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Does Economic Geography Matter for International Specialization?

Donald R. Davis and David E. Weinstein

ABSTRACT

There are two principal theories of why countries trade: comparative advantage and increasing returns to scale. Yet there is no empirical work that assesses the relative importance of these two theories in accounting for production structure and trade. We use a framework that nests an increasing returns model of economic geography featuring "home market" effects with that of Heckscher-Ohlin. We employ these trade models to account for the structure of OECD manufacturing production. The data militate against the economic geography framework. Relatively few sectors match its theoretical predictions. Moreover, of the explainable variation in production patterns, endowments account for 90 per cent, economic geography but 5 per cent.

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1 Introduction

Why do countries trade? What determines the pattern of trade? It is difficult to conceive of more fundamental problems for international trade economists. Two broad theories of international trade patterns have been devised. One is comparative advantage and the other is increasing returns. In reviewing the empirics of new trade theory, Krugman asks:

> "How much of world trade is explained by increasing returns as opposed to comparative advantage? That may not be a question with a precise answer. What is quite clear is that if a precise answer is possible, we do not know it." (1994, p. 23).

This is a deeply unsatisfactory state. Our paper will make progress in two directions. The first is that we implement tests designed to distinguish a trading world of increasing returns from one of comparative advantage. The second is that we estimate the relative contribution of each to the explanatory power of our model.

While our model is of a trading world, the direct object of estimation is the structure of manufacturing production in the OECD. We chose this focus as it is commonly argued that it is precisely there that increasing returns plays its most important role. Thus this provides the most promising setting for identifying the effects of increasing returns.

Of course, comparative advantage and increasing returns represent two classes of trade models. To make progress on the question, one is forced to select a model to represent each class. For comparative advantage we will rely on a variant of the Heckscher-Ohlin model. For increasing returns, one is forced immediately to confront a fundamental divide within these models. On one side is the set of zero transport cost models surveyed in Helpman and Krugman (1985). We do not pursue this avenue since, as we argue below, it is difficult to identify features of production or trade structure that distinguish these models from a variety of comparative advantage models. The second set interacts increasing returns with transport costs to create what Krugman (1991) has dubbed models of "economic geography."[1]

Even the latter represents a set of models, rather than a specific alternative. In selecting among the set of potential representative models for economic geography, we had three aims in mind. First, we wanted it to be a model that has featured prominently in discussions of the role of increasing returns in trade. Second, we needed its central theoretical result to be robust to the departures required to take a theory from blackboard to data. Finally, we needed it to present a clear contrast in its predictions relative to those of comparative advantage theories. These criteria yield a clear candidate, drawn from the classic paper of Krugman (1980).[2] This model features what has long been termed the "home market effect." This element of economic geography is then nested with a Heckscher-Ohlin model to ready it for empirical tests.

Our empirical results do not support the idea that this model of increasing returns makes a large contribution to our understanding of the structure of OECD manufacturing. Economic geography may play a role in certain sectors. However for the sample as a whole, home market effects are not robust to the inclusion of factor endowments. The home market effect accounts for

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[1] The reader should note that we use the term "economic geography" in a specific sense. As Krugman (1991) notes, there is a long tradition of work under this rubric both by economists (especially regional and urban) and geographers. In this paper our usage of the term "economic geography" does not refer to the broader sense, for which increasing returns to scale is a frequent, though not necessary, element. Instead, we use it to refer specifically to the class of models with increasing returns, monopolistic competition, and costs of trade.

[2] It should be emphasized that this is *one* model of economic geography, and so cannot represent the full breadth of this work. Nonetheless, it is a particularly prominent and influential version. For a broader cross-section of the theory, see Krugman (1991). Our focus on this model was strongly influenced by its amenability to empirical implementation on cross-country data.

only a small share of the variation in production, with 90 per cent attributable to factor endowments, and but 5 per cent to economic geography.

Our results do not provide a complete answer to Krugman's question of the relative importance of comparative advantage and increasing returns for trade. The first reason is simply that our dependent variable is not trade but production. The second reason is that we have examined only one increasing returns model, and this with a variety of strong identifying assumptions. Nonetheless, the absence of a significant contribution by increasing returns in explaining the OECD manufacturing production structure should be troubling for those who believe that increasing returns are pervasive there. And the excellent ability of the Heckscher-Ohlin framework to account for that structure is very promising for the comparative advantage theories.

2 Increasing Returns and Comparative Advantage: Separating the Models

2.1 Theory

In the last fifteen years, the analysis of international trade has undergone what Krugman (1990) describes as a "quiet revolution." This denotes the challenge of theories based on increasing returns to scale to the previously dominant paradigm of trade relations, that of comparative advantage.

From the start, the increasing returns theory has promised to account for a number of important observed phenomena that had seemed puzzling based on models of comparative advantage. It offered a simple account of intra-industry trade, the simultaneous import and export of goods of similar factor intensity. It promised to help us understand why so much of world trade is among countries with relatively similar endowment proportions, apparently at odds with the Heckscher-Ohlin theory. And it promised to provide a transparent theoretical underpinning for the gravity model, perhaps the empirical trade model with the greatest success. Each of these has been held up as an important advantage of the increasing returns models over those based on comparative advantage [see Helpman and Krugman (1985)].

These claims have been questioned, both theoretically and empirically. Work by Chipman (1992), Davis (1995, 1997), and Deardorff (1995) challenges the theoretical exclusivity of the increasing returns model in accounting for these phenomena. In a variety of settings, they demonstrate how each of these observations can arise quite naturally in a world of comparative advantage. This suggests a common feature that links these trade patterns in the two theoretical frameworks. In a word, it is specialization. Anything that gives rise to a high degree of specialization will generate these trade patterns. It can be increasing returns, Ricardian technical differences, Rybczynski-like "magnification" effects, or Armington preferences. The sense of this is appreciated by considering the simplest monopolistic competition trade models: what role does increasing returns play, apart from specialization, in giving rise to the characteristic trade patterns? The answer is none. In effect, the recent theoretical work demonstrates that the implications for trade patterns of the simple increasing returns models are equivalent to those from a variety of models based on comparative advantage which feature a high degree of specialization.[3]

[3] The reader should bear in mind that this observational equivalence cuts both ways. Our evidence that Heckscher-Ohlin does an excellent job in accounting for the structure of OECD production need not be read as a rejection of the zero transport cost increasing returns model. In fact, this is a possible outcome based on models such as Helpman (1981). This would require that the monopolistic competition be situated at a finer level of disaggregation than appears in our data.

This cumulation of theoretical and empirical studies has underscored a perverse success of the increasing returns theory. The work of Helpman (1981), showing how to integrate the increasing returns theory with the more traditional models, was a milestone in winning broad acceptance for the new work. Yet the integration of the theories is now so complete that there seem to be no empirical elements that can separate them. If this were the end of the story, one would have to be profoundly disappointed that a theory with such apparently revolutionary implications has come to so little. Yet we believe that this dejection is unwarranted.

We have to agree with Krugman (1991) that the truly revolutionary element in the increasing returns framework lies in the work which he has dubbed the new "economic geography." The distinctive element of this work is the interaction of increasing returns with transport costs across countries (or regions).[4] In such a world, a fundamental contrast emerges with respect to models of comparative advantage. This concerns the role of demand in determining trade patterns. In a model of comparative advantage, *ceteris paribus*, unusually strong demand for a class of goods will turn those goods into importables. Transport costs may diminish the trade volume, but will not lead the good to be exported. This result differs importantly from that which emerges in a world of increasing returns. The scale economies lead producers of individual goods to concentrate their production in a single location. If a country has an unusually strong demand for a class of goods, that country becomes a good choice as a site for production, and so it is likely to export the goods in question. [See Krugman (1980)]

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[4] Although we will speak of transport costs, the reader should interpret this broadly as any per-unit costs that exist for transactions between but not within countries.

International transport costs play a crucial role here in allowing us to separate comparative advantage from increasing returns. Yet we know that shipping and communications costs have fallen in recent decades. Nonetheless, we would assert that costs of trading between nations may yet substantially exceed that of trade within nations. Important evidence of this appears in McCallum (1995), which shows that the international border matters a great deal, as seen in the contrast between the volume of Canadian inter-provincial trade versus trade with similarly distant US states. We believe that this justifies our focus on an increasing returns model with transport costs.

In sum, when there are costs of trade, unusually strong demand for a good yields opposing predictions in a comparative advantage vs. an economic geography world. Comparative advantage suggests you will import that good; increasing returns suggests that you will export it. It is this basic contrast that we will exploit to separate the models in our empirical work.[5]

2.2 Empirics

Are increasing returns empirically important for explaining trade patterns? A natural first approach to answering this question is to ask whether they are of measurable importance at the plant, firm, and industry level. This has been a major empirical research question in industrial organization. The literature has tended to reject the idea that economies of scale are crucial for industrial market structure, with the exception of electrical power, telecommunications, and products with very high transportation costs. [See excellent surveys in Jorgenson (1986) and Scherer and Ross (1990)].

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[5] Cf. the Introduction to Krugman's (1990, p. 5) selected papers: "The main additional insight from [the AER (1980) article] is the 'home market effect,' the tendency of countries to export goods for which they have a relatively large domestic market."

However this direct evidence is in any case unlikely to settle the issue of the importance of scale economies for understanding trade patterns. From a theoretical perspective, it is the existence of economies of scale rather than their degree that is crucial in determining trade patterns. The results of economic geography could be driven by economies of scale too small to be detected by econometric techniques. Even if there are no economies of scale at the industry level, or economies of scope at the firm level, small economies at the level of the individual product suffice for the theoretical framework. On the other hand, if the alternative hypothesis is a world of constant returns to scale, the fact that any error bounds will always include a region of increasing returns means that direct evidence in principal cannot refute the increasing returns hypothesis. Finally, even if one were convinced that increasing returns is important at some levels, it does not follow that it matters for trade patterns. For example, if average cost curves declined over some region, so that constant returns to scale is literally incorrect, they may yet become flat or U-shaped at a level of output small enough to admit entrants that lead us to a competitive world. In effect, direct evidence on scale economies is unlikely to be decisive in settling their importance for trade patterns.

This suggests looking for the effects of scale economies in terms of their implications for trade patterns. A voluminous literature has sought to do this by examining the way that a variety of proxies for scale economies help to account for intraindustry trade. Our discussion of the theory above suggests that such studies cannot provide evidence that helps us to separate the theories.[6]

[6] For example, Harrigan (1994) notes that "A major difficulty in interpreting statistical models to explain the Grubel-Lloyd [intraindustry trade] indices is that the monopolistic competition model has very little to say about the cross-country and cross-industry variability of the Grubel-Lloyd index."

Furthermore, an uncertain match between the theoretical categories and the division of industries in the data provides additional cautions to this line of inquiry.[7]

Another effort to confirm the importance of scale economies in giving rise to trade has concerned the volume of bilateral trade. Again, we have outlined above the theoretical objections to using evidence on bilateral trade volumes as a way to separate increasing returns and comparative advantage theories. Here we take the studies on their own terms. Relatively simple gravity models have long been known to do a good job of accounting for the volume of bilateral trade. Helpman (1988) employed a variant of a gravity model based on an underlying monopolistic competition framework to examine time series data for fourteen industrial countries. Generally the model worked well, and Helpman viewed the results as evidence in favor of the scale economies framework. Hummels and Levinsohn (1995) approached these results with a clever twist. They applied a variant of Helpman's approach to a data set consisting mostly of developing countries for which the monopolistic competition model was *ex ante* not expected to work. Their results showed that the model "worked" almost as well as in the study of Helpman. Evidently something more than just increasing returns was at work.

Only a few years ago, chastisement of the increasing returns account of trade patterns for a paucity of empirical support would have been tendentious. After all, empirical work on the comparative advantage theories hardly inspired confidence. The studies of Leontief (1953), and Bowen, Leamer, and Sveikauskas (1987), suggested deep problems. Yet the last several years have witnessed a revival of empirical work on comparative advantage. This includes the work of Trefler

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[7] Based on such considerations, Krugman (1994, p. 19) concluded: "Conceptually, then, the data on intra-industry trade are a very ambiguous tool for investigating economies of scale and trade." See also Bhagwati and Davis (1995).

(1993, 1996), Davis, Weinstein, et al. (1997), Brecher and Choudhri (1993), and Harrigan (1997). To be sure, all of these have departed from the simplest factor price equalization models of Samuelson and Vanek. Yet the deviations have been very simple, and in the spirit of traditional comparative advantage, such as Ricardian technical differences, failures of factor price equalization, and consideration of cross-country differences in demand patterns. And they have shown that with sensible alterations, the simple comparative advantage models seem to do quite well.

3 A Theoretical Framework for Empirical Tests

3.1 Introduction

The aim of this section is to provide a theoretical framework for empirical examination of the structure of production across the OECD countries. The null hypothesis will be that the structure of production is determined entirely according to the multi-factor Heckscher-Ohlin theory. The alternative considered is that Heckscher-Ohlin must be augmented with a simple model of economic geography.

There are no prior tests for a very good reason. To be empirically implementable, a complete economic geography theory must allow for increasing returns and transport costs. It must allow for many countries, and for these to vary in endowment proportions, economic size, and demand patterns. Finally, it must allow for differences across industries in input proportions and size. Yet, there is no theoretical model that incorporates all of these elements. We do not fully remedy this shortcoming -- our aim is more modest. We propose to explore these variations separately to reveal the logic governing production patterns. Where necessary, we are willing to make strong maintained assumptions on the structure of the technology. And then — cognizant of the potential pitfalls — we will specify an estimating equation that embodies what we view as the robust core of these models. We believe that the necessity to initiate empirical work that places these elements in a common framework justifies our approach.

Our theoretical work proceeds in two broad stages. In Sections 3.2 and 3.3, we explore the role of idiosyncratic elements of demand in determining production patterns both in models of economic geography and comparative advantage. In section 4.1 we will proceed to show how to nest the two frameworks in a manner amenable to empirical testing.

3.2 Economic Geography and the Home Market Effect

In this section, we employ a model of economic geography to develop a number of results that form the foundation for our empirical work. The model draws strongly on the pioneering paper of Krugman (1980). Following Linder (1961), Krugman asked whether unusually strong demand for a good could lead that good to be exported. One wouldn't expect this in a conventional comparative advantage world, where instead strong demands translate into high imports. However Krugman showed that such a result could occur via what he termed a "home market effect."[8] In a world with

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[8] The reader should note that the "home market effect" is distinct from the concept of "home bias" discussed, for example, in Harrigan (1994) and Trefler (1995). The latter concept is often formally defined as a relatively strong preference by local consumers for locally produced goods. It is frequently recognized that the appearance of a home bias in consumption may in fact simply reflect the consequences of barriers to trade. In any case, "home bias" implies no presumption regarding market structure or returns to scale, so is not a central concern of the present paper. By contrast, the concept of a "home market effect," as developed by Krugman (1980, 1995), arises due to the interaction of costs of trading with increasing returns to scale. This is typically developed in a monopolistic competition framework. And it is the home market effect with which we are concerned here.

increasing returns to scale and costs of trade, idiosyncratic elements of demand would translate into a more than one-to-one response of local production, leading exports of the good to rise. These "home market effects" from demand to production structure, in the presence of trade costs and scale economies, could well be looked on as a defining characteristic of the economic geography approach pursued by Krugman (1991).

We summarize one elaboration of this framework due to Weder (1995). And we extend the basic model to check the robustness of the results for problems that become important when we turn to empirical implementation.

The model is developed with very strong symmetry conditions that provide a basis for factor price equalization. Consider a world of two countries endowed in equal amounts with the single factor labor, so that $L = L^*$. In this world, there are two groups of monopolistically competitive goods, indexed by X_1 and X_2. Production of a variety of either good takes place under increasing returns to scale with identical production functions across both varieties and goods. The labor usage in the production of an individual variety i is given as $l^i = a + b\,x^i$, for each variety of either good. The aggregate labor constraint, for example in the home country, requires $L = \Sigma_i\, l^i$.

There are two types of consumers in the world, those who consume only good X_1, and those who consume only good X_2. A key assumption of the model is that the former type are more prevalent in the home country, and the latter in the foreign country — in fact that the two are mirror images. A typical consumer with a preference for the type X_1 goods will maximize a utility function of the Dixit-Stiglitz kind, Max $U = [\Sigma_{i \in X1} D_i^{\,\rho}]^{1/\rho}$ subject to the available labor income.

An extremely convenient feature of Krugman's model is that even in the presence of transport costs, output per firm in equilibrium is at the same level in each of the countries. Along with the symmetries in demand and production, this implies that the production patterns of the two countries can be fully described by the number of varieties produced in each of the industries. Let μ be the number of varieties of good g produced at Home relative to those produced abroad. Let $\sigma < 1$ be the ratio of demand for a typical import relative to a domestically produced variety. Let λ represent the ratio of demanders for good g at Home relative to the number in Foreign. Krugman shows that in the range of incomplete specialization, the relative production levels μ can be described as:

$$\mu = \frac{\lambda - \sigma}{1 - \lambda \sigma}$$

When $\lambda = 1$, demand patterns are identical and the countries produce the same number of varieties in each industry, leaving a zero net balance. This will play an important role when we turn to our empirical implementation as it suggests that predictions of production structure, *ceteris paribus*, should be centered around an even distribution of the industries across the countries. Idiosyncratic demand components will then explain deviations from this neutral production structure.

Moreover, we need to consider closely the way in which idiosyncratic demand components will translate into alterations in production structure. From above, and for the range of incomplete specialization for which these relations are valid,

$$\frac{\partial \mu}{\partial \lambda} = \frac{1-\sigma^2}{(1-\sigma\lambda)^2} > 1$$

Krugman emphasized that this will imply that countries with a large "home market" for a good will be net exporters of that good. For our purposes it is convenient to focus on an *equivalent* statement of this result that speaks directly to the implications for production. That is, idiosyncratic demand patterns (indexed by λ) have a *magnified* impact on production patterns. This will play a crucial role in our empirical implementation, helping to separate the influences of economic geography from that of comparative advantage. These relations appear in Figure 1 in schematic form.

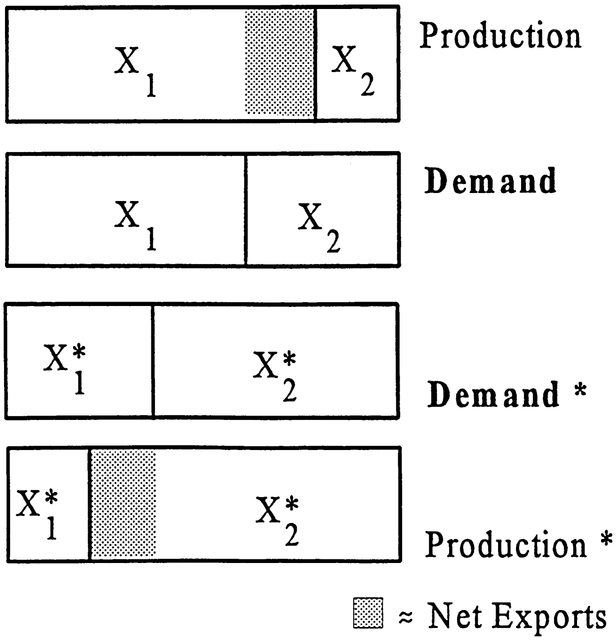

Figure 1 Demand Idiosyncracies have a Magnified Impact on Production

Krugman (1980) briefly considers a case in which the countries differ not only in demand patterns, but also in population. One version of this case is considered at length in Weder (1995). In the latter, the "mirror image" of the two countries is preserved in the sense that the *share* of individuals of each type is exactly opposite for the two goods and countries. However it is also assumed that one country is larger, so may even have an *absolutely* larger demand for all varieties of both goods.

Weder shows that there are in principle three influences on the pattern of production in his model: relative wages, w/w^*; relative country size, L/L^*; and relative spending patterns, h/f, where h is the proportion of consumers of the X_1 good at home, and f is the corresponding proportion for the foreign country. Weder shows that the first two influences in effect net out. His main result appears as Proposition 3: "In the open-economy equilibrium, each country is a net exporter of that group of differentiated goods where it has a comparative home-market advantage." And a country is said to have a comparative home-market advantage just when it has a higher *proportion* of demanders of one type relative to the other.

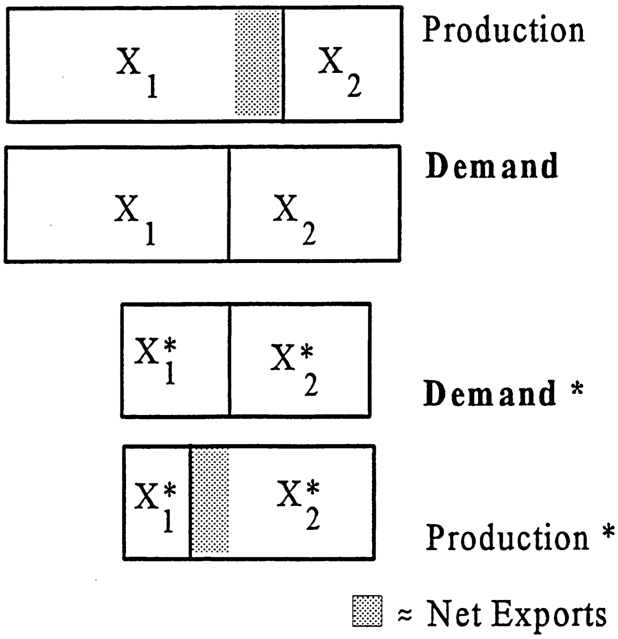

Figure 2 Production Patterns when Country Size Differs

Thus the country with the *relatively* high share of X_1 demanders will be the net exporter of the X_1 type goods. This remains true even when one country has an absolutely larger market for all varieties in both industries. Ultimately, this is not surprising for an economist trained in the theory of comparative advantage. The aggregate resource constraint for each country is going to force some ordering on the location of production. It is intuitively pleasing that this is decided, as above, by the comparative strength of the demand patterns. This result is depicted schematically in Figure 2.

There are two other directions in which generalizations are warranted. The first is to consider what happens when there are more than two industries. The second is to consider what happens when there are more than two countries. A brief acquaintance with the simpler cases of Krugman (1980) and Weder (1995) will convince the reader that such extensions threaten to become mired in a dense jumble of algebra. Hence we eschew brute force. Rather, we will seek to capitalize on the beauty of Krugman's symmetry assumptions to explore these problems. One element of this symmetry that will be key to the results that we examine is the fact that it results in factor price equalization among countries in spite of being separated by transport costs, facing different vectors of goods prices, and having quite distinct production and consumption patterns.

We will now examine the problem of trade in the varieties of more than two classes of goods. We approach this indirectly. Let there be two trading blocs isolated from each other, each bloc formed of two countries. Each pair of countries is in a trading equilibrium similar to that of Krugman described above (equal size, etc.). There are only two differences. One is that the goods being traded differ between the blocs. As before, the countries in Bloc One are trading varieties of the goods X_1 and X_2. In Bloc Two, the countries instead are trading in Y_1 and Y_2, with their populations divided between those who consume the respective goods. The second difference is that the strength of the demand idiosyncracies may vary across the two blocs. We assume that the demand differences are greater with respect to Bloc Two goods. Now consider what would happen if each of the countries in one bloc merged with one of the countries in the other bloc. This would have no implications for the real economy, although there would now be recorded trade between the two enlarged countries in all four goods. Assuming that there was initially incomplete specialization in both blocs, this will continue to be true in the two enlarged countries. Because of the symmetry, the two enlarged countries will have exactly opposite rankings in degree of demand specialization. The key result for our purposes is that the degree of production specialization will be greater for the goods with stronger demand specialization.

A similar approach can be used to investigate trade patterns in a three-country, three-good world. Let the classes of goods be indexed by X_1, X_2, and X_3. We will consider a case in which each country has only two types of consumers: Country One has consumers who demand only varieties of goods X_1 and X_2 ; Country Two has consumers who demand only varieties from goods X_2 and X_3; and Country Three has consumers who demand only varieties from goods X_3 and X_1. Assume again that the countries are the same size, and that the proportion of the consumers that demand the respective goods are f and $(1 - f)$ in each country, with $f > ½$. It is clear from the symmetry that the equilibrium will again feature factor price equalization. Moreover, given that the cost conditions are unchanged, and the local demand conditions in the two markets that demand a particular good are effectively the same as in the two country model, producers will face the same tradeoffs, and so we will observe the same division of production between the markets with positive demand. Thus, while the move to more countries makes the story marginally more intricate, the exact same kind of home market effects can be observed in a world of many countries (and goods).

The reader should be mindful that an exploration one at a time of these dimensions in which the home market effect is robust is not the same thing as solving a fully general model that includes all of these differences at once. The literature has not provided a fully general model and neither do we. However we find the robustness of the relation in these exercises encouraging. Moreover the central role within the economic geography literature occupied by these home market effects is itself strong motivation for our empirical inquiry.

3.3 Production and Idiosyncratic Demand under Comparative Advantage

We have already examined the relation between patterns of idiosyncratic demand and production in a model of economic geography. We now consider the same problem in models of comparative advantage. As Krugman (1980) noted, ". . . in a world of diminishing returns, strong domestic demand for a good will tend to make it an import rather than an export." We are in agreement with this, and hope simply to elucidate the reasoning in a few simple models. The answer one receives depends on the precise specification of the demand perturbation one considers. We begin by examining cross-country differences in demand structure arising from a different composition of consumer-types, as above.

Consider first a comparative advantage world with zero transport costs. A re-shuffling of the cross-country composition of demand will leave the structure of world demand unchanged. This implies that the same equilibrium prices will clear the goods market. Thus whenever goods prices are sufficient to determine supply (as e.g. in the conventional N good, N factor Heckscher-Ohlin framework), the supply response in each country will be zero, as prices have not changed. Of course, where goods prices fail to fully determine supply (e.g. in the Heckscher-Ohlin world of more goods than factors), one can only say that there is no need for supply in either country to change to meet the new structure of national demands, since world demand is unaffected. If supply on the national level is wholly unaffected, then the demand re-shuffling will imply one-for-one movements in trade volume (the direction depending on whether the rise in demand was for importables or exportables). If instead the trade pattern were to remain fixed, then by the identity $T \equiv X - D$, demand D and production X would move one-for-one.

Consider now a comparative advantage world with strictly positive iceberg transport costs at rate $\tau > 1$ on both goods (i.e. τ units of a good must be shipped for one unit to arrive). Let there be two countries, Home and Foreign, and two goods, X and Y. Home is a potential exporter of X for imports of Y. For simplicity, assume that the production sets are strictly convex, so that relative supply is strictly increasing in domestic relative prices. If transport costs are very high relative to the strength of comparative advantage, then in equilibrium the goods will not be traded. A small re-shuffling of the structure of national demands will leave these goods non-traded. Thus market clearing will be national, and idiosyncratic demand must elicit a one-for-one local supply response.

However if the forces of comparative advantage are sufficiently strong in comparison to transport costs, then trade will arise. Let a unit of X in the home country be the numeraire, and P_Y be the price of Y in the home country. Then if the home country is the exporter of X, the domestic prices in the foreign country must be $P_X^* = \tau$ and $P_Y^* = P_Y / \tau$. Thus the relative price of Y in the home country is P_Y, while that in the foreign country is P_Y / τ^2 . As this suggests, so long as trade is maintained, the changes in domestic relative prices will be perfectly correlated across the two countries. An idiosyncratic rise in demand, say for Y in the home country, can be met from two sources: local supply and imports from the foreign country. For there to be a rise in local supply, in our case, there must be a rise in P_Y (so also P_Y^*). Thus, so long as the foreign country's exports of Y are increasing in its own domestic price for Y, part of the incremental idiosyncratic demand for Y in the home country will be met via imports, implying that there is a less than one-to-one response of local supply to demand. In order to get a magnified impact of idiosyncratic demand on local production in the home country, one would need very strong income effects to give the foreign export supply curve a perverse slope in the relevant area. We assume that such strong income effects are not evident, so will interpret any "magnification effect" as evidence in favor of economic geography.

In summary, barring perverse export supply relations, the local supply response to idiosyncratic components of demand in a comparative advantage world may range between zero and unity. One would expect this response to be zero in a zero transport cost world in which goods prices suffice to determine supplies. One would expect it to be unity when high transport costs make the good non-traded in equilibrium, and possibly also in the case of more goods than factors. One would expect the response to be between zero and unity so long as the relevant import demand/export supply curves have the conventional slope.

4 Empirical Implementation

4.1 Empirical Specification

In this section we nest the models in a framework suitable for our empirical work. Consider a three-tier hierarchy of production, composed of industries, goods, and varieties. When we turn to the empirical implementation, industries will correspond to the 3-digit ISIC production, while goods will correspond to the 4-digit level. Varieties represent the many available types of particular 4-digit goods. They play an important theoretical role, but are never directly observed.

There are two models in contest: a conventional model of Heckscher-Ohlin and a model of economic geography. The former is very familiar, so we will only review it briefly. Consider a world in which all countries share identical constant returns to scale technologies. It will prove convenient to assume that the common input coefficients are in fact technologically fixed. There are N industries indexed by n, and within each industry n there are G_n goods. Let there also be $F=\sum_{n=1}^{N} G_n$ primary factors. Assume that the F x F technology matrix mapping output into factors is invertible, where the inverse is given by Ω. We assume throughout that all countries of interest are at least weakly diversified, and that transport costs are zero. Letting the vector of goods output for country c and good g in industry n be X_g^{nc} the vector of factor endowments be V^c , and Ω_g^n be the corresponding row of Ω, there is an exact relation:

(1) $$X_g^{nc}=\Omega_g^n V^c$$

In this framework, endowments fully suffice to determine the structure of goods production (at the 4-digit level).

We now sketch an alternative that serves as our empirical framework for assessing economic geography. Unfortunately, one cannot directly test the simple one-factor model of Krugman (1980). The data will reject the implicit premise that endowment structure does not matter for production structure. Thus, if we are to provide a reasonable chance for the economic geography theory to succeed, we will need to augment the Krugman model with an underlying Heckscher-Ohlin structure. We do so while trying to maintain the spirit of the simpler Krugman model, very much aware of the compromises required in moving from blackboard to data. Our inspiration in this is the Helpman (1981) integration of the simple monopolistic competition and Heckscher-Ohlin models.

Assume there are N industries and N primary factors. Let **A** be a technology matrix, and $\mathbf{A_n}$ be a column reflecting technology in industry n. All varieties i of all goods g produced within industry n share a common technology. As in Krugman (1980), production of any variety requires a fixed cost and a constant marginal cost in units of factors. We assume that both fixed and marginal costs are in scalar proportion to $\mathbf{A_n}$. We assume that demand is of the iso-elastic Spence-Dixit-Stiglitz form and that the elasticity of demand is common for all varieties of all goods within an industry (a feature preserved with the introduction of iceberg transport costs). In such a case, it is well known that the free entry zero profit condition insures that the equilibrium scale of production of any variety is constant, even though factor returns may differ across countries. Thus it is fully justifiable to treat $\mathbf{A_n}$ as the total input coefficients for a variety i of output in any good g within industry n.

In such a world, a country's endowments fully determine its broad industrial structure. Thus when we turn to the empirics, we can say that Heckscher-Ohlin determines the structure of production at the 3-digit ISIC level. This can be expressed as:

(2) $$X^{nc}=\sum_{g=1}^{G_n} X_g^{nc}=\bar{\Omega}^n V^c \quad ,$$

where $\bar{\Omega}$ is an N x N matrix. Full employment insures that we know the aggregate employment within each industry. Our formulation allows us to have a very special type of indeterminacy. While the aggregate output of industries is assumed to be driven by factor endowments, the output shares of goods within the industry are assumed not to be driven by factor endowments. To draw an example from the economic geography literature, factor endowments may tell us which countries have large textile industries, but may be very poor predictors of where specific goods like carpets are produced.

However, we can say more about this equilibrium. Each good is comprised of a number of varieties that are produced using increasing returns technology. To continue our example, we assume that within the industry "textiles" there is a good "carpets" that is comprised of monopolistically competitive varieties like "wall-to-wall carpets," "Persian carpets," "rugs," etc., each of which is produced with economies of scale. It is at the varieties level that we assume economies of scale drive specialization. Since we also know the equilibrium scale of each variety within an industry, we likewise know the total number of varieties produced within the industry in a given country. What we do not yet know is how these varieties are distributed across the various goods that comprise the industry. And this is where economic geography comes into play.

Since we have assumed that the relative input coefficients for industry *n,* indicated by $\mathbf{A}_n$, are technologically fixed for all countries, it proves useful to think of these as a composite factor — a parallel to "labor" in Krugman (1980). The endowments of the various countries determine the aggregate resources devoted by each to a particular industry *n*. Again, this serves as the same aggregate resource constraint as labor in the single-industry model. The principal differences between this setting and the single-industry model are that the composite factor return is determined in a setting broader than that of the single industry, and that the budget constraints likewise bind only in this broader setting.

In the full equilibrium a few conditions must hold. The cost of the composite input is the same for all varieties of all goods within an industry for a given country, although it may differ across countries. Since the elasticity of demand is assumed common for all varieties within an industry, they will also have a common markup everywhere. Thus the price of all varieties of all goods for a given industry and country will be the same, although prices for varieties within the same industry in another country may differ. As well, the level of output consistent with zero profits is the same for all varieties within an industry in all countries.

The demand facing the home country producer of a variety i of a good g in industry n in a two-country world can be taken from Helpman and Krugman (1985). Letting D_g^n and D_g^{n*} be total spending on good g respectively at home and abroad, the demand for variety i is given by:

(3) $$d_i = \frac{\left(p_{g,i}^n\right)^{-\sigma} D_g^n}{R_g^n\left(p_g^n\right)^{1-\sigma} + R_g^{n*}\left(\tau p_g^{n*}\right)^{1-\sigma}} + \frac{\tau^{1-\sigma}\left(p_{g,i}^n\right)^{-\sigma} D_g^{n*}}{R_g^n\left(\tau p_g^n\right)^{1-\sigma} + R_g^{n*}\left(p_g^{n*}\right)^{1-\sigma}}$$

where R_g^n (R_g^{n*}) denotes the home (foreign) number of varieties of good g, p_g^n $\left(p_g^{n*}\right)$ denotes the FOB home (foreign) price of each of the other varieties, and $p_{g,\,i}^n$ is the price of variety i. An important feature of this demand equation is that it is homogeneous of degree zero in (R_g^n , R_g^{n*} , D_g^n , and D_g^{n*}) jointly. A consequence of this is that if countries' spending across goods within an industry differs only by a scale factor, then it is consistent with market clearing that the number of varieties per good across the countries differ by the same scale factor. Put another way, absent idiosyncratic components of demand, a country will allocate its resources within an industry in proportion to the share of demand devoted to the various goods in that industry. Since this is true for each country, and in equilibrium demand and supply for each good must match, this will also equal the share of that good in world output of that industry.

In sum, the prediction arising from our economic geography framework is that countries' output of a good will have two components. First, there is a *base level* of predicted production. A country's output in an *industry* is predicted by endowments. The distribution of this output across the *goods* within an industry will be in the same proportion in each country as in the rest of the world. Second, this base level must be adjusted to reflect the influence of economic geography. We do this in the manner developed in Section 3.2, and as suggested by the work of Krugman (1980) and Weder (1995): From this base level, output of goods within an industry responds to idiosyncratic components of demand by more than one-for-one.

We now use these insights to make our empirical specification. Our empirical challenge is to determine whether economic geography determines production patterns at the goods level. Drawing on our discussion above, and Weder (1995), we model goods production as

(4) $$X_g^{nc}=f\left(\frac{X_g^{nW}-X_g^{nc}}{X^{nW}-X^{nc}}X^{nc},\left(\frac{D_g^{nc}}{D^{nc}}-\frac{D_g^{nW}}{D^{nW}}\right)X^{nc}\right)$$

where D denotes absorption in either the country, c, or the world, W, and the first derivatives are expected to be non-negative. The first term in $f(\cdot,\cdot)$ captures the tendency for each country to produce the same relative shares of each good. Specifically, we postulate that production of any good X_g^{nc} is going to be centered around industry output, X^{nc}, times the share of that good in production in the rest of the world. In other words, absent any demand differences, the share of production of any good g in industry n should be approximately equal to the share in rest of the world.[9] The second term mirrors Weder's condition for being a net exporter of a commodity in a two country world where one country differs in size from the other. High relative demand for a good in one country causes more varieties to locate in that country and thus raises production of that good. In our specification we suggest that this insight linking relative demands in two countries should be

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[9] One reasonable question to ask at this stage is whether one should assume that a country's 4-digit production share should be similar to that in the rest of the world or to the world as a whole. Both specifications yield qualitatively the same results, but because using world production creates a potential simultaneity problem since production of goods is on both sides of the equation, we use rest of world production on the right-hand side. However, our results are robust to using either world or rest of world production.

extendable to comparisons between one country and the rest of the world. This specification captures the notion that production should locate in countries with idiosyncratically high relative demands.

Writing the geography model in these terms enables us to have two competing models of how output is determined at the 4-digit level. The first is given by equation (1) and denotes the Heckscher-Ohlin model of production while the second is presented in equation (4). If we assume that equation (4) is linear in the terms we can now nest the two hypotheses in equation (5) below:

$$X_g^{nc} = \alpha_g^n + \beta_1 \frac{X_g^{nW} - X_g^{nc}}{X^{nW} - X^{nc}} X^{nc} + \beta_2 \left(\frac{D_g^{nc}}{D^{nc}} - \frac{D_g^{nW}}{D^{nW}} \right) X^{nc} + \Omega_g^n V^c + \epsilon_g^{nc} \tag{5}$$

or

$$X_g^{nc} = \alpha_g^n + \beta_1 SHARE_g^{nc} + \beta_2 IDIODEM_g^{nc} + \Omega_g^n V^c + \epsilon_g^{nc} \tag{5 ′}$$

where

$$SHARE_g^{nc} = \frac{X_g^{nW} - X_g^{nc}}{X^{nW} - X^{nc}} X^{nc} \quad , \quad IDIODEM_g^{nc} = \left(\frac{D_g^{nc}}{D^{nc}} - \frac{D_g^{nW}}{D^{nW}} \right) X^{nc} \quad ,$$

and Ω_g^n is a vector of coefficients on factor endowments.

We can now consider formal hypothesis testing. The coefficient on IDIODEM captures the impact that idiosyncratic patterns of demand have on production. If we estimate equation (5′), we can evaluate three hypotheses. First if β_2 is zero, then we conclude that we are in a comparative advantage world in which transport costs do not matter. As we have seen in the theoretical section, however, even in a comparative advantage world transportation costs can cause output to move as much as one-for-one with demand. We can test this hypothesis by examining if β_2 is between zero and unity. If β_2 falls within this range, then we conclude that we are in a world in which transportation costs and demand patterns affect the location of production, but there are no economies of scale driving specialization. Finally, if β_2 exceeds unity, then we conclude that the magnification or home market effects associated with economies of scale are playing some role in determining production. These hypotheses are summarized below:

Interpretation of β_2

1)	$\beta_2 = 0$:	Frictionless Comparative Advantage World
2)	$\beta_2 \in (0, 1]$:	Comparative Advantage World with Transport Costs
3)	$\beta_2 > 1$:	Economic Geography

One should not, however, simply look at the coefficient on IDIODEM to evaluate the model. If production at the 4-digit level is driven by the Heckscher-Ohlin model, it should also be the case that the coefficients on factor endowments should also be non-zero. Hence, regardless of whether transport costs are present, if we are in a comparative advantage world, we should be able to reject the hypothesis that endowments do not matter. Furthermore, the fact that we include a size-varying variable on the right-hand side, SHARE, means that the correlation between endowments and output will not simply reflect the fact that larger countries have larger output in all sectors. Finally, if factor endowments matter at the 3-digit but not at the 4-digit level, then SHARE will equal the expected level of production of a good given output at the industry level. In this case, one should expect the coefficient on SHARE to be unity.

There is also one additional issue that we need to address at this stage. Since we are considering a model with transport costs, even in a standard Heckscher-Ohlin framework, the FOB price is going to be lower than the CIF price. This implies that there may be a tendency for domestic absorption to be higher if a country is a net exporter of a good because domestic consumers pay the FOB price while consumers in countries that import the good must pay the CIF price. In order words, absorption may covary with production because countries with higher production levels are more likely to be net exporters of goods and therefore have lower prices. One way to correct for this problem is to include a dummy variable that is unity if the country is a net exporter of the good and zero otherwise. However, because the impact of this effect is likely to be proportional to the size of demand, we created EXPORTD which is the interaction of a net export dummy with domestic absorption.

4.2 Data

Implementation of the economic geography framework, as embodied in equation (5), requires data at two levels of aggregation. At the higher level of aggregation, endowments determine the structure of output, while at the more disaggregated level, economic geography is expected to exert its force. Unfortunately, theory does not indicate how to find a level of disaggregation where factor endowments cease determining production structure and specialization is driven by increasing returns and demand patterns. Our strategy was to use the most detailed cross-national data we could find, and then assume that goods at the most disaggregated levels represented a collection of monopolistically competitive varieties.

The data source most appropriate for our purposes was the OECD's Compatible Trade and Production (COMTAP) data set. This provides comparable trade and production data for 13 members of the OECD at the 4-digit ISIC level and 22 members of the OECD at the 3-digit ISIC classification level. These countries are listed in Table 1. World outputs and absorption levels were calculated by summing across all available countries.

One concern about use of these data is whether the actual criterion for industrial classification is congruent with the underlying theoretical categories. It is not. Actual classification is by product usage rather than simply by factor input composition, as would be strictly required by the theory. Maskus (1991) examined this issue for ISIC 3- and 4-digit industries and found that while there was greater similarity of factor intensities within 3-digit sectors than across them, there still was substantial variation within 3-digit sectors. Thus, although it is true, for example, that the skilled to unskilled ratio in precision instruments exceeds that in textiles, there is no guarantee that this is true in comparing every good produced within the respective industries. This could pose problems for our tests. Within the economic geography framework, the assumption that all 4-digit goods in a 3-digit industry use common input proportions served to replicate the one-factor world of Krugman (1980). Heuristically this implied that our production possibility surface had Ricardian flats, so a constant marginal opportunity cost of shifting production from one good to another. Assuming instead that the goods use different input proportions could then imply a rising marginal opportunity cost of expanding one good in terms of the other. This might tend to diminish the responsiveness of production to idiosyncratic demand, implying that the IDIODEM coefficients might be less than unity even if the world is one of economic geography. We acknowledge this possibility. Yet we remain skeptical that this view is correct. Quite apart from the empirical issues of how the goods are classified into industries, we know that if the number of goods is large relative to the number of primary factors, the production surface (here in units of varieties) will again have flats [see Chipman (1987)]. Demand again could play the crucial role in making the production and export patterns determinate — the key being that production expansion for a single good again need not imply rising marginal opportunity cost in terms of other goods.

In principle, working at the 4-digit level enabled us to break manufacturing up into 82 4-digit sectors, but because in 13 cases there was only one 4-digit sector within a 3 digit sector, our sample was reduced to 69 4-digit and 27 3-digit sectors. In addition, we had to drop another 14 4-digit sectors due to missing observations for some countries. Domestic absorption was calculated by subtracting net exports from production. In two sectors (fur dressing and dyeing and manufacturing goods, not elsewhere classified), we obtained large negative numbers for domestic absorption for a number of countries so we dropped those industries. For a few out of the remaining 702 observations, imputed domestic absorption was negative but very small (1-2 per cent of production), and we attributed these negatives to measurement error and reclassified these amounts as zeros. Table 2 reports the 53 4-digit industries that we eventually used in the analysis. As one can see from the table, many of the industries at the 4-digit level, such as carpets and rugs, and motor vehicles, have been used as examples of monopolistically competitive industries. Indeed this level of disaggregation is basically the same as the one used by Krugman (1991) to support his hypothesis that geography matters for trade.

Because of data limitations, we were forced to measure domestic absorption as a residual. Measuring domestic absorption by using a residual potentially introduces a bias into our sample through the mismeasurement of production. If production is recorded at too high a level for a particular year, that will also tend to cause measured absorption to rise. This creates a simultaneity problem if we use contemporaneous demand. Furthermore, since the spirit of economic geography models is to explore how long-run historical demand deviations affect production, we thought it inappropriate to regress current production on current demand. In order to deal with both of these issues, we decided to use average demand over the period 1970-1975 to identify idiosyncratic components of demand, while other variables in our regressions were values for 1985. We also ran all specifications with demand calculated over the time period 1976-1985 and just 1985 and obtained results qualitatively the same.[10]

Table 3 presents some sample statistics on the data. The first panel presents a correlation matrix of 4-digit output across our sample of countries. The striking feature of this table is that output is always positively correlated within our sample of countries and sometimes the correlation between countries is quite high. This table demonstrates the often expressed notion that OECD countries have a broadly similar production structure.

Table 3 also reports sample statistics for our consumption variables. The data reveals that there are typically four 4-digit sectors within a 3-digit sector. Furthermore, it appears that absorption idiosyncracies are fairly symmetrically distributed around zero in our sample.

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[10] Avinash Dixit pointed out to us a second potential bias in favor of the geography model. One can imagine a variety of reasons why local demand and production structure may positively covary independent of the elements that define economic geography. This would tend to bias our estimates of the home market effect upwards.

Our data on factor endowments came from a number of sources. Country capital stocks were taken from the Penn World Tables v. 5.6. World endowments of labor force by educational level were taken from the UNESCO *Statistical Yearbook*, and fuel production is equal to the sum of the production of solid fuels, liquid fuels, and natural gas in coal-equivalent units as recorded in United Nations' *Energy Statistics Yearbook.*

4.3 Econometric Issues

Equations (2) and (5′) can be estimated separately or as a system of seemingly unrelated regressions. The main problem with estimating each of the equations separately is missing observations at the 4-digit level. At the 3-digit level we have observations for each industry for 22 countries but at the 4-digit level we lose 9 countries. This greatly reduces the number of available degrees of freedom, especially in specifications where we would like to nest the two hypotheses. We therefore opted to estimate all of the equations three ways. First we estimated equation (5′) as a system of seemingly unrelated regressions where we imposed the restriction that the coefficients on the IDIODEM and SHARE had to be the same across goods.[11] Second, we allowed the coefficients to vary at the 4-digit level. And finally, we considered an intermediate case where coefficients were constrained to be identical within 3-digit sectors but not across them.

There are a series of econometric issues, however, that prevent direct estimation of these equations. First, in equation (5′) there is a simultaneity problem arising from the fact that X_g^{nc} is an element of X^{nc}. This makes the estimated coefficients biased and inconsistent. However, if we assume

[11] Degrees of freedom considerations also forced us to impose a diagonal variance-covariance matrix on the residuals.

that Heckscher-Ohlin is valid at higher levels of aggregation, then theory provides us with a good set of instruments. Namely, if we assume that equation (2) is valid, we can use factor endowments as instruments for the sectoral level of output.

In addition, we also must deal with two types of heteroskedasticity. First, larger countries tend to produce more of everything, and therefore the errors are likely to be correlated with country size. Second, when we estimate equation (5′), there is an additional element of heteroskedasticity that arises from the fact that when output is high, errors are likely to be high as well. We correct for these two types of heteroskedasticity by assuming that errors across countries are determined by the following stochastic process:

(6)
$$\epsilon_g^{nc} = \gamma_g GNP_c^{\theta_g} + \zeta_{gc}$$

where γ_g and θ_g are parameters and ζ_{gc} is assumed to be normally distributed across countries. Because equation (6) was estimated in logs, we had to take exponents of the fitted values to form the weighting series, so our heteroskedasticity corrected standard errors were close to unity but not exactly equal to one. This would result in small spurious deviations in the standard errors for each good, hence spurious weighting of one good over another. We therefore forced all industry standard errors to equal one by dividing all observations by the heteroskedasticity corrected standard errors appropriate for that good.

Finally, one may wonder whether it is appropriate to assume spherical errors when our dependent variable is bounded below at zero. Fortunately, in our sample, all countries produced positive amounts at all levels of disaggregation, so we feel that our assumption regarding the normality of the disturbances probably does not affect our results.

4.4 Estimating the Heckscher-Ohlin Production Model

We append an additive error term on the end of equation (2) in order to estimate the Heckscher-Ohlin production equation. Although many authors have regressed *trade* on a cross section of factor endowments, it is worth noting that as far as we know, no one has directly estimated equation (2) across countries. The closest work in this spirit is that of Harrigan (1995). Harrigan decided not to estimate equation (2) directly because he was concerned that with 20 countries and 4 factors (in our case we will use 22 countries and 5 factors), he would not have many degrees of freedom. Instead, he estimated equation (2) using time series data with country fixed effects and a procedure that allowed the coefficients to vary in a structured way over time. Although the time series estimates all had R^2 in excess of 0.9, when he compared the relative magnitudes of the fitted values to the actual outputs, Harrigan found large predictive errors. Harrigan therefore concluded that "the [Heckscher-Ohlin] model does not do a particularly good job at explaining cross-country variation in output."

The results were not promising for the Heckscher-Ohlin model, but, as Harrigan noted, it is difficult to assess whether the failure was due to a failure of the theory or simply in the way in which Ω was allowed to vary over time. Consider the following problem. Suppose productivity or price changes cause the technology matrix to move according to some well-behaved pattern, how would those changes appear in the Ω matrix? Since the elements of the Ω matrix are going to be a complex non-linear transformation of the elements of the technology matrix, it would be very surprising if movements in the Ω were also well behaved. We therefore should not be surprised if it is difficult to characterize movements in Ω over time.

Since rigorous application of the theory requires cross-sectional estimation, this is the path we will follow. Even so, we must bear in mind that the theory may fail an F-test and the regression may have a low adjusted R^2 because we are working with few degrees of freedom.

Table 4 presents the results of estimating equation (2) using 3-digit output data. Overall, output seems to be highly correlated with factor endowments with R^2 that are on average 0.9 and in most regressions the coefficients of several of the factors have significant t-statistics indicating that the coefficients can be measured with a reasonable amount of precision. We found the good fits of these regressions quite surprising. Our results clearly suggest that production patterns are actually extremely highly correlated with factor endowments.

We do not report the coefficients because their values are dependent on both the size of the sector and the units used to measure the factor endowments. This makes it very difficult to interpret magnitudes. The coefficient on capital was almost always significant, which indicates that aggregate capital stocks play an important role in the level of manufacturing activity. There did not seem to be much of a pattern to the estimates of the other coefficients. At first glance, this might appear troubling, but a bit more thought suggests that one should not be concerned. First, even if we accept the strong maintained assumption that there are an equal number of industries and factors and hence that our coefficients are Rybczynski derivatives, the coefficients we estimated correspond to elements in the inverse of a technology matrix with a dimension of around thirty. Since it is impossible to infer the coefficients of a high dimension technology matrix from parts of its inverse, we feel that the coefficients cannot be interpreted. Second, if there are more industries than factors, then despite the indeterminacy of the system, it still may be the case that production patterns are correlated with factor endowments, but the coefficients will not necessarily correspond to technological parameters.

Our output regression results were somewhat better than the results that typically obtain when net trade flows are regressed on factor endowments. Leamer (1984), for example, used ten factors and ten industries and obtained an average R^2 of 0.64 on 1975 data. One possible reason for our better fit is that in this sample we have restricted ourselves to only looking at the OECD while other authors, e.g. Leamer (1984), have typically used much broader samples of countries. Core assumptions of the Heckscher-Ohlin model such as identical technologies, factor price equalization, and the absence of barriers to trade are likely to be much closer to the truth for the OECD than for developing countries. Second, it may also be the case that factor endowments predict output better than consumption, causing the production side of the model to work better than the consumption side. Hunter and Markusen (1989) and Hunter (1991) have shown that non-homothetic preferences may be an important factor in explaining trade flows. Since differences in income are likely to be more pronounced in samples that include both the OECD and developing countries, it is possible that the relatively poorer fit in previous studies of trade are due to consumption differences across countries with very different per capita incomes. On the other hand, the fact that Heckscher-Ohlin is often thought to explain North-South trade more than North-North trade because of the greater differences in factor endowments between developed and developing countries tends to run counter to this second argument.

Oddly enough, the more troubling feature of these results was the very high R^2. We did not expect the HO model to fit cross-sectional data for the OECD this well. The most obvious candidate for a spurious correlation is country size. Our data contains two sorts of variation. The first type of variation is due solely to size factors. Suppose two countries have identical factor proportions, but one country is simply larger than the other. In this case one might obtain very good fits of a regression of output on factor endowments because factor endowments are simply a proxy for country size, and country size is proportional to output in each sector. The second type of variation arises solely from factor proportion differences. If two countries had the same GDP but differed only in their relative endowments, it also should be possible to predict output patterns knowing factor endowments. While theoretically both sources of variation should be related in the same way to factor endowments, it would be troubling if size were the only factor driving our results. Indeed, looking at the high correlations of output at the 4-digit level revealed in Table 3, it seems plausible that the first explanation could be driving our results.

Fortunately, this potential problem can be easily resolved. All of the size based variation can be eliminated by forcing θ to equal 2 in our heteroskedasticity correction. This deflates all output and factors by GDP and eliminates all of the size-based variation, leaving us with only the factor proportion based variation. Table 5 reports the results of industry-by-industry estimation making this correction. As one might suspect, the size-based variation did tend to increase our R^2's, but not by that much. On average, our adjusted R^2's averaged 0.6, which is still quite respectable. We therefore conclude that even when looking only at the purely compositional component of output variation, factors endowments explain a very large share of output within the OECD.

4.5 Testing for the Home Market Effect

The relationships that we seek to test can be portrayed graphically, and it makes sense to look at the data before plunging into the econometrics. Obviously, it is impossible to display a multivariate relationship in a bivariate graph, but we can obtain some sense of the data through the following exercise. If we divide both sides of equation (5′) by X^{nc}, set β_1 equal to unity and bring the share term over to the left-hand-side, we obtain

$$\frac{X_g^{nc}}{X^{nc}} - \frac{X_g^{nW} - X_g^{nc}}{X^{nW} - X^{nc}} = \frac{\alpha_g^n}{X^{nc}} + \beta_2 \left(\frac{D_g^{nc}}{D^{nc}} - \frac{D_g^{nW}}{D^{nW}} \right) + \tilde{\epsilon}_g^{nc}$$

The left-hand-side represents how much the share of a given 4-digit industry deviates relative to world levels while the term in parentheses tells us of the magnitude of the idiosyncratic demand component. Figure 3 presents the results of graphing the left-hand-side of the above equation against the term in parentheses. Plotting the data in this manner enables us to visually examine the various hypotheses that we have been considering. If transportation costs were zero and production was constant returns to scale (CRS), one would expect to see a scatter of points lying along the horizontal line through zero. In this case, local demand idiosyncracies would have no impact on production patterns. If the world is CRS but there are transportation costs one would expect the scatter of points to lie somewhere in between the 45-degree line and the horizontal line through zero. Finally, in the world of economic geography, one would expect the points to be scattered along a line with a slope larger than unity because idiosyncratic demand patterns should have magnified effects on production. The data clearly reject the hypothesis that we are in a frictionless comparative advantage world. The two series are highly correlated ($p = 0.79$), and the data appears to be distributed along a line with a slope of about unity.[12] This seems to suggest that either a weak home market effect or indeterminacy are apparent in these data. We also experimented by plotting the same variables for 2

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[12] The fitted line has a slope of 1.058 with a standard error of 0.031.

and 3-digit industries instead of 3 and 4-digit ones (see Figure 4). Overall, however, the plots displayed in Figures 3 and 4 do not seem to reveal strong economic geography effects.

Regression analysis confirms the general impression of the data we obtained in Figure 3. Table 6 presents the results of estimating equation (5′) under a variety of specifications. In the first panel, we estimate a version of the model in which only geography effects, not endowments, are allowed to operate at the 4-digit level. In this specification, the coefficient on IDIODEM is precisely measured but slightly smaller than unity, indicating that historical idiosyncratic demand patterns are associated with essentially one-for-one movements in production patterns. It is comforting to note that the coefficient on SHARE is close to unity, as one would expect.

We were concerned that the coefficient on IDIODEM might be biased by the fact that FOB prices are lower than CIF prices, so we corrected for this by adding EXPORTD in the second panel of Table 6. While the results indicate that being a net exporter is highly correlated with production, it had almost no impact on any of the other point estimates in the regressions. This suggests that our results are not being driven by the fact that countries that produce a lot tend to have lower prices and therefore consume more.

As we have seen in Figure 3 and this first set of regression results, when we do not allow factor endowments to affect output at the 4-digit level, there is a surprisingly high correlation between production and idiosyncratic demand. However, there is reason to suspect that these results may be driven by an omitted variables bias. Suppose that one's view of the world was that factor endowments mattered at the 4-digit level, i.e. that equation (1), not equation (2), was the true description of international production. If this were the case, absorption, which contains the demand for intermediate inputs, might be correlated with factor endowments because industrial production (and hence industrial demand for inputs) would be driven by factor endowments. Suppose, for example, the same factors that give countries a comparative advantage in automobile production also give them a comparative advantage in steel production. If we then regressed steel production on steel absorption we would obtain a spurious acceptance of economic geography because the same factors that caused the automobile sector to expand, and therefore demand more steel, would also generate a comparative advantage in steel production.

This suggests more information can be obtained by pitting both models against each other as suggested by equation (5′). The third and fourth columns of Table 6 perform this experiment. For every 4-digit good, we reject the hypothesis that the coefficients on endowments are jointly zero. Endowments do matter for the determination of 4-digit production.[13]

Most importantly, adding factor endowments as an explanatory variable causes the point estimate for the coefficient β_2 on IDIODEM to drop from 0.99 to 0.30. *Within the framework of our hypothesis test, we formally reject a model of economic geography in favor of a comparative advantage model with transport costs.* We believe that this is the first time that a model of economic geography has ever been rejected by international data using a theoretically rigorous test.

Several caveats are in order. Even in this more general specification, the coefficient on IDIODEM is still larger than zero. Within the context of the hypothesis tests that we have

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[13] It is interesting to note that the coefficient on SHARE is negative in specifications with factor endowments. This is largely a result of the high degree of multicollinearity between SHARE and the endowments. Since SHARE plays no role in the estimation beyond identifying the level of 3-digit output (which in all specifications can be assumed to be driven by endowments), we experimented with specifications that deleted SHARE from runs that included endowments (see the last column of Table 6) as well as with specifications that constrained the coefficient on share to equal one. None of these specifications qualitatively altered the point estimates of IDIODEM.

constructed, our interpretation is either that transportation costs matter or that economies of scale are only present in a subset of OECD manufacturing. There is reason for concern about whether transport costs, which are usually measured to be relatively small, could cause production to rise by 30 per cent as much as idiosyncratic demand. In defense of this estimate, we need to remember that if factor endowments matter, but there still is some indeterminacy in production patterns at the 4-digit level, then it is not surprising to see this sort of correlation. Indeed, McCallum (1995) has found that even apparently small barriers at the border have large impacts on trade flows between the US and Canada.

4.6 Robustness Checks

In considering these results, it is useful to consider one final theoretical twist. Krugman (1980) also develops a model with transport costs and two countries, one large and one small. The twist is that he allows for a mix of industries, one subject to increasing and the other to constant returns to scale. His conclusion was that even if the entire increasing returns to scale industry *could* fit into the smaller country, there would be a tendency for this industry instead to locate in the larger country because of the improved market access. That is, when there are a mix of constant and increasing returns sectors, and in contrast to the results of Weder, absolute — not only relative — market size may matter.

In applying this insight to our results, one must pay careful attention to the level of aggregation that is being considered. If some (3-digit) industries are increasing and others constant returns to scale, then the coefficient on IDIODEM pooled across industries does not have the structural interpretation that we have given it. Nevertheless, our use of the Weder framework based on relative demand will continue to hold exactly for those industries featuring increasing returns. The reason is that our assumption of Leontief technologies has made the resource constraints industry-specific. This suggests looking at coefficients on individual industry runs.

In order to see if there was a pattern to the magnitudes of the coefficients, we re-ran equation (5′) separately for each industry. The lack of degrees of freedom meant that it was difficult to obtain precise estimates of the coefficients, but even so, as Table 7 demonstrates we are able to reject a coefficient of zero in many industries. This suggests that demand does play some role in the location of production. Unfortunately for economic geography, however, we only obtained point estimates of larger than unity in one-third of the sample. We could reject a null that the coefficient on IDIODEM was less than unity only in tanneries and leather, and machinery and equipment. Interestingly, the latter is a plausible candidate for economic geography. Of course, it must be emphasized that the small number of degrees of freedom makes it very difficult to see statistical patterns in this type of analysis. Even if we expand our criteria to look only at industries with point estimates larger than unity, there does not seem to be a pattern to the industries that have (insignificant) coefficients larger than unity and our priors about which industries are likely to exhibit economies of scale.

A reasonable objection to analyzing the data in this manner is that there are very few degrees of freedom in each equation. One solution is to pool all of the 4-digit observations within a 3-digit sector and constrain the coefficients on SHARE and IDIODEM to be the same within 3-digit sectors, but not across 3-digit sectors. This experiment answers the question of whether we can observe economic geography effects in certain 3-digit sectors but not others. When we ran this in a specification without factors (see Table 8), only in textiles was the coefficient on IDIODEM significantly greater than unity, and no 3-digit sector had a coefficient on IDIODEM significantly greater than unity in specifications with endowments. We therefore conclude that there is not evidence of strong international economic geography effects in most sectors.

There is a second way that a mix of increasing returns and constant returns sectors might complicate our analysis. If (3-digit) industries are themselves a mix of (4-digit) goods, some of which are constant and others increasing returns to scale, then even the coefficients on IDIODEM in the individual industry runs fail to have the structural interpretation we have placed on them. In a case with trade costs only for differentiated goods, Krugman (1980) showed that countries with absolutely small markets will tend to concentrate on constant returns goods, while those with absolutely large markets will tend to concentrate on increasing returns goods. A rough test of this can be devised based on our earlier examination of output correlations. Since countries like the US and Japan are likely to have much larger domestic markets than countries like Norway and Finland, one would expect the increasing returns goods to locate in large countries and constant returns goods in small countries. This implies that we should see a negative correlation in production composition between large and small countries. However, Table 3 demonstrates that production composition is *positively* correlated between every country pair in our sample. This seems very hard to reconcile with absolute market size driving international specialization.

Another objection that one might have is that an alternative specification might have more power. In previous runs we used 4-digit output as our dependent variable because endowment levels directly predict output levels, not shares. However, this specification may be problematic for a number of reasons. First, having variables that are strongly correlated with size on both sides may generate spuriously good fits. Second, there is the simultaneity problem that we mentioned earlier.

Therefore, it might be better to divide both the dependent and independent variables in equation (4) by X^{nc} and try to explain the share of 4-digit output in 3-digit. In other words, we can eliminate the simultaneity problem by estimating equations of the form:

$$\frac{X_g^{nc}}{X^{nc}} = \beta_0 + \beta_1 NEWSHARE_g^{nc} + \beta_2 \Delta_g^{nc} \ , \tag{5''}$$

where

$$NEWSHARE_g^{nc} = \frac{X_g^{nW} - X_g^{nc}}{X^{nW} - X^{nc}}$$

and

$$\Delta_g^{nc} = \left(\frac{D_g^{nc}}{D^{nc}} - \frac{D_g^{nW}}{D^{nW}} \right)$$

Unfortunately, in this new format, we cannot nest the Heckscher-Ohlin and economic geography hypotheses because we cannot obtain a linear relationship between factor endowments and production shares. Even so, it is worth considering whether adopting a specification that predicts output shares significantly affects our results. Estimating equation (5″) produced results that were almost identical to those reported earlier. The coefficient on idiosyncratic demand actually declined relative to our other runs. Similarly allowing the coefficients on NEWSHARE and Δ to vary across 3-digit sectors revealed that we could only detect significant geography effects in textiles and transportation equipment. While this may indicate that these sectors are monopolistically competitive, our results do not alter our basic conclusion that for most sectors economic geography does not seem to drive international specialization.

One reason for caution in interpreting our results is that there are possible biases due to measurement error. There is little doubt that all of our variables are measured with some error. Very likely the variable with the largest measurement errors is IDIODEM. These errors arise out of the fact that international 4-digit data has a fair amount of noise in it even for the OECD. We tried to deal with this problem through several mechanisms. First, in all of our specifications we used 5-year averages so that any yearly aberrations would be averaged out. In addition we tried 10-year averages but this did not affect our results. Second, since the 2- and 3-digit data is of higher quality than the 4-digit data, we tried repeating our experiments with these data. This, however, produced similar results both when we estimated the data as a system and in individual 3-digit runs.

In addition, we sought to estimate how sensitive our 4-digit results were to measurement error. In a univariate regression, these errors will cause attenuation, but in a multiple regression there is little one can say. Following Klepper and Leamer (1984), we ran reverse regressions in order to calculate maximum likelihood bounds. These tests revealed that measurement error in IDIODEM is not severe enough to make the coefficient unbounded. But it could be severe enough to lead to attenuation. We therefore tried to get a sense of the magnitude of this potential bias.

One approach to investigating the impact of measurement error is to respecify our equation as a univariate regression. This is not so difficult if we model economic geography using

X_g^{nW}/X^{nW} instead of NEWSHARE. Since world shares do not vary at the country level, if we estimate a version of equation (5″) in which we subtract the mean, calculated for each good, from each variable, we can eliminate the share variable entirely and estimate a simple linear regression of output shares on Δ. In this new specification, there is no scope for measurement error of the other variables to influence β_2. Our estimate of β_2 in this specification is 0.93, which is actually lower than the corresponding estimate reported in the first column of Table 6. We of course still need to worry about attenuation in this estimate. Since the regression is linear, however, the bias is easier to calculate. Indeed, as long as the variance of measurement error is within 8 per cent of the variance of the true Δ, we can safely reject economic geography in this specification. Since we have no information on the magnitude of the measurement error, it is hard to know if this is reasonable or not, but even if one took a very pessimistic view of our data and suspected that the variance of the measurement error was half as large as the variance of the true Δ, this would still only result in a coefficient on Δ of 1.4. While we cannot rule out this possibility, the small size of this coefficient is indicative of the fact that measurement error probably is not causing us to miss very large economic geography effects.

In light of these results, we conclude that while we sometimes can detect a weak relationship that is supportive of economic geography in certain industries, in general these results are not robust to the inclusion of factor endowments. Economic geography does not appear to drive production in OECD manufacturing in general, but, in the most generous interpretation of the data, economic geography may play some role in the determination of production in as much as a third of all OECD manufacturing sectors.

4.7 Assessing the Economic Significance

So far, most of the analysis has focused on trying to identify statistically whether economic geography has an impact on production patterns. However, there is another equally important question surrounding the economic significance of the coefficients. Harking back to Krugman's initial question regarding the relative importance of increasing returns, we would like to know how sensitive production patterns are to demand factors. Following Leamer (1984), we try to ascertain the relative importance of factor endowments and economic geography by examining β-coefficients. Let $\boldsymbol{Z}$ denote our matrix of observations for the independent variables and $\boldsymbol{Z}^M$ the same matrix with the entries for only the set of variables M set equal to their sample means.[14] We define β^M as

$$\beta^M = \sqrt{\frac{\frac{1}{n-1}(\beta Z - \beta Z^M)'(\beta Z - \beta Z^M)}{\sigma_X^2}}$$

In other words, β^M tells us how many standard deviations of the dependent variable can be explained by a one standard deviation movement in the set of variables, M.

As one might expect, SHARE and the endowment variables are highly correlated because they both capture the effect of endowments on output (SHARE at the 3-digit level and endowments at the 4-digit). Therefore, it does not make sense to separate the effects of these two variables. If we assign the explanatory power of SHARE to the Heckscher-Ohlin model, we obtain:

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[14] Means were calculated separately for each 4-digit sector.

$$\beta^{SHARE,\ Factors}=0.89$$

$$\beta^{IDIODEM}=0.05$$

In other words, demand fluctuations only seem to account for around 5 per cent of OECD production patterns at the 4-digit level, with 90 per cent being accounted for by factor endowments. If we believe that part of the effect that has been attributed to economic geography is really due to transportation costs interacting with CRS industries, then this 5 per cent number overstates the role of economic geography. This also puts the results of Figure 3 and the non-nested results into perspective. Deflating the variables in Figure 3 by 3-digit production and allowing production at the 3-digit level to be driven by Heckscher-Ohlin resulted in virtually all of the production variance being attributed to Heckscher-Ohlin. In other words, even though we can see a pattern in Figure 3, its importance for overall OECD production is small. We therefore conclude that economic geography is not only statistically insignificant, but economically small as well.

5 Conclusion

This paper reports the first tests that nest the trade models of economic geography and Heckscher-Ohlin for estimation on international data. The particular model of economic geography which we employ is based on Krugman (1980), and features the "home market" effect. To test this, we select a setting often cited as featuring pervasive increasing returns — i.e. one we believed *ex ante* to be most propitious for finding the effects of economic geography. Accordingly, our study focuses on explaining the structure of manufacturing production across the OECD.

Our principal result is that economic geography appears to play little or no role in determining the cross-national structure of OECD manufacturing production. The home market effects characteristic of this theory are not in evidence. Estimable economic effects of economic geography explain just 5 per cent of the variation in OECD production. By contrast, the cross-national structure of factor endowments is highly informative about OECD production structure.

These results raise an important question. While our focus has been on the cross-national structure of production, an important strand of the literature has instead focused on accounting for inter-regional differences in production structure (i.e. at the sub-national level). Is it possible that economic geography may matter little for the cross-national structure of production, yet matter a great deal for explaining regional production structure? This is entirely possible. Theory requires trade costs for the existence of these home market effects. Yet these effects are stronger when the trade costs are low. Recent work by McCallum (1995) and Engel and Rogers (1996) has given reason to suspect that trade costs are significantly lower within rather than between countries. This suggests that for sectors in which such effects are potentially at work, the economic significance could be much greater at the regional level. This is a fruitful area for further inquiry.

References

Bhagwati, Jagdish and Donald R. Davis (1995) "Intraindustry Trade: Issues and Theory", forthcoming in James Melvin, James Moore, and Ray Riezman, eds., *Trade, Welfare, and Econometrics: Essays in Honor of John S. Chipman*, New York: Routledge.

Bowen, Harry P., Edward Leamer, and Leo Sveikauskas (1987) "Multicountry, Multifactor Tests of the Factor Abundance Theory," *American Economic Review*, v. 77.

Brecher, Richard A. and Ehsan Choudhri (1993) "Some Empirical Support for the Heckscher-Ohlin Model of Production," *Canadian Journal of Economics*, 26:2.

Chipman, John S. (1992) "Intra-Industry Trade, Factor Proportions and Aggregation," in *Economic Theory and International Trade: Essays in Memoriam, J. Trout Rader*, NY: Springer-Verlag.

Chipman, John S. (1987) "International Trade," in J. Eatwell, M. Milgate, and P. Newman, *The New Palgrave: A Dictionary of Economics*, NY: Macmillan.

Davis, Donald R. (1995) "Intra-Industry Trade: A Heckscher-Ohlin-Ricardo Approach,", *Journal of International Economics*, 39:3-4, November.

Davis, Donald R. (1997) "Critical Evidence on Comparative Advantage? North-North Trade in a Multilateral World." forthcoming *Journal of Political Economy*, October.

Davis, Donald R., David E. Weinstein, Scott C. Bradford and Kazushige Shimpo (1997) "Using International and Japanese Regional Data to Determine When the Factor Abundance Theory of Trade Works," *American Economic Review*, June.

Deardorff, Alan V. (1995) "Determinants of Bilateral Trade: Does Gravity Work in a Neoclassical World?" forthcoming in Jeffrey Frankel, ed., *Regionalization of the World Economy*, Chicago: U. of Chicago and NBER.

Dixit, Avinash K., and Stiglitz, Joseph E. (1977) "Monopolistic Competition and Optimum Product Diversity," *American Economic Review* 67 (3), 297-308.

Dixit, Avinash K., and Norman, Victor (1980) *Theory of International Trade*, Cambridge: Cambridge U. Pr.

Engel, Charles and John H. Rogers (1996) "How Wide is the Border?" *American Economic Review*, December.

Grubel, H.G. and P.J. Lloyd (1975) *Intra-Industry Trade: The Theory and Measurement of International Trade in Differentiated Products*, New York: John Wiley and Sons.

Harrigan, James (1994) "Scale Economies and the Volume of Trade," *Review of Economics and Statistics*, 76:2.

Harrigan, James (1995) "Factor Endowments and the International Location of Production: Econometric Evidence from the OECD, 1970-1985," *Journal of International Economics*.

Harrigan, James (1997) "Technology, Factor Supplies and International Specialization: Testing the Neoclassical Model," forthcoming *American Economic Review*.

Helpman, Elhanan (1981) "International Trade in the Presence of Product Differentiation, Economies of Scale and Monopolistic Competition: A Chamberlin-Heckscher-Ohlin Approach," *Journal of International Economics*, 11:3.

Helpman, Elhanan (1988) "Imperfect Competition and International Trade: Evidence From Fourteen Industrial Countries," in A. Michael Spence and Heather Hazard, eds., *International Competitiveness*, NY: Ballinger Publishing.

Helpman, Elhanan and Krugman, Paul (1985) *Market Structure and Foreign Trade*, Cambridge: MIT Press.

Hummels, David, and Levinsohn, James (1995) "Monopolistic Competition and International Trade: Reconsidering the Evidence," *Quarterly Journal of Economics*, Vol. CX, August, pp. 799-836.

Hunter, Linda and James R. Markusen, (1989) "Per-Capita Income as a Determinant of Trade," in Feenstra, *Empirical Methods for International Trade*, 89-109.

Hunter, Linda. (1991) "The Contribution of Nonhomothetic Preferences to Trade," *Journal of International Economics*, May , 345-358.

Jorgenson, Dale (1986) "Econometric Methods for Modeling Producer Behavior," in Griliches, Zvi, and Michael Intriligator, eds., *Handbook of Econometrics*. Volume 3, New York: Elsevier Science.

Klepper, S. and Leamer E. E. (1984) "Sets of Maximum Likelihood Estimates for Regressions with All Variables Measured with Error," *Econometrica*, January, pp. 163-183.

Krugman, Paul R. (1980) "Scale Economies, Product Differentiation, and the Pattern of Trade," *American Economic Review*, 70, 950-959.

Krugman, Paul R. (1984) "Import Protection as Export Promotion," in H. Kierzkowski, ed., *Monopolistic Competition and International Trade*, New York: Oxford U. Pr.

Krugman, Paul R. (1990) "Introduction," *Rethinking International Trade*, Cambridge: MIT.

Krugman, Paul R. (1991) *Geography and Trade*, Cambridge: MIT.

Krugman, Paul R. (1994) "Empirical Evidence on the New Trade Theories: The Current State of Play," in *New Trade Theories: A Look at the Empirical Evidence*, London: Center for Economic Policy Research.

Leamer, Edward (1984) *Sources of International Comparative Advantage*, Cambridge: MIT Press.

Leamer, Edward (1980) "The Leontief Paradox Reconsidered," *Journal of Political Economy*, 88, 495-503.

Leamer, Edward and James Levinsohn (1995) "International Trade Theory: The Evidence" in Gene Grossman and Kenneth Rogoff, eds., *Handbook of International Economics*, vol. 3, New York: Elsevier.

Leontief, Wassily (1953) "Domestic Production and Foreign Trade: The American Capital Position Re-Examined," *Proceedings of the American Philosophical Society*, 97, 332-349.

Linder, Staffan Burenstam (1961) *An Essay on Trade and Transformation*, NY: John Wiley and Sons.

McCallum, John (1995) "National Borders Matter: Canada-US Regional Trade Patterns," *American Economic Review*, 85:3.

Markusen, James R. (1986) "Explaining the Volume of Trade: An Eclectic Approach," *American Economic Review*, 76, 1002-1011.

Markusen, James R. and Wigle, Randall M. (1990) "Explaining the Volume of North-South Trade," *Economic Journal*, 100, 1206-1215.

Maskus, Keith (1991) "Comparing International Trade Data and Product and National Characteristics Data for the Analysis of Trade Models," in Hooper, Peter; Richardson, J. David, eds. *International economic transactions: Issues in measurement and empirical research.* National Bureau of Economic Research Studies in Income and Wealth, vol. 55, Chicago and London: University of Chicago Press, 17-56.

Scherer, F. M. and David Ross (1990) *Industrial Market Structure and Economic Performance*, Boston: Houghton Mifflin Company.

Trefler, Daniel (1993) "International Factor Price Differences: Leontief was Right!", *Journal of Political Economy*, 101.

Trefler, Daniel (1996) "The Case of the Missing Trade and other Mysteries," *American Economic Review.*

Weder, Rolf (1995) "Linking Absolute and Comparative Advantage to Intra-Industry Trade Theory," *Review of International Economics*, 3:3, October.

Table 1

Countries in Data Set

Countries Used	No 4-digit data Available
Australia	
Austria	X
Belgium/Lux	
Canada	
Denmark	X
Finland	
France	
Germany	
Greece	X
Ireland	X
Italy	
Japan	
Netherlands	
New Zealand	X
Norway	
Portugal	X
Spain	X
Sweden	
Turkey	X
UK	
USA	
Yugoslavia	X

Table 2

Industries Used in the Analysis

Dropped (X)	ISIC	Industry
	311	Food products
	3111	Slaughtering, preparing and preserving meat
	3112	Dairy products
	3113	Canning and preserving of fruits and vegetables
	3114	Canning, preserving and processing of fish, crustacea and similar foods
	3115	Vegetable and animal oils and fats
	3116	Grain mill products
	3117	Bakery products
X	3118	Sugar factories and refineries
	3119	Cocoa, chocolate and sugar confectionery
	312	Other food products
X	3121	Food products not elsewhere classified
	3122	Prepared animal feeds
	313	Beverage industries
	3131	Distilling, rectifying and blending spirits
X	3132	Wine industries
	3133	Malt liquors and malt
X	3134	Soft drinks and carbonated waters industries
X	314	Tobacco manufactures
	321	Textiles
	3211	Spinning, weaving and finishing textiles
	3212	Made-up textile goods except wearing apparel
	3213	Knitting mills
	3214	Carpets and rugs
	3215	Cordage, rope and twine industries
	3219	Textiles nec
X	322	Wearing apparel, except footwear
	323	Leather and products of leather, leather substitutes and fur, except footwear and wearing apparel
	3231	Tanneries and leather finishing
X	3232	Fur dressing and dyeing industries
	3233	Products of leather and leather substitutes, except footwear and wearing apparel
X	324	Footwear, except vulcanized or molded rubber or plastic footwear
	331	Wood and wood and cork products, except furniture
	3311	Sawmills, planing and other wood mills
	3312	Wooden and cane containers and small cane ware
	3319	Wood and cork products nec
X	332	Furniture and fixtures, except primarily of metal

Table 2 (Continued)

Table 2 (Continued)

Industries Used in the Analysis

Dropped (X)	ISIC	Industry
	341	Paper and paper products
	3411	Pulp, paper and paperboard
	3412	Containers and boxes of paper and paperboard
	3419	Pulp, paper and paperboard articles nec
X	342	Printing, publishing and allied industries
		Plastic Products
	351	Industrial chemicals
	3511	Basic industrial chemicals except fertilizer
	3512	Fertilizers and pesticides
	3513	Synthetic resins, plastic materials and man-made fibers except glass
	352	Other chemical products
	3521	Paints, varnishes and lacquers
	3522	Drugs and medicines
	3523	Soap and cleaning preparations, perfumes, cosmetics and other toilet preps.
	3529	Chemical products nec
X	353	Petroleum refineries
X	354	Miscellaneous products of petroleum and coal
	355	Rubber products
X	3551	Tire and tube industries
	3559	Rubber products nec
X	356	Plastic products nec
X	361	Pottery, china and earthenware
X	362	Glass and glass products
	369	Other non-metallic mineral products
	3691	Structural clay products
	3692	Cement, lime and plaster
	3699	Non-metallic mineral products nec
X	371	Iron and steel basic industries
X	372	Non-ferrous metal basic industries

Table 2 (Continued)

Industries Used in the Analysis

Dropped (X)	ISIC	Industry
	381	Fabricated metal products, except machinery and equipment
	3811	Cutlery, hand tools and general hardware
	3812	Furniture and fixtures primarily of metal
	3813	Structural metal products
	3819	Fabricated metal products except machinery and equipment not elsewhere classified
	382	Machinery except electrical
	3821	Engines and turbines
	3822	Agriculture machinery and equipment
	3823	Metal and wood working machinery
	3824	Special industrial machinery and equipment except metal and wood working machinery
	3825	Office, computing and accounting machinery
	3829	Machinery and equipment, except electrical nec
	383	Electrical machinery apparatus, appliance and supplies
	3831	Electrical industrial machinery and apparatus
	3832	Radio, television and communication equipment and apparatus
	3833	Electrical appliances and housewares
	3839	Electrical apparatus and supplies nec
	384	Transport equipment
	3841	Shipbuilding and repairing
X	3842	Railroad equipment
	3843	Motor vehicles
X	3844	Motorcycles and bicycles
X	3845	Aircraft
X	3849	Transport equipment nec
	385	Professional and scientific and measuring and controlling equipment nec, and of photographic and optical goods
	3851	Professional and scientific, and measuring and controlling equipment nec
X	3852	Photographic and optical goods
X	3853	Watches and clocks
X	3901	Jewelry and related articles
X	3902	Musical instruments
X	3903	Sporting and athletic goods
X	3909	Manufacturing industries nec

Table 3

Sample Statistics

Correlation of 4-digit Output by Country (1985)

	CAN	USA	JPN	AUS
CAN	1.00			
USA	0.82	1.00		
JPN	0.76	0.91	1.00	
AUS	0.80	0.77	0.62	1.00
BLX	0.79	0.79	0.76	0.63
FIN	0.51	0.33	0.14	0.36
FRA	0.77	0.88	0.77	0.79
GER	0.83	0.89	0.88	0.70
ITA	0.75	0.78	0.81	0.60
NTH	0.33	0.50	0.32	0.46
NOR	0.40	0.34	0.17	0.45
SWE	0.91	0.82	0.72	0.72
UK	0.62	0.88	0.81	0.64

	BLX	FIN	FRA	GER
BLX	1.00			
FIN	0.20	1.00		
FRA	0.73	0.32	1.00	
GER	0.90	0.16	0.80	1.00
ITA	0.85	0.19	0.77	0.88
NTH	0.53	0.36	0.52	0.38
NOR	0.23	0.65	0.34	0.20
SWE	0.64	0.69	0.74	0.73
UK	0.75	0.24	0.84	0.81

	ITA	NTH	NOR	SWE
ITA	1.00			
NTH	0.44	1.00		
NOR	0.19	0.49	1.00	
SWE	0.61	0.32	0.50	1.00
UK	0.73	0.60	0.29	0.66

Table 3 (Continued)

Sample Statistics

Variable	Mean	Std Dev	Minimum	Maximum
IDIODEM/X3	0.01	0.11	-0.59	0.61
SHARE/X3	0.27	0.21	0.01	0.87
CAP85	785511000	1009220000	91670300	3512070000
LABOR85	20763	23547	1796	79190
EDUC85	5287	10145	243	37610
LAND85	26480	51487	771	189799
FUEL85	239358	520333	22	1935810
RGDP85	709383000	1054510000	59084700	3962220000

Table 4

3-Digit Production Regressed on Factor Endowments
(22 Countries, Endogenous Heteroskedasticity Correction)

	t-statistics						$F_{.01,5,16}$ = 4.4	
	Constant	Capital	Labor	Education	Land	Fuel	*F*-Statistic	Adjusted R^2
Food Products	1.425	2.768	-0.874	0.444	0.375	1.826	55.03	0.9279
Other food	-1.41	7.458	-4.901	-4.392	-3.152	6.329	198.27	0.988
Beverages	-0.86	3.347	0.08	-1.206	-0.715	2.625	52.27	0.9423
Tobacco	-1.056	2.239	0.962	-1.801	-1.238	2.898	23.8	0.8444
Textiles	-0.284	2.332	0.967	0.469	0.058	0.433	42.25	0.9076
Apparel	-0.623	2.908	-0.623	0.108	0.6	2.086	91.39	0.9556
Leather Goods	-0.193	2.541	0.449	-1.606	0.844	0.528	11.07	0.7056
Footwear	0.421	1.63	0.696	-0.861	0.741	-0.131	4.59	0.4611
Wood and Wood Products	1.089	3.216	-2.21	0.504	0.737	0.734	73.99	0.9456
Furniture and Fixtures	1.335	3.183	0.538	0.655	-0.892	1.03	120.86	0.9661
Paper and Paper Products	0.94	1.276	-1.202	1.604	-0.257	1.063	24.73	0.8496
Printing and Publishing	-0.243	1.654	-0.194	0.689	-0.666	2.451	52.22	0.9242
Industrial Chemicals	-1.087	4.005	0.576	1.085	-3.004	2.991	68.77	0.9416
Other Chemical Products	-1.369	3.445	-0.402	0.791	-1.264	2.554	137.72	0.9702
Petroleum Refining	-0.587	0.785	0.09	1.472	-0.457	1.658	23.69	0.8438

Table 4 (Continued)

3-Digit Production Regressed on Factor Endowments (22 Countries, Endogenous Heteroskedasticity Correction)

	t-statistics						$F_{.01,5,16}$ = 4.4	
	Constant	Capital	Labor	Education	Land	Fuel	*F*-Statistic	Adjusted R^2
Misc. Petroleum and Coal Prods	-0.593	1.329	0.619	0.285	-1.197	1.145	18.46	0.8212
Rubber Prods.	-1.328	3.492	-0.566	-0.036	0.335	1.128	81.93	0.9507
Plastic Prods. NEC	-0.982	2.881	-0.922	0.003	-0.173	0.467	22.97	0.8395
Pottery, china	-0.916	3.061	0.316	-2.405	0.274	1.714	8.36	0.6367
Glass and Glass Prods	-0.588	3.098	0.331	1.348	-0.96	0.625	53.05	0.9253
Other Non-Metallic Min. Prods	-0.192	3.816	-0.799	-0.877	0.453	0.306	27.93	0.8651
Iron and steel	-1.301	4.731	-0.37	-1.646	-0.258	1.037	48.73	0.9191
Non-ferrous Metals	-0.553	3.857	-1.716	0.33	1.528	2.044	57.89	0.9312
Fabricated Metal Prods	-0.58	2.684	-0.668	1.642	-0.77	0.666	59.93	0.9335
Machinery	-1.398	3.857	-0.696	0.804	-1.575	2.058	193.57	0.9787
Electrical Machinery	-1.106	3.015	-0.687	-0.021	-0.81	0.559	27.62	0.8637
Transportation Equipment	-1.74	4.172	-1.055	1.881	-0.67	0.236	94.62	0.9571
Professional & Scientific Equip.	-1.302	2.095	-0.454	1.275	-1.496	0.608	40.67	0.9043
Other Manufacturing Industries	-1.327	3.723	-1.417	-0.42	-0.039	1.021	56.46	0.9296

Table 5

3-Digit Production Regressed on Factor Endowments (22 Countries, All Data Deflated by GDP)

	t-statistics						$F_{.01,5,16}$ = 4.4	
	Constant	Capital	Labor	Education	Land	Fuel	*F*-Statistic	Adjusted R^2
Food Products	5.32	2.018	-0.706	0.98	-0.074	-0.192	5.15	0.4969
Other food	0.31	0.102	0.612	0.429	-0.988	0.973	3.05	0.4601
Beverages	0.9	2.447	-0.046	0.13	-0.052	0.005	5.59	0.5223
Tobacco	-0.5	1.352	1.983	-0.403	-0.538	0.758	4.89	0.4811
Textiles	1.132	2.196	2.588	-0.449	0.176	-1.579	10.13	0.685
Apparel	0.843	2.505	0.106	0.661	0.522	-1.077	8.16	0.6302
Leather Goods	1.316	0.765	1.12	0.49	0.114	-0.938	2.63	0.2797
Footwear	0.694	1.183	0.973	-0.21	0.299	-0.991	2.32	0.2392
Wood and Wood Products	1.071	1.933	-1.051	0.691	0.203	0.232	4.29	0.4391
Furniture and Fixtures	2.215	1.412	0.03	0.98	-0.009	-1.011	3.5	0.3734
Paper and Paper Products	0.457	1.892	-1.156	0.209	0.08	-0.673	1.96	0.1858
Printing and Publishing	0.629	2.767	0.187	0.098	-0.398	1.044	8.69	0.6466
Industrial Chemicals	-0.878	3.642	0.468	0.335	-2.003	1.02	13.19	0.7438
Other Chemical Products	-2.776	4.378	-0.302	0.7	-1.236	-0.328	16.38	0.7855
Petroleum Refining	-1.53	2.167	1.29	0.177	-0.821	1.139	8.31	0.6349

Table 5 (Continued)

3-Digit Production Regressed on Factor Endowments (22 Countries, All Data Deflated by GDP)

	t-statistics						$F_{.01,5,16}$ = 4.4	
	Constant	Capital	Labor	Education	Land	Fuel	*F*-Statistic	Adjusted R^2
Misc. Petroleum and Coal Prods	-0.554	0.817	2.521	1.434	-1.959	0.876	7.04	0.6139
Rubber Prods.	-1.061	2.301	0.946	1.129	-0.287	-0.965	9.95	0.6806
Plastic Prods. NEC	-0.468	2.849	-0.219	0.416	-0.154	-0.315	7.59	0.6106
Pottery, china	0.053	2.198	1.055	-0.917	-0.349	-1.09	3.5	0.373
Glass and Glass Prods	0.549	3.519	0.604	-0.117	-0.655	-1.114	9.69	0.6742
Other Non-Metallic Min. Prods	1.837	4.223	-0.367	-1.283	1.001	-1.052	9.6	0.6719
Iron and steel	-2.683	4.277	0.472	-0.491	-0.167	-0.873	13.67	0.7511
Non-ferrous Metals	-1.671	4.634	-1.42	-1.043	1.583	3.582	24.29	0.8472
Fabricated Metal Prods	-0.339	3.074	-0.272	1.682	-0.486	-0.623	13.74	0.7521
Machinery	-1.278	3.809	0.094	1.685	-2.275	-0.05	17.64	0.7985
Electrical Machinery	-1.393	2.906	0.517	0.709	-1.474	-0.525	8.67	0.6462
Transportation Equipment	-3.000	3.462	0.056	2.449	-1.385	-0.494	20.59	0.8235
Professional & Scientific Equip.	-0.790	1.092	0.294	2.092	-1.743	-0.52	4.77	0.4728
Other Manufacturing Industries	-0.554	1.91	-0.553	2.233	-0.794	-0.617	8.41	0.6383

Table 6

Seemingly Unrelated Regression Results

Dependent Variable is 4-Digit Production

	1	2	3	4	5
IDIODEM	0.9902	0.999	0.3052	0.3426	0.5442
	0.007	0.007	0.0437	0.044	0.3975
SHARE	1.1003	1.022	-1.7441	-1.5241	
	0.003	0.004	0.1773	0.1799	
EXPORTD		0.1169		0.2211	
		0.004		0.0305	
FACTORS	No	No	Yes	Yes	Yes
Observations	702	702	702	702	702

(Standard errors are below estimates)

Table 7

Equation by Equation of Nested Model (Std. Errs. Below estimates)
Number of Observations = 13

Ind	Adj. R2	IDIODEM	SHARE		Ind	Adj. R2	IDIODEM	SHARE
3111	0.9638 34	0.9542 0.3631	-0.4568 2.4173		3214	0.995	0.5548 0.6187	-3.2204 3.8860
3112	0.8299	-0.9642 1.1258	-7.9472 8.1058		3215	0.9885	0.8011 0.3959	-0.4004 1.3463
3113	0.9996	0.0211 0.1635	-3.0439 0.4761		3219	0.7931	0.9203 0.4799	-2.5505 4.4532
3114	0.9895	1.4225 0.2976	1.2932 0.9814		3231	0.9794	2.7260 0.3722	-5.2760 1.4663
3115	0.9929	-0.1287 0.2753	-4.3137 1.1322		3232			
3116	0.9619	1.0140 1.3788	-5.7246 11.3227		3233	0.98877	-1.0902 1.4095	-5.1911 6.5735
3117	0.9985	1.2559 0.2924	4.1511 1.1939		3311	0.9932	5.4715 3.8189	23.4115 12.6616
3118					3312	0.9953	0.3496 0.2559	5.1138 7.2139
3119	0.9992	-0.4273 0.2316	-2.3542 1.7529		3319	0.9981	0.7121 0.2908	-5.080 1.003
3121					3411	0.9993	3.6079 1.8022	-0.6812 2.1700
3122	0.9895	1.1562 0.4741	2.8542 2.3116		3412	0.9998	-0.0896 0.6342	-3.9658 1.4976
3131	0.8521	0.7751 0.7823	-1.7315 1.7057		3419	0.9979	-0.1170 0.7495	-4.0163 2.6105
3132					3511	0.9997	0.6074 0.5961	- 10.6539 6.8991
3133	0.983	1.5266 0.5496	16.3702 8.8253		3512	0.9101	0.3229 0.2903	-3.0394 5.9418
3134					3513	0.9976	1.3547 0.7256	19.6792 11.6716
3211	0.9358	0.05185 3.0225	9.2572 11.7023		3521	0.994	0.7453 0.5713	6.6812 4.5924
3212	0.9994	2.6769 1.8919	3.0599 3.4351		3522	0.9848	3.6563 2.6043	6.2399 3.5527
3213	0.9975	0.4472 0.7014	3.1345 1.7187		3523	0.9957	0.2188 0.9770	- 28.5175 6.6156

Ind	Adj. R2	IDIODEM	SHARE		Ind	Adj. R2	IDIODEM	SHARE
3529	0.9945	2.1110 1.1744	1.1038 2.5067		3823	0.9983	-0.0561 0.7322	-4.9992 5.5501
3551					3824	0.9977	0.6022 0.3250	0.9640 1.0336
3559	0.9954	-0.6350 1.9345	-3.2285 11.3668		3825	0.9989	-1.7742 0.6539	-2.5859 0.6887
3691	0.7896	-0.1839 0.2535	-2.2782 1.4239		3829	0.9969	2.1627 0.4582	6.8014 3.4381
3692	0.9784	0.3221 0.6933	-2.4411 3.8966		3831	0.9993	1.0182 0.3497	7.9956 2.2419
3699	0.9982	0.6001 1.0187	-0.0682 4.1044		3832	0.9985	2.6308 1.6184	-2.0013 6.1382
3811	0.9615	0.5574 0.4117	7.1593 6.6452		3833	0.9931	-0.2761 0.7397	-0.8170 0.6852
3812	0.9932	-0.1915 0.2168	-3.2808 0.9106		3839	0.9979	0.6456 0.9310	0.5322 1.3317
3813	0.9438	0.4869 0.4893	-0.7262 2.3555		3841	0.9986	-0.1365 0.4192	-1.8157 4.2953
3819	0.9984	0.7178 0.4324	1.2066 2.1264		3843	0.996	2.5799 1.6320	1.4460 2.7469
3821	0.9977	0.1618 0.1505	0.5092 1.2547		3851	0.9978	-0.7012 1.5377	-0.1295 1.0630
3822	0.9305	0.7144 0.4965	-2.9214 3.2849					

Table 8
3-Digit Level Industry Estimation of Nested Model
(Std. Errs. Below estimates)

Ind	SHARE	IDIODEM	Observations
311	-3.0068 0.2178	-0.0547 0.0572	104
312	2.3893 2.2199	1.1092 0.4240	13
313	-1.8816 1.2601	0.3915 0.2597	26
321	0.3176 0.4700	1.0398 0.1477	78
323	-9.1796 0.9281	1.4072 0.2630	26
331	-5.3076 0.7584	0.2199 0.1179	39
341	-3.5558 0.9333	-0.0142 0.3659	39
351	-7.0278 3.3532	0.2917 0.2054	39
352	-1.3284 0.7691	0.4327 0.2557	52
355	0.6150 10.5759	0.0329 1.7569	13
369	-3.3974 1.0456	0.0961 0.1802	39
381	-2.8833 0.3273	-0.0819 0.0744	52
382	-1.0196 0.4462	0.3531 0.0965	78
383	0.0027 0.5541	-0.0857 0.1887	52
384	-2.4763 1.2490	-0.1208 0.2649	26
385	-0.1588 0.9507	-0.5919 1.3681	13

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