Economic Geography, Industry Location and Trade: The Evidence

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Abstract:

General-equilibrium models based on increasing returns, product differentiation and monopolistic competition have attained a prominent position in trade theory and, more recently, in economic geography. This paper surveys empirical studies on issues raised by the new wave of theoretical thinking. There is a growing literature documenting spatial distributions of industries at country and regional levels, which focuses predominantly on the United States and the European Union. This body of work has produced robust findings as well as puzzles. Particular ambiguity appears in studies of location trends in the European Union. In addition, empirical researchers have devised methods to separate and test alternative theoretical paradigms. Analytical work confirms the complementarity and relevance of both neo-classical and "new" models. Existing results, however, do not permit firm conclusions about the relative explanatory power of the main theoretical approaches for location patterns overall and in particular industries.

Keywords: industry location, trade theory, new economic geography
JEL classification: F1, R1, R3

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1. INTRODUCTION

The 1990s have seen a spectacular resurgence of academic interest in the spatial dimension of economics. This interest was fostered primarily by the improvement of the analytical tool kit available to economists through the "new" theories of trade and economic geography. In other words, renewed attention to spatial economics was the result of theoretical advances rather than to a changed empirical context.[1] Yet, economic knowledge cannot be gleaned from theory alone. For theoretical innovations to convince, they need to be validated through observed facts. Therefore, empirical work soon followed the advances made on the theoretical side, and earlier results could be reinterpreted against the new paradigms. This paper summarises the current state of play in the empirical agenda opened up by the "new economic geography". It shows that there already exists a substantial body of evidence against which one can judge the merits of competing theories. Yet, given the prominence reached by the theory and given the welfare relevance of the topic, the empirical literature still presents ample scope for fruitful extension.

This paper is structured as follows. First, I briefly summarise the predictions generated by the main strands of trade and location theory in Section 2. In Section 3, I survey recent empirical work which does not explicitly test competing theories, but which describes economic location patterns. Section 4 is dedicated to studies which analyse economic data explicitly against the background of location and trade theory. Section 5 concludes with an overall summary and suggestions for future empirical research.

[1] Note, however, that the theoretical advances in turn were largely motivated by a change in the empirical context, namely the emergence of pervasive intra-industry trade. I discuss this issue in Section 3.1.

2. THEORY

Illuminating surveys of recent advances in location theory have been written, and I do not want to replicate them here.[2] This section merely serves as the necessary backdrop for the later discussion of empirical work.

2.1 Location, Specialisation, Agglomeration, etc.

Some terminology needs to be clarified at the outset. This paper uses the terms "economic geography", "spatial economics" and "economics of location" interchangeably, and in the widest sense. These terms encompass two dimensions which are conventionally treated as separate sub-disciplines: international trade and regional economics.

It is sometimes argued that the distinction between international and regional economics is no longer valid in a world where economic boundaries are becoming increasingly different from those of nation states. This is true in so far as the criterion for distinguishing the two sub-disciplines relates to political borders. However, there is a more general criterion which separates regional from international economics: factor mobility. The bulk of trade theory studies the effects of integrated product markets across spatially segmented factor markets, whereas most models of regional economics look at the joint effects of geographical mobility in goods and factors. In this paper, I employ the terms "specialisation" and "agglomeration", where factors are immobile in the former and mobile in the latter. Somewhat less rigorously, it can also be said that specialisation tends to affect locational shifts of comparatively narrowly defined economic sectors with homogenous input structures (e.g. the automobile industry), while agglomeration involves movements of more broadly defined sectors comprising goods with very dissimilar input requirements (e.g. manufacturing activity as a whole). I treat the terms "specialisation", "concentration", "clustering" and "localisation" as synonyms.[3]

[2] See, for instance, Fujita *et al*. (1998), Fujita and Thisse (1997), and Ottaviano and Puga (1997).
[3] "Concentration" is understood in the geographical sense, not in terms of firm numbers and market structure.

2.2 Location Theory in a Nutshell

It is impossible to do justice to a vast body of theoretical thinking in a summary of a few paragraphs. This overview is therefore vulnerable to accusations of incompleteness and over-simplification. Yet, it will be useful to have a simple categorisation of intellectual contributions, which can give structure to my survey of empirical findings.

Table 1 sets out a categorisation of location theory into three broad theoretical schools, and it lists their principal distinguishing features.[4] The distinguishing features of the three schools are as follows.

1. *Neo-classical theory (NCT)* is characterised by perfect competition, homogeneous products and non-increasing returns to scale. Location is determined exogenously, by what Krugman (1993a) has termed "first nature": given spatial distributions of natural endowments, technologies and/or factors. Economic activity is spread or concentrated over space according to the spread or concentration of these underlying features. The dominating location pattern is inter-industry specialisation: sectors settle in locations with a matching comparative advantage. In this framework, and assuming zero trade costs, the spatial distribution of demand affects the pattern of trade, but not the location of production. If, realistically, trade costs are assumed, and if demand is more evenly spread over space that endowments, then locational dispersion of activity will correlate positively with the level of trade costs. At the limit, prohibitive trade costs induce perfect dispersion of ("non-traded") industries following the geographical distribution of demand.
2. Models of the *new trade theory (NTT)* dispense with all exogenous, "first nature" elements bar one: market size. Market size is determined primarily by the size of the labour force in a particular country, and labour is immobile across countries. These models introduce activity-specific features ("second nature") such as imperfect competition, differentiated products and increasing returns. The typical outcome has two layers. First, there is inter-industry specialisation, with sectors clustering in locations which offer best access to product markets. Second, there is intra-industry specialisation across firms, each of which produces a unique, horizontally differentiated variety of the industry's product. As long as some firms are left in the smaller market, intra-industry trade will ensue. As trade costs fall towards zero, however, all increasing-returns activity will tend to concentrate near the core market, and intra-industry trade between the core and the periphery vanishes.

[4] The current terminology labels all three schools as "new", even though the first has its roots in the 18th century, and the second is over twenty years old.

3. In *new economic geography (NEG)* models, location becomes entirely endogenous: "second nature" determines everything. As production factors and/or firms are mobile, even market size is explained within the model. The analytical starting point is normally a featureless two- or three-dimensional space with uniformly distributed labour and output of a single industry. This distribution tends to be unstable, due to the assumed "second nature" characteristics of the economy, such as market-size externalities and input-output linkages. These characteristics generally produce self-reinforcing agglomeration processes. Hence, any disturbance to that initial distribution will set the economy on a path towards a new locational equilibrium. There are many possible and locally stable equilibria. Which one is attained depends on the starting distribution, on the nature of the disturbance and on various industry characteristics. In these models, agglomeration mechanisms can meet opposing forces, generally in the form of increases in the prices of immobile factors. Pronounced agglomeration and the resulting centre-periphery structure is therefore just one of several possible outcomes. A typical result is that agglomeration relates non-monotonically to economic integration: the economy becomes most spatially polarised at intermediate trade costs. In view of the multiple outcomes which can be accommodated in this theoretical framework, it is no surprise that empirical researchers have found it difficult to devise rigorous tests for the NEG.[5]

2.3 Are Location Theories Testable?

When confronting theoretical priors to economic data, the careful researcher does not seek to accept one theory and to reject another unequivocally. Strictly speaking, all theories are wrong, as they are without exception based on restrictive and unrealistic assumptions. The correct question is: which theory is best at approximating real-world events at a particular time, in a particular sector and/or at a particular location? In other words, one expects *a priori* that there is place for all theoretical approaches, and empirical testing is about relative rather than absolute merit, and about conditional rather than general validation.

There are two fundamental ways of testing economic theories. The first approach is to evaluate the real-world relevance of economic *mechanisms* underlying a particular theoretical model. For instance, one could try to assess which type of market structure is a

[5] Another salient feature of some NEG models is that they consider full two-dimensional spatial structures rather than treating countries and/or regions as dimensionless points (see, e.g., Krugman and Venables, 1995b).

more appropriate description of conditions in particular economic sectors: perfect competition as in neo-classical theory or monopolistic competition as in the new theories. This is in principle the most compelling approach. However, it relies to a very large extent on qualitative information. Firm numbers or estimates of cost functions, for example, are very poor proxies for the type of market structure in a sector. Similarly, the existence of locational externalities is notoriously difficult to measure.

The overwhelming majority of empirical studies has therefore employed the second approach to testing theory: a comparison of predicted and observed *outcomes*. In so far as theories produce crisply differing predictions, they should be easily separable in the data. Unfortunately, the outcomes predicted by various strands of location theory are often neither crisp nor different. The obvious example is the NEG: multiple equilibria and path dependency are intrinsic features of these models. In effect this means that NEG models can predict a wide range of outcomes which may well look like those generated by other theories. Another example is the existence of intra-industry trade, which is generally deemed incompatible with neo-classical theories, and compatible with the NTT. However, the most celebrated model of the NTT (Krugman, 1980) predicts that, as trade barriers are reduced, increasing-returns industry concentrates in the large market. The share of intra-industry trade should therefore tend to zero with economic integration.[6] Great care clearly needs to be taken in interpreting empirical findings as corroboration or rejection of theoretical models.

The structure of this survey reflects the difficulty in devising clear-cut tests of the available theories. The next Section is entirely dedicated to empirical evidence which is at best loosely interpretable as tests of competing models. However, there have been some more rigorous tests of theoretical priors. These studies are surveyed in Section 4.

3 DESCRIPTIVE EMPIRICS

The spatial distribution of economic activity in itself is one of the most important research topics in economics. Hence, much of the relevant empirical literature is not designed as an explicit test of competing theories, but mainly as a descriptive account of locational

[6] This issue is discussed in greater detail in Section 3.1.

structures and trends. In this Section, I provide a summary of recent work in this field. I look separately at studies which draw on trade data and at studies which use production data.

3.1 Trade Data

Almost all empirical papers dealing with location at an international level are based on trade data. Many of these analyses are concerned with the pattern of trade flows *per se*, but most of them draw on trade data as an indicator of specialisation patterns in production. Yet, trade statistics only yield approximate measures of specialisation; it is through employment or output data that location patterns can be quantified directly. The popularity of trade data stems, of course, from the fact that they are so widely available, relatively reliable and highly disaggregated. Therefore, exports are generally used as a proxy for production, with the implicit assumption that export propensities are similar across countries and sectors.

Intra-Industry Trade

The emergence of the new theories of trade and geography can essentially be attributed to the empirical finding of high and growing shares of intra-industry trade (IIT). IIT is the simultaneous importing and exporting of goods which are very similar in terms of their production requirements.[7] This type of trade has been deemed incompatible with NCT. Hence, a new theoretical approach was needed, and the NTT and NEG were developed.

Since the new theories can accommodate IIT, while NCT, in most guises, cannot, the share of IIT in total trade flows has often been interpreted as a *prima facie* indicator of the relative importance of the NTT/NEG. According to this interpretation, the new theories appear to be increasingly relevant in explaining international specialisation patterns, while neo-classical determinants seem to be gradually losing importance. The reason is that IIT shares have shown a secular rise throughout the post-war years in most countries. As a representative illustration, Table 2 shows that, averaged across eleven EU countries, the share of IIT at the five-digit level has increased from 48 to 64 percent between 1961 and 1992. The OECD (1994) calculated IIT shares for all its members and confirmed that the

[7] Some authors have defined IIT to include two-way trade in goods with high substitution elasticities in consumption, or simply in goods falling into the same statistical product category. However, the only definition relevant in the present context is the one which defines industries in terms of production characteristics.

upward trend observed in intra-EU trade was also evident in the evolution of trade patterns in the rest of the OECD, as well as in trade between the OECD and the newly industrialised countries of South-East Asia.[8] Greenaway and Torstensson (1997), in an analysis of Swedish bilateral trade patterns, found that the share of "horizontal" IIT, that is IIT in goods with very similar unit values, continued to increase until 1994, albeit at a decreasing rate. On the face of it, therefore, IIT results point to the growing importance of "new" determinants of international trade and specialisation.

However, inferences from rising IIT shares to the relative importance of neo-classical and new theories are complicated by three problems. *First*, there is some ambiguity in the interpretation of measured IIT shares, since the statistical definition of "industries" does not necessarily follow the criteria which define industries in the theoretical models.[9] The problem stems from the fact that product categories in international trade statistics are not strictly defined in terms of similarity in input requirements. In addition, observed shares of IIT tend to be lower at higher levels of sectoral disaggregation, and IIT shares are therefore difficult to interpret in an absolute sense. However, the observation of steady increases in the IIT shares of most industrialised countries is very robust to changes in statistical aggregation levels.[10] The industry-definition problem is therefore a weak argument against reading real significance into the secular rise of observed IIT.

A *second* caveat arises from the fact that recent theoretical work has shown that IIT can be compatible with neo-classical trade models. Davis (1995), for instance, has shown that IIT is perfectly compatible with a framework characterised by constant returns and perfect competition. All that is necessary in order to reconcile IIT with the neo-classical paradigm is to drop the assumption that technologies are identical across countries. Even if countries share equal relative factor endowments, and goods are homogeneous in terms of factor intensities, unequal technologies (i.e. different 'isoquant scales' in the factor space) yield linear production possibility frontiers with different slopes for different countries, and opportunities for trade arise. This explanation is theoretically compelling. Nevertheless, it is questionable that the assumption of technological differences among countries is of

[8] The finding of Globerman and Dean (1990) whereby IIT growth may have levelled off in the 1980s therefore appears to have been premature.

[9] This has been referred to in the literature as the "categorical aggregation problem". An authoritative discussion is given in Greenaway and Milner (1986). Studies by Grubel and Lloyd (1975) and Brülhart and McAleese (1995) show that IIT dynamics are remarkably robust to differences in the level of sectoral aggregation.

[10] For instance, the results reported in Table 2 are calculated from SITC 5-digit data, while the results computed in OECD (1994) were based on 3-digit statistics. The time trends evident from the two sets of results are almost identical.

empirical relevance, particularly in the context of proximate industrialised countries such as the EU. There is ample empirical evidence of cross-border technology diffusion (see, e.g., Coe and Helpman, 1995; Verspagen, 1997).[11] The model of Davis (1995) would arguably be more relevant if it were couched in terms of small inter-country and inter-product differences in specific factors, but this could not provide a theory of "pure" IIT. The observation of IIT in narrowly defined industries therefore still appears to be indicative of the forces emphasised in the new theories rather than of the neo-classical comparative-advantage setting.[12]

Third, it must be noted that models of the NTT and NEG can accommodate IIT, but that they generally predict a positive relationship between the share of IIT and the level of trade costs.[13] Since the observed rise of IIT has occurred alongside a generalised fall in trade costs, the upward trend in IIT cannot be taken as a straightforward corroboration of the new theories. However, it is quite plausible that NTT and NEG models have different relevance across economic sectors. Aggregate trends in IIT shares might obscure offsetting developments at industry level, where some industries conform to the stylised predictions of the new theories and some do not.[14] This issue is addressed in Brülhart (1998), where the evolution of intra-EU IIT is studied separately for five different classes of industries over the 1961-1990 period. It is found that IIT shares in two industry groups, namely in the resource-intensive and scale-intensive sectors, are significantly below the overall average. In addition, these sectors show a reversal of the upward IIT trend in the late 1980s, hence an indication of increasing inter-industry specialisation. These results support the predictions of NCT (in the case of resource-intensive industries) and of the NTT and NEG (scale-intensive sectors). They clearly point out the importance of cross-sectional disaggregation in an analysis of trade and location.

The discussion of IIT results points to the importance of cross-sectional disaggregation in a study of industrial location. Yet, IIT indices are of limited usefulness in a cross-section analysis of economic geography. The problem is that IIT indices relate to the locational concentration or dispersion of a particular industry, but they cannot tell us *where* a

[11] On the other hand, Harrigan (1997a, b) has offered evidence of persistent cross-country differences in total factor productivity which cannot be explained by scale effects. Bowen *et al*. (1987) and Trefler (1993, 1995) found that technological differences have substantial explanatory power for trade flows among OECD countries.

[12] An illuminating industry case study by Jordan (1993) shows how "pure" IIT can result from imperfect competition in the shape of oligopolistic interaction among firms in different countries.

[13] This point was formally derived in a model of the NTT by Brülhart (1995).

[14] Note that this interpretation of theory is not strictly rigorous. Since the location theory considered in this paper is based on general equilibrium,

particular industry is concentrated. Likewise, IIT results tell us about a country's degree of specialisation, but not about *which sector*(*s*) a country is specialised in. For example, numerous econometric studies of IIT determinants have detected a negative partial correlation between the share of IIT in total trade of a particular country, and that country's geographical distance from its main trading partners (see Greenaway and Milner). This result indicates that peripheral countries are more strongly specialised than central ones, but it says nothing about the key question, i.e. which industries are concentrated in central/peripheral locations.[15] One solution is to apply indices of net trade. Melchior (1998), using an index of trade specialisation on bilateral flows among 16 European countries in 1970-1992, found that some sectors which are plausible representatives of the NTT/NEG (chemicals and machinery) show pronounced and sustained concentration in centrally located EU countries.

Two major conclusions can be retained from the empirical literature on IIT, one positive and one negative. The positive conclusion is that studies of IIT produce overwhelming support for theoretical approaches which go beyond the neo-classical framework. A large and increasing proportion of the forces which drive international trade are different from those identified in NCT. The negative conclusion is that the available evidence on IIT patterns does not lend strong support to the approach taken in most of the new theories. The general trend is for the trade share of IIT to grow in tandem with the lowering of trade costs. This runs against the prediction of the standard NTT model (e.g. Krugman, 1980). Note, however, that some NEG models predict "re-dispersion" of industrial activity below a critical threshold of trade costs, and thus, implicitly, sustained IIT even at very low trade costs. In view of this, the part of the "u curve" (Krugman and Venables, 1995a; Puga and Venables, 1997) which corresponds to low trade costs and industrial re-dispersion might be a highly relevant approximation of observed specialisation patterns among industrialised countries.[16]

The Gravity Model

Of course, empirical analysis of specialisation through trade data has not been confined to IIT. Particular attention has been devoted to the cross-country study of aggregate trade volumes, conventionally labelled "gravity analysis". This is probably the longest established strand of the empirical trade literature. The gravity model identifies three fundamental determinants of bilateral trade volumes: (1) export supply, captured by income

[15] For a discussion and empirical scrutiny of this point on EU data, see Brülhart (1998).
[16] Barry (1996) has conducted a case study on Ireland which suggests that the "u curve" provides a useful description of Irish specialisation trends.

and income per capita of the exporting country, (2) import demand, captured by income and income per capita of the importing country, and (3) transaction costs, captured by geographical distance and variables representing policy and cultural barriers to trade. Since its inception by Tinbergen (1962), this model has become popular thanks to its parsimony and empirical robustness. Work by Anderson (1979), Bergstrand (1985) and Helpman and Krugman (1985, ch. 8) and Helpman (1987) served to place this at first purely empirical model on a theoretical footing, whereby the gravity equation came to be interpreted as a reduced-form version of the core model underlying the NTT. With such an interpretation, the empirical success of the gravity model could be taken as a ringing endorsement of the NTT framework.

However, this view has encountered strong criticism. Deardorff (1998) and Haveman and Hummels (1996) have shown that the gravity equation can be explained in the framework of NCT just as well as by NTT. Furthermore, Hummels and Levinsohn (1995) showed that the gravity model succeeds similarly well in describing trade among developing countries, for which, *a priori*, one would not expect the pure NTT model to be important. It has thus become evident that the gravity model, whilst a useful empirical device, cannot be employed as a tool to separate and test competing theories of trade and location.

3.2 Production Data

Trade statistics are easy to come by and tend to be highly disaggregated across industries. However, they must be considered a second-best indicator of locational patterns. An uninitiated commentator would surely opt for employment, output or value-added data as the correct gauge of specialisation. In addition, trade data are only available at country level, and are not available, therefore, for analyses of regional specialisation.

One can distinguish two classes of empirical location studies: studies of *specialisation*, which use sectorally disaggregated production data, and studies of *agglomeration*, which use aggregate production data. I shall discuss them in turn.

Measuring Geographical Specialisation with Production Data

The resurgence of interest in economic geography is partly due to some casual observations made by Krugman (1991b): many industries are concentrated in small areas without “obvious” reasons. The by now familiar examples range from carpets in Dalton, Georgia,

to computer software in Silicon Valley. Krugman (1991b) also provides some more rigorous empirical evidence of geographical specialisation, in the form of locational Gini indices for 106 industries across U.S. regions. His results indicate that traditional, low-tech industries tend to be most strongly localised. In addition, Krugman (1991b) conducted a rough comparison of industrial specialisation measures between the United States (split into four regions) and the four largest EU economies. This exercise confirmed that the European Union has a more dispersed, less specialised industrial geography than the United States. It also indicated that the U.S. economy had become less regionally specialised over the 1947-1985 period. The empirical results of Krugman (1991b) are crude but compelling. They sparked an ongoing debate about whether or not further integration in Europe, particularly through monetary union, would push the EU's economic geography in the direction of the clustered structure observed in the United States. NEG models are ambiguous on this point: on the one hand, they generally emphasise the unleashing of agglomeration forces after trade liberalisation, but on the other hand, they also accommodate multiple equilibria and non-monotonicity. Hence the continued empirical efforts to distil long-run trends in location patterns.

Krugman's (1991b) empirical observations could conceivably be dismissed as being largely the result of a random location process, and hence not supporting any theory of locational concentration. After all, a random distribution of a finite number of plants over a certain number of regions is most likely not uniform. Some production clustering might be random, and some might be due to small plant numbers. This issue was formally explored by Ellison and Glaeser (1997). They measured sectoral employment concentration across U.S. states for 1987, controlling for differences in the size distribution of plants and in the size of the geographic areas. According to their own stringent criterion, they found that observed concentration exceeded "what would be expected to arise randomly" in 446 out of their 459 sample industries. Their study provides strong evidence that locational clustering of industries is a genuine empirical phenomenon which warrants an explanation through location theory.

Kim (1995) has studied U.S. regional specialisation with an intertemporal perspective, comparing manufacturing concentration patterns over the 1860-1987 period. This analysis suggests that industry concentration and regional specialisation increased up until the inter-war years, but steadily decreased since. Locational clustering of U.S. manufacturing industries was stronger in 1860 than in 1987, having reached its high-water mark in the 1920s. Kim (1995, p. 904) interpreted this result as an indication that the ascent of the NTT/NEG was badly timed: "despite the serious inroads made in recent years by models

based on increasing returns against the standard neo-classical Heckscher-Ohlin model, empirical analysis based on the long-run trends in U.S. regional specialization cautions against this shift in the tide". Two main objections can be levelled against this interpretation. First, a general trend towards locational dispersion might well be compatible with NEG models. Second, patterns detected for U.S. manufacturing need not be representative of developments elsewhere.

Further descriptions of spatial concentration patterns in the United States are provided in Hanson (1998a) and Dumais *et al*. (1997). The former, using state-level wage data, confirms that agglomeration is a persistent feature of the U.S. economy, and it illustrates how the pole of economic agglomeration has shifted from the north-east and Midwest towards the Southeast between 1970 and 1990. The latter, which draws on state- and plant-level employment data, finds a slight decrease in the average industry concentration in the 1972-92 period, and establishes that this dispersion process is mainly due to new plants locating at the periphery, rather than by different growth rates of incumbent firms in core and peripheral regions. Finally, Hanson's (1994, 1996, 1997, 1998b) work on the industrial geography of Mexico documents the bipolar agglomeration of manufacturing in Mexico City and along the U.S. border, and how the border region has gained relative importance in tandem with the liberalisation of U.S.-Mexican trade.

Descriptive exercises have also been conducted for the European Union. Brülhart and Torstensson (1996) and Brülhart (1998) have computed locational Gini indices. Table 3 reports these indices for 18 manufacturing sectors across 11 EU countries in 1980 and 1990. An increase in the Gini index, indicating a rise in industry concentration, appears for 14 of the 18 industries. These 14 industries accounted for 77.3 percent of manufacturing employment in 1990. Similar results were obtained by Amiti (1997, 1998). Using several specialisation measures and data sets, she found evidence of a general increase in manufacturing specialisation among EU countries over the 1968-90 period. The upward trend in specialisation manifested itself with particular consistency in the second half of this time interval, i.e. during the 1980s.

However, we still do not avail of a consistent and comprehensive description of specialisation trends in the EU. There is an evident contradiction between the specialisation results based on trade data, which show rising IIT, and those based on production data, which suggest increasing concentration. Furthermore, studies using production data by Helg *et al*. (1995) and by De Nardis *et al*. (1996) suggest that the number of dispersing

sectors roughly equalled that of concentrating sectors in the EU during the 1980s.[17] One cannot, therefore, conclusively accept as a stylised empirical fact that EU industry has become more localised in recent years.

It can be argued that looking at aggregate trends is misleading. Since locational determinants differ across industries, specialisation trends will also vary across industries. Hence, inconspicuous aggregate results might obscure pronounced patterns within certain types of sectors. Using intra-EU trade data, IIT in the resource-intensive and scale-intensive sectors is found to be significantly below the overall average as well as indications of increasing *inter*-industry specialisation in the late 1980s (Brülhart, 1998). In addition, production data indicate that scale-sensitive industries are localised at the EU core and that labour-intensive industries are relatively dispersed. These findings are loosely supportive of theoretical priors (if it is assumed that labour-intensive sectors consist of differentiated goods, and hence generate IIT). It is also found in Brülhart (1998) that the strongest recent localisation trends appear in industries tagged as labour intensive, which appear to be concentrating in peripheral EU regions.[18] That study therefore suggests that factor-cost considerations are likely to dominate increasing returns as the main locational determinant of impending specialisation trends in Europe. This conclusion mirrors that of Kim (1995), whereby the recent theoretical emphasis on increasing returns might not capture the main locational forces of our time.

Measuring Agglomeration with Production Data: The Convergence and Divergence of Regional Income

So far, I have discussed empirical work on industrial *specialisation*. A much larger body of applied analysis has dealt – at least indirectly and implicitly - with the issue of *agglomeration*. Some relevant information can be gleaned from the last row of Table 3, which reports locational Gini coefficients for industrial employment across 11 EU countries in 1980 and 1990. The index rises by 21 percent over that period, which could be taken as evidence of manufacturing agglomeration.

However, the bulk of the empirical work which, in the widest sense, is concerned with agglomeration has not measured shares of manufacturing in total employment, but traced

[17] These studies use relatively highly aggregated statistics, distinguishing only eight and nine industrial sectors respectively. More disaggregate specialisation measures, which distinguish 82 industries and 9 countries are reported in Brülhart and Trionfetti (1998). However, these results refer to one year only (1989).

[18] Ireland seems to be a special case among EU peripheral regions, as it is specialising out of labour-intensive and low-tech industries and into scale-sensitive and high-tech sectors. This specialisation process is mainly driven by foreign direct investment (see Brülhart *et al*., 1998; and Barry and Bradley, 1997).

the evolution of regional differences in per-capita incomes. If it is assumed that factors are mobile among regions, and that increasing-returns activities are associated with above-average productivity and growth potential, then integration-induced agglomeration effects will translate into divergent regional growth rates.[19] On the other hand, if endowments are controlled for, then perfect competition and non-increasing returns tend to produce dispersive forces and convergence of per-capita incomes, when spatial barriers are reduced.

An exhaustive review of the empirical literature on regional income convergence is beyond the scope of this paper.[20] I will focus on recent convergence findings for EU regions. This emphasis is not arbitrary: the European Union has become the principal object of this empirical agenda, since it presents us with the closest approximation to a natural experiment of integration effects.

This literature reveals two pervasive stylised facts. First, the dispersion of per-capita incomes across EU regions, measured by the standard deviation of log per-capita income levels and generally studied under the label "σ-convergence", was narrowing consistently in the 1960s and 1970s, but came to a halt in the 1980s (Neven and Gouyette, 1995; Paci, 1997; Sala-i-Martin, 1996).[21] Second, β-convergence, the rate at which regional per-capita incomes tend towards the mean, conditional on given initial levels, has been positive until 1980 (albeit slower than in U.S. regions), but no clear trend emerges once again for the 1980s (Fagerberg and Verspagen, 1996; Neven and Gouyette, 1995; Paci, 1997; Sala-i-Martin, 1996). These patterns are remarkably consistent despite differences in methodology and geographical coverage among the empirical studies. Whilst a host of explanations could be put forward for the trend break in the 1980s, they correspond with the predictions of NEG theories, which emphasise agglomeration forces triggered once integration has proceeded beyond a certain threshold of spatial barriers in product and factor markets.

The analysis of σ- and β-convergence reveals only part of the relevant distribution dynamics.[22] Some analyses have split the sample of EU regions and discovered the presence of "growth clubs". Neven and Gouyette (1995), Cambridge Econometrics (1997) and Paci and Pigliaru (1998) have detected significantly stronger convergence among

[19] See Grossman and Helpman (1991).
[20] A survey can be found in de la Fuente (1997).
[21] There appear to be significant differences in regional convergence across economic sectors. For example, a convergence test by Fingleton and McCombie (1998), which is confined to labour productivity in *manufacturing* across EU regions for the 1980s, suggests a very high rate of β-convergence, with estimates ranging between four and nine percent per annum.
[22] This point has been made forcefully by Quah (1996b).

northern EU regions than among their Mediterranean counterparts. Quah (1996a) has analysed the full distributions of regional EU per-capita incomes over the 1990s (i) without conditioning, (ii) normalised by mean income of the host nation and (iii) normalised by the mean income of neighbouring regions. Distributions (ii) and (iii) were found to be significantly more compact than distribution (i), which indicates that geography matters. Since distribution (iii) was found to be more compact than distribution (ii), spatial inter-region spillovers seem to dominate country-level determinants: "growth clubs" in the European Union do not respect political borders. These findings do not favour one theoretical story over another. What they do suggest is that there are spatial regularities, but that these are so complex that attention should be paid to the dynamics in the full cross-sectional distributions.

What can be concluded from the broad sweep of descriptive empirics? Two stylised facts are uncontroversial: the United States have a more concentrated economic geography than the European Union, and recent U.S. specialisation trends have been marked by dispersion rather than by further concentration. Specialisation trends in the European Union are less clear-cut. On the one hand, IIT measures suggest continuing sectoral dispersion, but, on the other hand, production-based concentration measures and analyses of growth patterns rather suggest that concentration and agglomeration forces have been dominating since the 1980s. This apparent paradox can only be solved by an analysis of integrated trade and production data. The scope for further research on specialisation trends also in other parts of the world is obvious.

4 ANALYTICAL EMPIRICS

The main shortcoming of descriptive work is that it has little to reveal about the processes which generate the observed outcomes, and that they provide no rigorous tests of alternative theoretical paradigms. As a consequence, Krugman (1994, pp. 26f.) berated "the thinness of the empirical work on new trade theory" and noted that "there has not been any dramatic empirical confirmation of the models". Given that the theoretical results particularly of the NEG are far from clear-cut, this is not necessarily surprising. Nevertheless, useful analytical work on the topic has been produced (some of which predates Krugman's remarks). This is reviewed in the current section.

4.1 Trade Data

Leontief (1953) sparked off an enormous amount of empirical work with his finding that the United States were net importers of capital-intensive goods and net exporters of labour-intensive goods. This result ran against the prediction of Heckscher-Ohlin NCT. The Leontief paradox is now generally considered as resolved, for two principal reasons. First, it had disappeared from the data by the 1970s (Stern and Maskus, 1981). Second, and more fundamentally, Leamer (1980) has shown that the Leontief methodology was misleading, as it computes factor contents separately for exports and imports, whereas NCT, in the Heckscher-Ohlin-Vanek (HOV) specification, relates to net exports. Using the correct trade-balance-adjusted measures, the paradox vanishes even in the data used by Leontief (Leamer, 1980).

The Leontief paradox may have been resolved, and NCT therefore established as not running diametrically against the data, but empirical support for the relevance of factor endowments to international trade and specialisation has nevertheless been lukewarm. Bowen *et al*. (1987), using data for 1967, compared the content of 12 factors in net trade of 27 countries with measures of factor abundance of these countries. They found that the signs on countries' factor contents in net trade flows (positive/negative for net exports/imports of each factor) were different from the signs on their relative factor endowments (positive/negative for abundant/scarce factors) in about 35 percent of the country-factor observations in the sample. A more stringent test, which compares ranks of factor contents and endowments, found that about 50 percent of the observations violated the HOV null hypothesis of rank equality.

The poor empirical performance of the HOV paradigm spurred experimentation with alternative specifications in the search for a more successful model of what drives international trade in factor services. Bowen *et al*. (1987) and Trefler (1993) tested several alternative models and found that the principal improvement came from allowing for inter-country productivity differences of factors. In addition, Trefler (1995) found that allowing for home-biased consumption further enhanced the explanatory power of the model significantly. The apparent conclusion is that HOV explains only part of observed international trade, and that a "HOV-Ricardo-Armington" specification is most successful.

Whilst this literature has been persuasive in revealing the limits to the explanatory power of the mainstream neo-classical paradigms, it does not provide us with an explicit test which juxtaposes NCT and NTT/NEG.

4.2 Production Data

The Determinants of Industry Concentration

Probably the most intuitive method to estimate the contribution of various location models is to regress a measure of industry concentration over a set of determinants identified in the competing theories. This was done by Kim (1995), who constructed a panel of state-level concentration measures of 20 industries in the United States for five sample years between 1880 and 1987, and estimated parameters on scale economies (measured by average plant sizes) and on resource intensity (measured by raw material costs as a share of value added) as exogenous variables. Scale economies are interpreted as a proxy for the determinants in "new" theories, while resource intensity represents the forces which are emphasised in NCT. The paper finds that industry correlation increases in both of the independent variables, and concludes that support is found for the relevance of both theories.

Amiti (1997) conducted a similar exercise on a panel with 65 industries in five EU countries for 1967-89. She regressed locational Gini coefficients on scale economies (measured as in Kim, 1995), intermediate-good intensity (measured as the difference between turnover and value added) and factor intensity (measured as the deviation from the mean of the share of labour costs), with all variables time first-differenced. The results suggest that scale economies and intermediate-good intensity have a positive and significant effect on geographical concentration, while factor intensity does not. This is interpreted as corroboration of the NTT/NEG (particularly in the guise of Venables, 1996), but not of NCT.

Do increasing returns and backward/forward linkages really dominate industry location decisions in the European Union, and are factor considerations irrelevant? The results of Brülhart and Trionfetti (1998) suggest otherwise. In a cross-section for 1989 with 82 industries and nine EU countries we have estimated the impact on an industry-country specialisation measure derived from Hoover (1936), of matching variables representing NCT (2*2 Heckscher-Ohlin), NTT (Krugman, 1980) and NEG (Venables, 1996). All variables have the expected signs and are statistically significant. This strongly suggests that all of the theoretical contributions are of relevance to industrial location, even in an area which has as little endowment heterogeneity as the European Union.[23]

[23] In a study of manufacturing agglomeration across EU regions, van den Berg and Sturm (1997) also find evidence that both factor-related and "new" determinants play a role in the economic geography of Europe.

Regression analysis of industry concentration suggests that all major theoretical approaches are relevant. However, they have not been used so far to assess the relative merits of competing models across industries or countries.

Specialisation and the Home Market Effect

A rigorous econometric test to separate NCT from NTT has been developed in a series of papers by Davis and Weinstein (1996, 1997, 1998). This test is based on a feature of increasing-returns settings which distinguishes them from neo-classical models: the "home market effect". In neo-classical models with no trade costs, location is determined entirely by endowments, and completely independent from the spatial distribution of demand. Hence, the expected correlation across spatial units between demand shares and production shares is zero. In a neo-classical framework with trade costs, high demand for a good in a particular location will tend to attract production of that good, and the correlation between demand and production shares will be positive. The crucial point is that in NCT frameworks this relationship between demand and production idiosyncrasies will be one-to-one *at most*. Hence, relatively high demand share for a good in a particular country will in general lead to net imports of that good. In the Krugman (1980) NTT model, however, the relationship between demand and production idiosyncrasies is more than one-to-one: comparatively high demand shares for certain increasing-returns goods will attract a more than proportional share of production and give rise to net exports of those goods. Weder (1995) showed that this result, derived in Krugman (1980) for equal-sized countries, also holds when countries are allowed to differ in size.

Davis and Weinstein have operationalised the market-size test econometrically and found substantial empirical support for the NTT. First, they scrutinised patterns of production and apparent consumption across 54 industries and 13 OECD countries in 1985. Their initial findings were unfavourable to the NTT: only around 10 percent of the explainable variance in production shares could be attributed to home-market effects, while the remaining 90 percent were accounted for by factor endowments (Davis and Weinstein, 1996). However, they soon recognised that the early results were affected by inadequate specification of demand idiosyncrasies. The relevant level of demand for producers in one country is not just that exercised by residents of that country, but also that of residents in other countries, where the importance of foreign demand decreases with distance. Therefore, Davis and Weinstein (1997) re-estimated their model with a demand variable that takes account of foreign demand, using a gravity weighting. The results were much more favourable to the NTT hypothesis: half of the industries exhibited demand-production relationships larger

than unity, accounting for 64 percent of total output. Similar results are reported in Davis and Weinstein (1998), which carries out the analysis across 19 industries and 40 Japanese regions in 1985. In that study, a significantly larger than one-to-one demand-production relationship is found for eight of the 19 industries. Given that the Japanese exercise did not use the gravity weighting on the demand variable, this result must be a lower-bound estimate.

The work of Davis and Weinstein gives strong support to the increasing-return paradigm, indicating that, via the home-market effect, increasing returns could well account for over one half of observed specialisation in manufacturing. The exact list of sectors from Davis and Weinstein (1997) is given in Table 4. Industries are sorted in decreasing order by the size of the estimated parameter on *IDIODEM*, the explanatory variable which captures demand idiosyncrasies. In this table one can single out sectors which correspond particularly well with NTT predictions, that is those sectors which produce parameter estimates larger than unity. Table 4 shows that these include some of the usual suspects: textiles, iron and steel, transport equipment and precision instruments. This result is corroborated by the fact that home-market effects are also found for these four industries across Japanese regions in Davis and Weinstein (1998).

Davis and Weinstein have devised a useful method for separating theoretical paradigms empirically, and their results are enlightening. Yet, their work does not constitute a final verdict on the NCT vs. NTT question. There is obvious potential for replication on data sets for other regions, industry divisions and time periods. For instance, with 22 observations the degrees of freedom underlying the exercise leading to the results given in Table 4 are very limited. Hence, it is not surprising that statistical significance is found for only eight of the 26 industries, and that some unlikely candidates appear in the group with home-market effects (e.g. food products and non-metallic minerals). The large number of industries with negative parameter estimates on *IDIODEM* are a cause for concern. [24] In addition, the "industries" of Table 4 (3-digit ISIC) might well be defined too broadly to represent horizontally differentiated sectors adequately.

The principal limitation of the Davis-Weinstein test, however, lies in the fact that the home-market effect is not a generic result of increasing-returns models. For a start, the size

[24] Lundbäck and Torstensson (1997) augmented the Davis and Weinstein (1997) specification by a variable representing home-biased demand, and found in a sample of 17 OECD countries that home bias is consistently associated with net exports. This points to the importance of analysing not just the product composition of demand but also discrimination in demand according to the country of origin of products (see Brülhart and Trionfetti, 1998).

of home markets is endogenous in NEG settings. While intuition suggests that the more-than-proportional response of production to market size also applies in a NEG framework, this has yet to be shown formally. It has been demonstrated that the home-market effect is overturned if the standard NTT set-up is slightly altered. Davis (1998) himself has argued that dropping the conventional assumption of zero trade costs for the homogeneous good destroys the home-market effect. Furthermore, modifications to the standard demand structure in increasing-returns models can change their locational predictions. Trionfetti (1997), for instance, has shown that a discriminatory demand, biased in favour of domestic production, can dramatically alter the locational results of a NEG model. Hence, the question remains as to how well the home-market effect actually represents features of real economies akin to those identified in NTT and NEG models.

Agglomeration and Wage Gradients

Another way of testing the relative merits of competing theories has been employed by Hanson (1997, 1998a, 1998b). His test for the presence of increasing returns is based on the observation that, while NEG-type agglomeration is observationally equivalent to agglomeration driven by endowments, only the former type of agglomeration produces a spatial wage structure where wages decrease monotonically as one moves away from industrial centres.

In Hanson (1997), abrupt and far-reaching trade liberalisation in Mexico is taken as a natural experiment. Prior to liberalisation, Mexico's industrial core was the region around its capital; after liberalisation, the access to input and output markets improved significantly for Mexican border region with the United States. Hence, agglomeration in Mexican border regions induced by improved market access would have resulted in an increase in regional wage disparities relative to border regions and a comparative decrease in regional wage disparities vis-à-vis the Mexico City area. Hanson (1997) did not find a statistically significant structural break in wage gradients after the period of liberalisation.[25] Hence, he could not rigorously validate the presence of agglomeration effects due to increasing returns.

Hanson (1998a) uses U.S. wage data to estimate parameters of a reduced-form version of the Krugman (1991a) NEG model. As in Hanson (1997), the exercise centres on the fact that NEG models predict industrial agglomeration resulting in centre-periphery gradients in

[25] Hanson (1997) did find a negative relationship between regional wages and distance from the industrial cores (Mexico City and U.S. border). This finding, while consistent with the NEG scenario, does not constitute a successful test, since other factors, such as government policy, might explain this phenomenon.

wages. Wage gradients, in turn, are determined by the degree of increasing returns, by the share of expenditure on differentiated and traded goods, and by the level of transport costs. Hanson (1998a) finds estimates for parameters which are roughly consistent with theoretical priors, and therefore interprets the results as a validation of NEG predictions. He also concludes that estimated equilibrium scale economies and shares of differentiated goods are so high that agglomeration is a persistent feature of the U.S. economy, irrespective of the level of trade costs.

The findings of Hanson's work are favourable to the NEG scenario: increasing returns and market access matter for location, and wages are higher in economic agglomerations. However, these results do not constitute a rigorous test of alternative theoretical explanations. The main limitation is that he does not control for region-specific endowments and industry-specific resource requirements, i.e. the locational determinants identified in NCT.

5. CONCLUSIONS

This survey paper documents the rapid growth of the empirical literature on economic geography and trade, and it shows that this body of work has already produced a number of valuable insights. At the same time, the scope for further analysis is evident. In this section, I draw together what I deem the most important results and the main outstanding issues.

The Key Findings

Some stylised facts are by now well established, and can be easily summarised. Industry clustering is a real and significant phenomenon, which cannot be explained as the outcome of a random distribution of discrete plant numbers. Industries tend to be more strongly localised across regions within countries than across countries. This distinction is most apparent in a comparison of specialisation patterns in the United States and in the European Union: on average, industries are more strongly clustered in the United States. In addition, growing shares of intra-industry trade in global trade flows suggest that sectoral dispersion is more prevalent than concentration on the international scale. On an inter-regional level, a decreasing intensity of sectoral clustering is also apparent within the United States. In

contrast, production statistics (but not trade data) indicate increasing clustering in the European Union.

Some robust findings can also be distilled from analytical studies. Empirical work clearly shows that there is a valid place for all the main theoretical paradigms. As common sense would suggest, the relevance of competing models depends primarily on the sector at hand. The very existence of intra-industry trade, as well as the findings of numerous econometric studies on the determinants of inter-industry trade, are evidence that neo-classical endowments-based models are an insufficient explanation of trade and specialisation patterns, particularly in developed economies. In recent work, some specific features of the "new" models have been tested. These features include home-market effects and centre-periphery wage gradients, and their pervasive presence strongly suggests that the "new" theories make a useful contribution to explaining observed specialisation patterns.

Unresolved Issues

There exists ample scope for further descriptive work. One motivation is that there remain some apparent puzzles. For instance, observed specialisation trends in the European Union present a paradox. While trade statistics deliver ever rising measures of intra-industry trade, production data suggest an increase in industry concentration. Since time coverage of the extant studies on the production side has been limited, and production data were not integrated with the trade statistics, a more comprehensive and coherent study might shed light on this highly policy-relevant issue. The inclusion of additional statistical information could also provide us with a broader understanding of the complex mechanisms which drive aggregate location patterns. New data sources with development potential include firm- and plant-level micro data as in Dumais *et al*. (1997) and data on R&D activity and patent generation as in Paci and Usai (1998). Given the increasing importance of trade in services, descriptive work in this area is clearly also called for. Finally, advances could be made not only in terms of statistical coverage, but also in terms of empirical methodology. In view of the multiple equilibria and polarised spatial structures which are typical of the "new" theories, it will be enlightening to complement conventional specialisation measures such as Grubel-Lloyd and Gini indices by analyses of dynamics in the full cross-sectional distributions, along the lines proposed by Quah (1996a, b), on a sectorally disaggregated basis, as in Bernard and Jones (1996).

Ample scope also exists for further empirical testing of competing theories. The basic difficulty arises from the fact that very different theoretical approaches often produce

observationally equivalent predictions. For instance, an industry's concentration in central locations could be due to abundance of relevant natural endowments (NCT), proximity to consumer markets (NTT), or vertical linkages and externalities (NEG). Further creative thinking on how to separate theoretical paradigms in empirical work is clearly called for. Useful work in this direction has already been undertaken, and it has provided compelling corroboration of all the main paradigms. Yet, we still know little about their relative merits overall, and about their relevance to particular sectors and regions. Some studies suggest that endowments-based determinants are gaining in relative importance (Kim, 1995; Brülhart 1998), while the continuing growth in intra-industry trade as well as some analytical studies (Davis and Weinstein, 1997; Hanson, 1998b) point towards increasing returns as the dominant driving force of economic geography. More empirical work is also called for on the locational "u curve", which features so prominently in recent geography models but has yet to be convincingly traced in economic data.

Table 1: **Three Strands of Location Theory**

	Neo-Classical Theory (NCT)	**New Trade Theory (NTT)**	**New Economic Geography (NEG)**
Seminal papers	Ricardo (1817)[a], Heckscher (1919), Ohlin (1933), Weber (1909), Vanek (1986)	Krugman (1979, 1980, 1981), Dixit and Norman (1980), Helpman and Krugman (1985), Weder (1995)	Marshall (1920)[b], Krugman (1991a, b, 1993b), Krugman and Venables (1995a, b), Venables (1996), Markusen and Venables (1996), Puga and Venables (1997), Fujita, Krugman and Venables (1998)
Market structure	Perfect competition	Monopolistic competition	Monopolistic competition
Determinants of location	• Technological differences • Natural resource endowments • Factor endowments and factor intensities	• Degree of plant-level increasing returns • Substitutability of differentiated goods • Size of home market[c]	• Pecuniary externalities (labour-market pooling, input-output linkages, migration-induced demand linkages) • Technological externalities[d] • Trade costs
Location of industry	• Overall distribution of economic activity (labour) determined by given endowments • Inter-industry specialisation • Unique equilibria	• Overall distribution of economic activity (labour) exogenously given • Intra- and inter-industry specialisation • Unique equilibria	• Overall distribution of economic activity (labour) endogenous • Centripetal agglomeration forces • Intra- and inter-industry specialisation • Multiple equilibria • "u curve"
Trade structure	Inter-industry trade[e]	Intra- and inter-industry trade	Intra- and inter-industry trade
Welfare effects of non-discriminatory trade liberalisation	• Net welfare gains • All countries gain • Owners of scarce factors lose	• Net welfare gains • Large countries benefit more than small ones • Possibility that owners of all factors gain	• Net welfare gains • "u curve": periphery/core can lose at intermediate/advanced stages of integration

[a] Strictly speaking, Ricardo's work is part of pre-Marshallian "classical" economic theory.
[b] Recent work on NEG theory mainly amounts to a formalisation of Marshall's ideas.
[c] Some authors consider models with non-zero trade costs (à la Krugman, 1980) as part of NEG.
[d] This is not formally an element of NEG models, but implicitly cannot be disassociated from other concentration forces.
[e] Davis (1995) has shown that IIT can be compatible with a Ricardian trade model.

Table 2: **Intra-Industry Trade in the European Union by Country, 1961-92**
(unadjusted Grubel-Lloyd indices)[1]

Country	**1961**	**1967**	**1972**	**1977**	**1985**	**1988**	**1990**	**1992**
Belgium-Lux.	0.51	0.56	0.49	0.57	0.56	0.57	0.58	0.60
Denmark	0.30	0.37	0.41	0.44	0.42	0.44	0.43	0.47
France	0.60	0.69	0.67	0.71	0.68	0.67	0.67	0.72
Germany	0.47	0.56	0.57	0.57	0.60	0.59	0.61	0.68
Greece	0.02	0.06	0.08	0.10	0.15	0.15	0.16	0.15
Ireland	0.22	0.28	0.36	0.45	0.40	0.38	0.38	0.41
Italy	0.44	0.56	0.57	0.56	0.52	0.51	0.51	0.51
Netherlands	0.54	0.57	0.59	0.59	0.60	0.62	0.61	0.67
Portugal	0.04	0.10	0.13	0.14	0.24	0.25	0.30	0.31
Spain	0.10	0.16	0.29	0.38	0.47	0.56	0.57	0.60
U.K.	0.51	0.67	0.65	0.71	0.62	0.59	0.64	0.68
EU[2]	0.48	0.56	0.57	0.59	0.58	0.58	0.59	0.64

[1]reproduced from Brülhart and Elliott (1998); indices calculated from SITC 5-digit OECD trade statistics for SITC Sections 5-8.
[2]average of 11 countries, weighted by values of intra-EU manufactured imports and exports

Table 3: **Dispersion of Industrial Employment in the EU, 1980 and 1990**[1]

NACE	Industry Description	Employment Share (%)		Locational Gini Coefficients			Speciali-sation[2]	
		(1) 1980	*(2)* 1990	*(3)* 1980	*(4)* 1990	*(5)* 1980-90 (%change)	*(6)* Highest (1990)	*(7)* Lowest (1990)
43	Textiles	6.2	4.9	0.106	0.170	60	P	NL
45	Clothing/footw.	5.7	5.1	0.096	0.148	54	P	NL
44	Leather goods	0.5	0.5	0.150	0.212	42	I	DK
48	Rubber/plastics	4.0	4.9	0.174	0.226	29	F	P
25/6	Chemicals	7.2	7.8	0.178	0.230	29	NL	P
22	Metals	5.4	3.6	0.188	0.242	29	B	IRL
35	Motor vehicles	8.2	8.3	0.270	0.344	28	D	GR
34	Electr. engin.	11.2	12.0	0.254	0.316	25	D	GR
36	Other transp. eq.	3.8	3.4	0.238	0.288	21	UK	IRL
24	N.-metal. miner.	5.0	4.5	0.100	0.122	20	P	D
31	Misc. metal art.	9.3	9.6	0.192	0.228	19	E	IRL
32	Mech. engin.	10.2	10.5	0.320	0.370	15	DK	GR
33	Office/data proc.	0.8	1.2	0.312	0.328	5	IRL	P
49	Misc. manufact.	1.1	1.1	0.194	0.198	2	DK	P
46	Timber/furniture	4.2	4.1	0.206	0.202	-2	E	IRL
37	Instrum. engin.	1.4	1.5	0.402	0.392	-3	IRL	GR
47	Paper/printing	5.8	6.5	0.208	0.192	-7	NL	D
41/2	Food/drink/toba.	10.0	10.6	0.176	0.162	-8	IRL	D
	ALL	100.0	100.0	0.156	0.188	21	D[3]	GR[3]

[1] Reproduced from Brülhart (1998).

[2] Specialisation ratio = $(\{E_{ij} / \sum_j E_{ij}\} / \{\sum_i E_{ij} / \sum_i \sum_j E_{ij}\})$, where E_{ij} denotes employment in the manufacturing sector *i* of EU country *j*.

[3] Based on the ratio between the share in EU manufacturing employment and the share in EU population.

Table 4: **Davis-Weinstein Estimates of Home-Market Effects by Industry**[1]
(No. of observations = 22, dependent variable = output)

ISIC	Description	***IDIODEM***[2]	*t* statistic	Adj. R^2
321	Textiles	**62.64**	3.08	0.83
311	Food products	**18.28**	1.05	0.72
342	Printing and publishing	**12.94**	1.25	0.76
371	Iron and steel	**3.42**	1.73	0.81
361	Pottery and china	**3.05**	3.55	0.64
385	Precision instruments	**2.95**	1.37	0.80
369	Non-metallic mineral products	**1.61**	2.24	0.74
384	Transport equipment	**1.42**	1.14	0.91
356	Plastic products	**1.32**	6.60	0.91
314	Tobacco products	**0.81**	2.79	0.69
352	Chemicals n.e.c.	**0.71**	0.62	0.88
362	Glass	**0.71**	0.64	0.84
331	Wood products	**0.70**	1.75	0.69
332	Furniture	**0.56**	0.62	0.65
313	Beverages	**0.15**	0.33	0.70
372	Non-ferrous metals	**-0.09**	-0.07	0.86
324	Footwear	**-0.12**	-0.27	-0.03
323	Leather products	**-0.32**	-0.40	0.20
381	Fabricated metal products	**-0.33**	-0.42	0.84
322	Clothing	**-0.53**	-2.94	0.85
351	Industrial chemicals	**-0.61**	-1.36	0.91
355	Rubber products	**-1.03**	-1.02	0.82
341	Paper	**-1.07**	-1.02	0.59
353	Petroleum refineries	**-1.28**	-3.20	0.82
383	Electrical machinery and apparatus	**-1.81**	-0.40	0.71
382	Non-electrical machinery	**-5.40**	-2.18	0.92

[1] reproduced from Davis and Weinstein (1997). Based on 22 OECD countries.

[2] *IDIODEM* is the parameter on deviations from the mean in apparent consumption, *ceteris paribus*. A value larger than one indicates the presence of a "home-market effect".

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