.

In related models, Fujita, Krugman and Mori (1995) and Fujita and Mori (1997) look at the effects of population growth on urbanisation patterns. As the agricultural hinterland of existing cities grows distant from them, new cities form, and the sequence of urbanisation mirrors East to West urbanisation in the US.

Non-tradability as a dispersion force

Wage differences are one possible reason why globalisation can bring convergence of income levels, but not the only one. An interesting alternative is modelled by Helpman

(1997). He takes Krugman's (1991b) model and turns the agricultural sector producing a freely tradeable commodity into a non-tradeable housing sector. Helpman finds the reverse results to those in Krugman's paper: reductions in trade costs improve the availability of manufactures in less congested areas and induces workers to migrate out of more congested areas to save in housing costs, thus working against agglomeration. Interestingly, intermediate cases between Krugman's and Helpman's models (studied by Adrian (1996) and by Hadar (1996)) produce a picture in which industry is agglomerated for intermediate values of trade costs, but not for high and low values of trade costs.

The general picture coming out of these models is therefore one in which, for high trade costs, the need to supply markets locally encourages firms to locate in different regions. For intermediate values of trade costs, cost and demand linkages take over and firms and workers cluster together. Finally, for low values of trade costs location is determined by the price of those factors and goods that are not mobile.

Industrial specialisation

Most of the models reviewed so far depict somewhat dramatic pictures, with the whole of industry moving together into and out of regions. We have already seen from the results in Puga (1998b) that taking into account factor price effects can produce outcomes such as those depicted in figure 3, in which regions keep industry in different amounts. Yet this still ignores the possibility of regional specialisation in different sectors (which in this context simply means agglomeration at a more disaggregated level than overall manufacturing). One of the strongest trends in the economic geography of Europe has been the increasing specialisation of countries in different manufacturing sectors (Brühlhart (1996)).

Krugman and Venables (1996) show that the observation that firms have stronger buyer/supplier relationships with some types of firms than with others can help us understand the process of regional specialisation. They consider a setup like that in Krugman and Venables (1995), with one main difference: the two production sectors are imperfectly competitive, and 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 in the other sector.

The forward and backward linkages operating in this case are essentially the same as in Venables (1996), Krugman and Venables (1995), and Puga (1998*b*). The difference is that, if one more firm locates in a region, the beneficial cost and demand linkages affect more intensely firms in the same sector, while the increased product and labour market competition harms firms in both sectors equally (Henderson (1987) uses a similar argument to explain city specialisation). As a result, integration leads each region to become specialised in the production of one sector.

Venables (1998) extends the model in Krugman and Venables (1996) to a continuum of imperfectly competitive sectors, and a perfectly competitive sector. They then ask what proportion of sectors will be located in each of the two regions when agglomeration occurs. With just two sectors the answer was one industry in each region, this meaning that both regions have the same income levels. But with many industries the division need not be half and half. One region can have more industries than the other, this leading to real income differences between regions. What Venables shows is that there are bounds to sustainable regional differences, and that the maximum share of total industry that one region can capture first increases and then decreases during a process of regional integration. However, because within those bounds the actual division of sectors between regions is indeterminate, there are strong incentives for each region to try to secure the maximum possible number of sectors.

Considering something closer to an actual input-output matrix, with a finite number of sectors which employ the output of other sectors in very different proportions, constrains the number of possible outcomes. So do more traditional comparative advantage considerations. Yet the underlying trends predicted by these models persist even when one introduces more structure into them. Integration encourages firms to cluster together to exploit linkages, opening differences between regions both in the level of total manufacturing employment (and hence in income levels) and in its sectoral composition. As integration proceeds, firms become more sensitive to cost differences. Being close to firms in related activities becomes even more important, while firms tend to move away from firms in unrelated activities, to avoid having to compete with them

for immobile factors. Regions then become increasingly specialised in different sectors, but, insofar they have similar endowments and technologies, may converge in total employment and income levels.

5. Concluding remarks

A casual look at different models of location using the Spence (1976) and Dixit and Stiglitz (1977) model of monopolistic competition can give the false impression that they have different, or even contradictory, predictions for the effects of closer economic integration on the location of economic activities. A closer look, however, uncovers a clear common set of conclusions.

Firms producing in locations with relatively many firms face stronger competition in the local product and factor markets. This tends to make activities dispersed in space. However, the combination of increasing returns to scale and trade costs encourages firms to locate close to large markets, which in turn are those with relatively many firms. This creates pecuniary externalities which favour the agglomeration of economic activities.

Economic integration, by affecting the balance between dispersion and agglomeration forces can decisively affect the spatial location of economic activities. For high trade costs, the need to supply markets locally encourages firms to locate in different regions. For intermediate values of trade costs, the incentives for self-sufficiency weaken. Pecuniary externalities then take over, and firms and workers cluster together. However, the price of local factors and goods tends to rise wherever agglomeration takes place. If most factors and goods can be imported from other regions, rising factor prices simply give an additional kick to agglomeration by inducing immigration. If instead there are some immobile factors which are particularly important for production (such as labour), or non-tradeable goods that are particularly important for consumption (such as housing), as further integration reduces the importance of pecuniary externalities, differences in the prices of immobile goods and

factors take over. What arises then is a stage of globalisation in which industry spreads to less developed regions.

The somewhat paradoxical corollary to this is that when high trade costs prevent strong spatial interactions the size and characteristics of the local market and factor availability determine what is produced where. Initially economic integration diminishes the importance of such considerations, so for intermediate trade costs creates what Fujita and Thisse (1996) call 'putty clay' geography: there is a priori great flexibility on where particular activities locate, but once spatial differences take shape they become quite rigid. However, for low trade costs the weight of location shifts back to local underlying characteristics. But what matters then is good local availability, not of all goods and factors, but of those whose mobility has been less improved by globalisation.

First empirical tests

What empirical evidence is there to support both the relevance of pecuniary externalities as agglomeration forces, and the way in which their relative strength with respect to dispersion forces is affected by economic integration?

The direct test of these models is still at an infant stage. Trade economists are notoriously slow in taking their theoretical models to empirical ground, and economic geography has been no exception. In the absence of comprehensive studies, the most interesting analyses still focus on special cases. In particular, the bulk of the existing empirical literature is devoted to the North American Free Trade Agreement (NAFTA) and the European Union. This is partly due to data availability and demand from policy makers, but also motivated by the natural experiments provided by rapid and sustained integration in recent years in these two geographical areas.

So far, the most rigorous and complete assessment of the locational forces identified by the models surveyed in this paper is provided by the work of Hanson on US-Mexican integration. He finds support for the hypothesis that agglomeration is associated with increasing returns, and shows that integration with the US has shifted Mexican industry away from Mexico city and towards states with good access to the US market. This is

reflected in the falling importance of distance from the capital and the rising importance of distance from the border in explaining interregional wage differentials (Hanson, (1997a, 1997b, 1998a)). A similar movement towards the border states can be observed in the US.

Hanson (1996) argues that frontier economies are the natural laboratories in which to identify any relocation effects of integration, and that border cities are the best units of analysis. He finds that integration not only has shifted industry towards border cities both in the US and in Mexico, but also that it has made demand and cost linkages more important determinants of industrial location: employment has grown more in those regions that have larger agglomerations of industries with buyer/supplier relationships.

With respect to Europe, Brülhart (1996) and Brülhart and Torstensson (1996) study the evolution of industrial employment patterns in 11 EU members (all except Luxembourg, and the more recent member states, Austria, Finland, and Sweden) between 1980 and 1990. They find support for some of the main implications of theoretical models.

First, Brülhart (1996) finds that between 1980 and 1990 14 of the 18 industries considered have become more geographically concentrated in Europe (as measured by locational Gini coefficients). Second, sectors characterised by large economies of scale have shown larger increases in concentration. Finally, Brülhart and Torstensson (1996) find some support for the U-shaped relationship between the degree of regional integration and spatial agglomeration predicted by the models when labour mobility is low: activities with larger scale economies were more concentrated in regions close to the geographical core of the EU during the early stages of European integration, while concentration in the core has fallen in the 1980s.

Also in the context of Europe, Quah (1996) studies through conditioning in models of explicit distribution dynamics to what extent observed income inequalities across EU (NUTS II) regions can be explained by spatial spillovers from neighbouring regions and to what extent by being part of a particular Member State. From that comparison he concludes that spatial spillovers matter more than national characteristics for explaining income inequalities across EU regions, even if both factors are important.

Directions for further research

The single most important direction in which research in this area needs to be extended is empirical testing. Because the theoretical models have very clear predictions for the relationship between production, wages, and trade flows, it seems particularly important to test more directly how well these models fit the data. A promising step in this direction is taken by Hanson (1998*b*) who, using data on US counties, estimates the structural parameters of a variant of Krugman's (1991*b*) model and finds support for small but significant scale economies.

Another clear weakness of this approach is that most papers use the same basic framework with Spence-Dixit-Stiglitz monopolistic competition and iceberg trade costs. Three directions are worth exploring: what would change if different specifications were adopted for the specific functional forms used, for the transportation technology, and for market structure. The latter may prove particularly important. As argued by Matsuyama (1995) monopolistic competition enables to concentrate on the aggregate implications of increasing returns to scale without being concerned about strategic interactions amongst firms. However, because firms are likely to be more worried about closer competitors, strategic interaction is inherent to spatial models (Fujita and Thisse, 1996). In fact, strategic interaction could in itself be a powerful force driving location, as shown by Combes (1997) in a two-country two-sector model with Cournot competition.

Ottaviano and Thisse (1998) make a first step towards introducing different forms of imperfect competition by modifying Krugman's (1991*b*) set-up in a way that permits a more detailed analysis of the forces at work as well as more explicit connections to the industrial organisation literature. By departing from the Dixit and Stiglitz (1977) version of Chamberlinian monopolistic competition, they can show that the pricing decisions of firms are affected both by the total number of competitors and by their geographical locations. They also model transportation as a costly activity that uses other resources than the transported good itself, and investigate the role of the alternative pricing policies on the agglomeration of economic activities. This is crucial because, as argued by Smith and Venables (1988) in the context of European integration, some of the most

dramatic effects of integration may come from the switching from segmented to integrated markets. Interestingly, the results of Ottaviano and Thisse (1998) provide support to the generality of the main tendencies toward agglomeration highlighted by Krugman (1991*b*) and suggest that his insights could be extended to a whole class of models.

Another important direction for future research concerns multinational corporations. Since much of the recent relocation of activity has taken the form of foreign direct investment, multinational corporations are very relevant to the issues studied by these models. A first attempt to bring multinational corporations and the economics of agglomeration into the theory of trade under imperfect competition as presented by Helpman and Krugman (1985) is made by Markusen and Venables (1995). The implications of strategic interactions on the plant location decisions of multinational enterprises are explored by Baldwin and Ottaviano (1998).

Also, all the models surveyed in this paper assume full employment. Yet in Europe it is the threat of unemployment that has drawn most attention towards industrial relocation. Bringing in tools from matching theories of unemployment may be a useful route to follow. Helsley and Strange (1990) model micro-foundations for agglomeration economies at the city level as improvements in labour market matching (see also Midelfart-Knarvik, 1996, in a framework more closely related to the models surveyed here).

The argument made by Martin and Ottaviano (1996*a*, 1998) and Walz (1996*a*, *b*), that location and the long run rate of growth of the economy cannot be treated independently, also needs to be followed upon. Two particular aspects are worth emphasising. First, one should address the role of pecuniary externalities for growth. Second, with the output of the fastest growing economies becoming increasingly weightless (Quah (1997)), sectors like information technology, with possibly very different location determinants from traditional manufacturing, need to be looked at carefully.

Finally, although these models have a clear policy dimension, little work has been done so far to draw their policy implications. The focus on trade or transport costs makes trade and infrastructure policies the first natural candidates for analysis. Some

recent papers have started looking at the effects of trade policy on agglomeration (Brülhart and Torstensson (1996), Martin and Ottaviano (1996b), Ottaviano (1996b), Puga and Venables (1996, 1997a, 1997b, 1998), and Walz (1997, 1998)). A first attempt to study the impact of infrastructure provisions in the same framework has been undertaken by Martin and Rogers (1995), while Venables and Gasiorek (1997) show how a calibrated new economic geography model can complement more traditional cost benefit analysis for infrastructure projects. Also on the policy front, Trionfetti (1997) looks at the consequences for industrial location of different procurement policies. A common idea in these papers is that the design of trade agreements and of infrastructure networks shapes the location advantage in terms of access to world markets. This is applied by Puga (1997) to discuss the implications of the new economic geography for European regional policy. Over the next few years we can expect policy issues to be more carefully incorporated into the analysis. As that happens, adding a political economy dimension will be a natural direction to follow.

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