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INDUSTRIALIZATION IN DEVELOPING COUNTRIES: SOME EVIDENCE FROM A NEW ECONOMIC GEOGRAPHY PERSPECTIVE

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Contents

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(United Nations Conference on Trade and Development)

Abstract

The paper draws broad predictions from the developmental elements of new economic geography models and subjects them to empirical scrutiny. Industrial activity has spread from developed to geographically close developing countries in sectors that are intensive in immobile primary factors and not too heavily dependent on linkages with other firms. Only developing countries with an already established industrial base achieved industrialization in other sectors. The sizable change in both the size and structure of manufactured exports from developing countries has not been associated with corresponding changes in manufacturing value added. To benefit more from relocating industrial activities, developing countries need to create the critical mass of linkages that provide pecuniary externalities to industrial firms.

I. INTRODUCTION

Changes in the sectoral composition of trade and production constitute a centrepiece in the structural transformation that accompanies economic development (see Syrquin (1988) for a survey). Differences in relative factor endowments, technology or policy regimes have traditionally been seen as determining differences in the pattern of economic activities across countries. Such explanations have recently been supplemented by contributions to the new economic geography, which emphasize mechanisms that lead to agglomeration of industrial activities in geographic space and show why even initially similar countries can develop very different production and trade structures. These models (e.g. Fujita, Krugman and Venables 1999) formalize forward and backward linkages between industrial firms that had long been discussed by development economists (e.g. Hirschmann 1958) and show that firms benefit from being close to each other because of direct input-output linkages among them.

In this framework, the current process of globalization – in particular the decline in trade barriers and the growing role of intermediate inputs in world trade – has a crucial effect on the geographical location of industrial activities. A decline in trade barriers below a certain threshold reduces linkages pulling towards agglomeration and strengthens forces related to relative endowments of immobile factors that pull towards a less concentrated distribution of industrial activities in geographic space. Thus, globalization tends to change the balance between dispersion and agglomeration forces and to favour the spread of industrial activities from developed to developing countries. However, this spread of industry is unlikely to be a smooth process and affects neither all developing countries nor all industrial sectors at the same time or to the same extent. In particular, the intensity of intermediate input use differs across industrial sectors so that rapid growth in world trade of intermediate production inputs may cause specialization trends in trade to differ from those in production. This raises important empirical questions as to the impact of the current wave of globalization on the development of countries' production and trade structures and on the geographic concentration of a particular economic activity. The main objective of this paper is to examine these questions with a focus on industrialization in developing countries.

Empirical studies on the relationship between trade, industrial location and development accompanied the theoretical work of Hirschmann (1958) and other early development economists and, indeed, were a prominent feature of the development literature in the 1950s and 1960s. By contrast, work in the area of the new economic geography has remained mostly theoretical. Given the focus of the major part of new economic geography models on the different fortunes of economies with similar underlying characteristics, there is little systematic empirical evidence on changes in locational patterns at the international scale, except for a number of studies that focus on the European Union or other member states of the OECD (for a survey see Overman et al. 2003).

This paper goes beyond existing studies in a number of ways. First, it emphasizes the developmental elements of the new economic geography literature and draws broad predictions for empirical analysis from this framework. However, its main contribution is to the empirical literature as it supplements (i) empirical work of the early development literature on the relationship between trade, industrial location and development by looking at the more recent years that have been characterized by a strong decline in trade barriers, and (ii) empirical work within the new economic geography literature by basing the statistical and econometric analysis on a wide geographical coverage that includes countries at different levels of development, as well as by focusing on the difference in evolution of manufactured exports and manufacturing value added.[1] Finally, the paper estimates an empirical model on the centre-periphery dimension in sectoral location patterns for a sample that includes countries at different levels of development and on the basis of two different measures.

The remainder of the paper is in six sections. Section II presents the theoretical setting and distils broad predictions regarding changes in the spatial distribution of manufactured exports and manufacturing value added. Section III concentrates on data and measurement issues. Section IV discusses aggregate evidence on changes in the distribution of world exports of manufactures and manufacturing value added during 1980–2000. Section V examines locational Gini coefficients for countries and for manufacturing sectors. Section VI presents and estimates the empirical model on the importance of centre-periphery gradients in sectoral location patterns. The last section summarizes the main conclusions.

II. THEORETICAL FRAMEWORK AND EMPIRICAL PREDICTIONS

II.1. The general framework of new economic geography models

What determines the structure of trade and production of an economy that is open to international trade and what impact does a decline in trade costs have on this structure when there are forward and backward linkages among industrial firms? Trade theory answers these questions by referring to the relationship between characteristics of countries and characteristics of goods. However, different trade theories include a more or a less wide range of factors in their definition of country and goods characteristics.

Traditional Heckscher-Ohlin (H-O) theory focuses on relative endowments of internationally immobile production factors across countries and on differences in factor intensities across goods. Set

[1] Existing empirical work in the new economic geography literature that examines both developed and developing countries has a more limited focus. Hanson (1996, 1997) only looks at the United States and Mexico, Redding and Venables (2004a) concentrate on the cross-country distribution of income, and Redding and Venables (2004b) only look at countries' export performance.

in the general framework of a competitive market structure, which implies constant returns of scale at the firm level, the theory predicts that an economy exports goods whose production uses intensively the factor with which the country is comparatively well endowed and imports the other goods. Differences in countries' relative factor abundance also determine the extent to which industrial activities are spread across the global economy or concentrated in just a few countries. H-O does not consider forward and backward linkages, which are of no importance in a world of perfect competition. While fully applying only in a world of costless trade, the theoretical framework implies that a decline in trade costs leads to increased specialization of countries in sectors of relative factor abundance.

The new trade theory provides a systematic treatment of increasing returns to scale at the firm level and imperfectly competitive market structures. Regarding the pattern of trade, new trade models give a theoretical explanation of how market size can provide a basis for comparative advantage. Building on this insight, the new economic geography models focus on pecuniary externalities that occur in increasing returns to scale industrial sectors and are created by the existence of forward and backward linkages – manufacturing firms use both primary factors and other manufactures as production inputs and sell their output to both consumers and other manufacturing firms – and make firms decide to locate close to other firms that supply some of their inputs and provide some of their markets.

The new economic geography models predict that firms in increasing returns to scale industries that face positive trade costs will tend to locate in a large market. As shown by Krugman and Venables (1995), this is (i) because of forward (cost) linkages – having more firms in a location means more competition and implies that more intermediate inputs are available locally and that these intermediate inputs tend to be cheaper than elsewhere allowing downstream firms to produce more efficiently and enjoy higher short-run profits, and (ii) because of backward (demand) linkages – having more firms in a location enlarges the market for intermediate goods, allowing upstream firms to produce at a more efficient scale and raise short-run profitability – in order to save trade costs. As a result, economies with large markets will get a disproportionally large share of increasing return activities. However, forces related to product and factor market competition work in the opposite direction, i.e. towards a dispersion of industrial activity. This is because the presence of a large number of firms will tend to drive wages up and output prices down, thereby lowering the short-term profitability of firms. Tension between forward and backward linkages on the one and product and factor market competition on the other hand determines the degree to which industrial activity is characterized by agglomeration or dispersion. The result of this tension on industrial location is likely to be non-monotonic. "At high trade costs, the dominant force in determining location is the need to be close to final consumption, preventing any strong geographical concentration of manufacturing. At low trade costs, the dominant determinant of location is wage costs, again mandating dispersed manufacturing to keep labor costs down. Therefore the linkage forces that can cause agglomeration are strongest relative to other forces at intermediate values of trade costs" (Fujita, Krugman and Venables 1999:258–259).

Accordingly, in new economic geography models, the structure of production in individual countries is determined, as in traditional trade theory, by the interaction between country characteristics and industry characteristics. But while traditional trade theory focuses on relative factor endowments of countries and factor intensities of goods, the mechanisms of new economic geography models also take account of market size and countries' geographical distance from the markets of main developed countries, as well as of transport intensity of industrial sectors, including the size of transport costs and the dependence on intermediate inputs.

What does this imply for the evolution of industrial structure in developed and developing countries as globalization forces gain strength? As Puga (1999:305) points out "the reliance on very special – and sometimes opposite – assumptions makes … [the new economic geography] literature appear as a collection of special cases; and it is not always clear what each case buys, nor how they relate to each other. Furthermore, as the models have become more complex they have also relied increasingly on numerical methods, making comparisons even more difficult." Consequently, there is no unified theoretical model with a consistent set of assumptions that could be applied to test a set of specific empirical predictions regarding the evolution of countries' industrial structure and trade patterns.[2]

While keeping the absence of a unified theoretical model in mind as a caveat for the interpretation of the empirical findings, a number of general predictions can be distilled from this literature regarding development issues. These broad predictions can be based on an analysis of how specific exogenous changes impact on the balance between forces that pull towards agglomeration and those that pull towards dispersion. Cost and demand linkages between industries pull towards agglomeration, while cross-country differences in the endowment of immobile production factors, the cost of trade between countries, and the strength of final consumer demand in locations other than the industrial centre pull towards dispersion. The remainder of this section discusses (i) the change in balance between agglomeration and dispersion brought about by the decline in communication and transport costs and the resulting increased tradability of intermediate production inputs that has given rise to international production fragmentation, (ii) how these changes might have impacted on the spread of industrial activities from developed to developing countries, and (iii) how trade liberalization and preferential trade arrangements, whose importance in the world trading system has risen strongly over the past few years, might have influenced the spread of industry in addition to the decline in communication and transport costs. All three subsections distil broad predictions on the evolution of manufactured exports and manufacturing value added that the following sections subject to empirical scrutiny.

II.2. Trade in intermediate inputs and international production fragmentation

The decline in communication and transport costs over the past few years has made it economically viable to break up integrated production processes and undertake downstream production activities in one country, and upstream production activities in another (see, for example, Jones and Kierzkowski 2001). The optimal location of industrial activities is likely to change when this kind of production fragmentation occurs in industrial sectors with increasing returns to scale at the firm level because transport and communication costs on intermediate goods determine where pecuniary externalities occur. The new balance between agglomeration and dispersion forces is then determined by the degree to which final goods production relies on intermediate goods inputs, the relative factor intensities of upstream and downstream production, whether or not transport and communication costs also decline for final goods, and where final output is consumed.

Following Venables (1996 and 1998), this mechanism can be described as follows: if there is variation in factor intensity across production stages and the downstream activity (e.g. assembly) is more labour intensive than the upstream activity (including the provision of product designs and process technology, and the production of intermediate goods) but trade costs (i.e. transport and communication costs, tariffs, non-tariff barriers, etc.) fall only for the upstream product, the downstream activity moves from the developed to the developing country, while the upstream activity

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[2] For reviews of the new economic geography models see Ottaviano and Puga (1998), Henderson et al. (2001) and Neary (2001) of which, however, only brief sections in the first two reviews address development issues.

remains in the developed country. The reason for this is that a decline in trade costs makes firms less sensitive to the pecuniary externalities created by forward linkages and more sensitive to international differences in factor prices. The level of final goods production activities in the developing country depends on the costs of shipping the final good. If these are high, final goods production in the developing country will become more profitable because of the availability of cheaper production inputs, but not rise above the amount sufficient to supply the developing country market, while the developed country will retain final goods production to supply its domestic market. Taken together this means that the developed country produces all intermediate goods, while the developed and the developing country share final goods production.

If trading costs for the final good also fall below a certain threshold, final goods production in the developing country will increase.[3] This is because final goods producing firms in the developed country will find shipping the intermediate good to the developing country and the final good back home more profitable than producing both the intermediate and the final good at home. On the other hand, a decline in trade costs for the final good will make final goods imports from the developed country cheaper and raise competition for final goods producers in the developing countries, reducing their profitability. The outcome for final goods producing firms in the developing country will be more favourable the higher is the share of imported intermediate goods in the production of the final good and the larger is the market for the final good in the developing country. By contrast, if final goods demand in the developing country is small, the cost saving effect of fragmentation must be very high in order to make up for shipping the intermediate good from the developed to the developing country and the final good back to the developed country. In other words, the wage difference between the two countries must be high and/or trade costs must be very low, for example, because of close geographical proximity between the developed and the developing country, for international production fragmentation to occur.

The resulting broad empirical predictions are:

- A strong rise of exports from both developed and developing countries in sectors where production stages are easily separable, components are less labour-intensive than final goods, and demand for final goods is small in the low-wage (i.e. developing) country;
- Manufactured exports grow more rapidly in developing than in developed countries;
- Manufacturing value added declines in developed and rises in developing countries but the bulk of manufacturing value added remains in developed countries;
- Manufactured exports in developing countries grow much more rapidly than manufacturing value added.

II.3. The spread of industry from developed to developing countries

According to new economic geography models, economic development is not a smooth process of many developing countries catching up with the industrialized countries. Rather, starting from a situation where a rich and a poor group of countries coexist, the models outline mechanisms that make industrialization spread in waves from country to country causing a few countries to make a rapid transition from the poor to the rich club (Puga and Venables 1996 and 1999; Puga 1999; see also Amiti 1998). As outlined above, these mechanisms work on the basis of the interplay between pecuniary externalities and trade costs but with a crucial role also for differences in wages between the

[3] Amiti (2003) discusses a similar case.

industrialized and the developing countries. Agglomeration of industrial activities in a developed country becomes less sustainable the larger is the wage gap with the developing country, the lower are trade costs between the developed and developing country, the lower are forward linkages (because of a low degree of intermediate input use in final good production) and backward linkages (the benefit from being close to industrial consumers) in the developed country, and the higher are forward and backward linkages in the developing country.

Initially, the industrialized countries have higher wages than the developing countries but the positive pecuniary externalities created by linkages among industrial firms compensate for the higher wage costs. The spread of industry is triggered by an exogenous increase in world demand for manufactures, relative to demand for other tradable goods, which increases demand for labour in the established industrialized countries and opens up a larger and larger wage gap between the industrialized and the other countries. At some point the wage gap becomes too large to be compensated by the benefits coming from linkages in the industrialized country, and industrial firms start to relocate to low-wage economies.

However, the dispersion of industry does not lead to steady industrial development in all low-wage economies. Very small initial cross-country differences will determine which of the low-wage countries attract relocating firms – if all countries are identical, it will simply be a matter of chance. As succinctly put by Henderson et al. (2001:86): "The pertinent dimensions of difference are those which determine the profitability of the first firms to relocate, so include labour market factors, internal infrastructure …, as well as institutional characteristics of a country. Since the first entrants will be highly dependent on imported intermediate and capital goods and on export markets for final sales, they will tend to go to locations close (or with good transport links) to established centres. … The first sectors to become detached from an existing agglomeration will typically be those that are intensive in immobile primary factors (the prices of which are high in the centre), and that are not too heavily dependent on linkages with other firms. These may be firms with low usage of intermediate goods, low levels of sales to other industrial sectors, or that do not need to cluster with related activities to gain new technology. As these sectors relocate, so they may begin to create linkages and attract other sectors. The sequence in which industries enter then depends on their factor intensities, their tradability, and the way in which they benefit from linkages to other activities, and create their own linkage effects."

The importance given to differences in wages across countries and differences in factor intensity and intermediate input use across industrial sectors departs from the standard new economic geography models that focus on two countries with similar underlying characteristics and on the industrial sector as a whole. This allows for the formulation of predictions that can be tested empirically for a sample that includes different industrial sectors and countries with different underlying characteristics.

However, the spread of industry will follow the path outlined in the preceding paragraphs only if initially linkages do not exceed a critical mass in any developing economy. If this is the case, firms looking for lower prices of immobile factors will move industrial activity earlier than firms looking to exploit linkages in the developing country who will move industrial activity only after the creation of sizable linkage effects in developing countries. By contrast, if there is a developing country that has the critical mass of domestic linkages already before the spread of industry sets in, both types of firms move industrial activity at the same time but to different developing countries: firms primarily wanting to exploit factor price differences will go to the developing countries with few linkages and among them to those that are geographically close, while firms primarily looking to benefit from linkages in the new location will go to the already relatively more industrialized developing country with geographical proximity playing a secondary role.

The impact on the developing country's structures of manufactured exports and manufacturing value added depends on the type of firm that moves industrial activity. If the developing country does not have a critical mass of linkages that provide pecuniary externalities to industrial firms because of insufficient domestic production of intermediate inputs or insufficient domestic demand from either other industrial firms or final consumers, the developing country will import a large fraction of production inputs and export the bulk of output without much domestic value added. As a result, the country's manufactured exports will strongly rise, while manufacturing value added will go up only little. By contrast, a developing country with established domestic linkages will provide a large share of intermediate inputs from domestic production and a large share of output will go into further domestic production or consumption. As a result, the country's manufactured exports will rise much less, while its manufactured value added will rise much more than in the first case.

The resulting broad empirical predictions on the spread of industry are:

- Developing countries geographically close to a main developed country market benefit from industrial dispersion in labour-intensive sectors earlier than others provided that non-tradable goods and immobile factors are readily available;
- If all developing countries have a low level of wages and linkages, the spread of industry will differ in time with early movers looking for both close geographic proximity and lower prices of immobile factors relative to more industrialized countries, and later movers (after a critical mass of firms is created in some sectors) looking to exploit newly created linkages in the economically less developed regions. If developing countries differ regarding the level of wages and linkages, firms with different underlying motivations will move industrial activity at the same time with firms primarily looking for lower prices of immobile factors moving activity to the geographically close and relatively less industrialized developing countries, and firms looking to exploit linkages in the new location moving activity to the relatively more industrialized developing countries. The spread of industry from firms looking to exploit linkages will lead to a strong change in the developing country's manufacturing value added and a small change in its manufactured exports, while the opposite holds when the other firms move.

II.4. Trade liberalization and preferential trading arrangements

The characteristics of an individual country's external trading regime strongly influence the country-specific effects of shifts in the balance between agglomeration and dispersion forces discussed above. This is because trade barriers (such as tariffs and non-tariff measures) are essentially just another form of trade costs, which come in addition to communications and transport costs. Accordingly, the forces triggered by trade liberalization and preferential trading arrangements (PTAs) are very similar to those coming from a decline in transport and communication costs. The main additional feature of trade barriers is the possibility of discriminatory policies favouring one country over another. Therefore, the following discussion of the mechanisms features two developing countries, in addition to one developed country, in order to emphasize the effects of discriminatory trade policy. Following Puga and Venables (1997, 1998), two cases without discrimination (multilateral and unilateral trade liberalization) and two cases with discrimination (PTAs between the developed and one of the developing countries, and PTAs among the two developing countries) are considered.

Multilateral trade liberalization leads to an equal decline in the trade barriers on both the intermediate and the final good in all three countries and has the same effects as a decrease in transport and communication costs for the two goods, as discussed above. Unilateral trade liberalization for the intermediate good in one of the developing countries has the same effect as a decline in transport costs for the intermediate good. The effects of unilateral trade liberalization by one of the developing countries for both the intermediate and the final good are less clear because cheaper intermediate goods imports decrease production costs for final goods producers in the liberalizing country, while cheaper final goods imports decrease their domestic sales. Given only unilateral trade liberalization, this decline in profitability cannot be compensated by higher exports. Indeed, as pointed out by Puga and Venables (1998:231): "Under unilateral liberalization the continuing barriers to developing countries' exports mean both that it takes a lower tariff rate to start industrialization [in developing countries] and that, once industrialization has started, … [the developing country] has a lower share of manufacturing than it would in the multilateral case."

When the two developing countries engage in a PTA with each other, industrial activity rises if the enlargement effect from combining the size of the two markets is sufficient to create additional pecuniary externalities for firms through either rising demand or falling costs. If PTAs between developing countries lower restrictions on the movement of labour, labour migration between the two developing countries can cause such a decline in costs by enlarging the pool of workers required by firms. When the developed and one of the developing countries form a PTA, the effects for the two countries are essentially the same as in the case of multilateral trade liberalization. By contrast, the other developing country will be relatively worse off because it will not attract additional industrial activities and lose market shares for its industrial exports in the developed country market.

The resulting broad empirical predictions on the spread of industry that weaken or reinforce the pure geographical effects, which were discussed in the last section, are:

- Industrial activity moves most in sectors where trade barriers on intermediate goods are low in developing countries or where trade barriers on final goods are low in developed countries – these are likely to be sectors where international production fragmentation has played an increasingly important role, i.e. wearing apparel[4] (Gereffi 1999), electrical and non-electrical machinery (Ernst and Ravenhill 1999), and transport equipment (Spatz and Nunnenkamp 2002);
- Industrial activity in developing countries rises more in sectors favoured by preferential trading arrangements among developing countries provided that the market enlargement creates additional pecuniary externalities for industrial firms;
- Under preferential trading arrangements between a developed and a developing country, the developing country that is part of the arrangement attracts more industrial activity than excluded developing countries, provided that differences in the geographical distance and/or the wage level and/or the excluded developing country's market size do not outweigh the effects coming from discriminatory trade policy. Empirical scrutiny of this prediction requires an examination of sector-specific data on effectively applied tariffs and on bilateral trade that is beyond the scope of this study.

[4] Tariff escalation and tariff peaks are a prominent feature of trade barriers in apparel trade in general, but import-weighted actually applied tariffs on clothing and footwear in PTAs are relatively low (Mayer 2004, table 5).

III. DATA AND MEASUREMENT ISSUES

Most empirical papers that address the spatial dispersion of industrial activities at an international level are based on trade data either to analyse the pattern of trade flows itself or to use trade data as an indicator of specialization patterns in production. Trade data have the advantage of being relatively reliable and easily available at highly disaggregated levels for a wide range of countries. However, trade data are only an indirect measure of the underlying production changes. In order to measure specialization patterns on the basis of production data, it is possible to opt for employment, output or value-added data but value-added is probably the most precise measure of the size of an industrial sector and of specialization in production, as well as the measure most closely related to income and hence development.

Nicita and Olarreaga (2001) provide a database that covers a wide range of countries and includes both trade and value-added data for a consistently defined set of industrial sectors. The analysis of sections V–VII of this paper draws on this dataset and covers a sample of 34 countries and 22 industrial sectors for the period 1980–1998 (see Appendix 1).

A potential problem of the dataset is that some sector-specific data are not available for all of the 34 countries (see Appendix 1 for detail). However, these missing values usually concern sectors of comparatively little importance, such as pottery and glass products, or countries whose production and export activities are of comparatively little importance in a specific sector, such as Costa Rica in iron and steel. The main exception to this is the lack of data for China regarding wearing apparel and footwear. This implies that the sectoral analysis for wearing apparel and footwear refers to only 33 of the 34 countries in the sample. Regarding the other sectors, data are often unavailable for several years either for the beginning or the end of the sample period. This means that it is not possible to intrapolate the missing data and that extrapolating the missing data is fraught with great uncertainty. The approach adopted was not to fill the gap but, given the interest in comparing development in exports with developments in value added, to make the dataset on exports compatible with the dataset on value added. Should these data gaps, nonetheless, be important, they are likely to bias observed specialization in favour of a discontinuation of previous or later trends.

Turning to measurements issues, changes in the spatial distribution of economic activity in the world economy can be analysed on the basis of changes in the shares of countries or economic sectors in world totals or on the basis of changes in locational Gini indices, i.e. the indicator that, following Krugman (1991), has become the standard measure of the spatial dispersion of industry (see Amiti 1999, for discussion). The following section focuses on changes in shares to analyse general developments in manufacturing activities, while the analysis in sections V and VI uses locational Gini coefficients.

Locational Gini coefficients can be calculated for countries or for sectors and are based on a modified version of the Balassa index. To calculate sector-specific locational Gini coefficients, the Balassa index can be rewritten as

$$B_{ij} = (q_{ij}/q_i) / (q_j/Q)$$

where q_{ij} is industry i value added in country j, q_i is total industry i value added in the 34-country sample, q_j is total manufacturing value added in country j, and Q is total manufacturing value added in the 34-country sample. The Balassa index, then, needs to be ranked in descending order plotting the cumulative of the numeraire on the vertical axis against the cumulative of the denominator on the horizontal axis to get the Lorenz curve. The Gini coefficient corresponds to twice the area between a 45-degree line and the Lorenz curve. The coefficient varies between zero and one where values closer to unity indicate higher degrees of concentration. To calculate country-specific Gini coefficients, the Balassa index needs to be rewritten as

$$B_{ij} = (q_{ij}/q_j) / (q_i/Q)$$

and aggregated across countries instead of across industries, with the remaining steps as explained above. The development of specialization patterns over time can be measured by the growth rate of the Gini coefficients calculated by regressing the log of each Gini coefficient on a linear time trend.

Locational Gini coefficients indicate the degree of specialization but are silent on the ordering of industries along the specialization spectrum. Thus, to complete the picture on specialization patterns, Krugman (1991) suggests using an index that captures the similarity of industrial specialization structures across country pairs. It can be written as

$$S_{HF} = \sum_i \left| s_H^i - s_F^i \right|$$

where H and F denote the two countries, i refers to sectors, and s is the share of a particular sector in total exports of manufactures or in total manufacturing value added in that country. This measure calculates the absolute value of the difference in sectoral shares and varies between zero and two; a value of zero indicates identical sector compositions of the two economies, and a value of two indicates complete dissimilarity of sectoral structures.

IV. World exports of manufactures and world manufacturing value added

This section addresses the predictions that following the decline in trade barriers and the rise in importance of intermediate production inputs in world exports associated with international production fragmentation: (i) manufactured exports have grown more rapidly in developing than in developed countries, (ii) manufacturing value added has declined in developed and risen in developing countries but the bulk of manufacturing value added has remained in developed countries, and (iii) manufactured exports in developing countries have grown much more rapidly than manufacturing value added.

The examination draws on statistics on the share of different country groups and individual countries in world exports of manufactures and world manufacturing value added. One part of these statistics relies on a variety of sources that present aggregate data, while the other part of the statistics refer to the Nicita and Olarreaga (2001) dataset that will be used also for the disaggregated analysis in the following two sections. Comparing the results from the different data sources helps to assess to what extent the 34-country sample confers a representative picture of the world. The four columns on the left-hand side of table 1 compare the share of different country groups and individual economies in world exports of manufactures with their share in world manufacturing value added in 1980 and 2000. The export data refer to the definition of manufactures used in the Standard International Trade Classification (SITC), while the data on manufacturing value added refer to the definition used in the

Table 1

Share of selected regional groups and developing economies in world exports of manufactures and manufacturing value added, 1980–2000

(Percentage share)

	World				*Sample of 34 countries*			
	Share in exports of manufactures		*Share in manufacturing value added*		*Share in exports of manufactures*		*Share in manufacturing value added*	
Region/economy	*1980*	*2000*	*1980*	*2000*	*1980*	*1998*	*1980*	*1998*
Developed countries	82.3	67.7	64.5	72.4	90.4	76.0	90.1	87.7
Core developed countries	69.4	49.4	n.a.	62.9	75.7	61.5	80.5	79.7
France	8.2	5.3	6.6	3.6	8.9	6.7	6.7	4.8
Germany	16.3	9.9	n.a.	6.8	17.4	13.1	11.4	11.8
Italy	6.6	4.6	5.2	3.5	7.1	6.0	4.5	2.8
Japan	12.4	9.6	12.8	17.4	13.3	10.2	15.4	16.3
Netherlands	3.7	2.7	1.3	1.1 [c]	4.0	3.2	1.2	0.8
United Kingdom	8.3	4.9	5.2	4.0	8.6	6.4	7.1	4.3
United States	14.0	12.6	24.3	26.5	16.4	15.9	34.2	38.9
European periphery	2.5	3.9	n.a.	2.8	2.8	4.6	2.9	2.6
Greece	0.2	0.1	0.3	0.2	0.3	0.2	0.2	0.2
Ireland	0.5	1.4	n.a.	0.5	0.5	1.5	0.2	0.6
Portugal	0.3	0.4	n.a.	0.3 [c]	0.4	0.6	0.2	0.3
Spain	1.5	1.9	n.a.	1.8 [c]	1.6	2.4	2.2	1.6
Developing countries	10.6	29.5	16.6	24.5	8.3	22.8	8.6	11.6
Latin America	1.5	4.3	7.1	6.2	0.6	3.2	1.6	1.4
Argentina	0.2	0.2	0.9	0.8	n.a.	n.a.	n.a.	n.a.
Brazil	0.7	0.7	2.9	1.4	n.a.	n.a.	n.a.	n.a.
Mexico	0.2	3.0	1.9	1.8	0.4	2.8	0.5	0.6
South and East Asia	6.0 [a]	19.1	7.3	15.4	7.7	19.1	3.5	9.6
NIEs	5.1	9.4	1.7	4.6	6.0	10.1	2.0	5.5
Hong Kong (China)	0.2	0.5	0.3	0.2	1.5	1.3	0.4	0.2
Republic of Korea	1.4	3.3	0.7	2.4	1.7	3.2	0.8	3.3
Singapore	0.9	2.5	0.1	0.4	0.9	2.6	0.2	0.5
Taiwan Province of China	1.6	3.0	0.6	1.6 [d]	1.9	3.0	0.6	1.5
ASEAN-4	0.6	4.3	1.2	2.1	0.5	2.4	0.3	0.6
Indonesia	0.1	0.8	0.4	0.7	n.a.	n.a.	n.a.	n.a.
Malaysia	0.2	1.7	0.2	0.5	0.3	1.6	0.1	0.4
Philippines	0.1	0.7	0.3	0.3	0.2	0.7	0.2	0.2
Thailand	0.2	1.1	0.3	0.7	n.a.	n.a.	n.a.	n.a.
China	1.1 [b]	4.7	3.3	6.2	0.7	5.9	0.6	2.8
Countries in Eastern Europe and the former Soviet Union	7.1	2.8	18.9	3.1	1.3	1.2	1.3	0.6

Source: Data in columns (1) and (2) are from the United Nations *Monthly Bulletin of Statistics*, data in columns (3) and (4) for the aggregates of developed countries, developing countries, Latin America, South and East Asia, and countries in Eastern Europe, as well as the data for China, are from the UNIDO *International Yearbook of Industrial Statistics* table 1.1, while the other individual country data are from the World Bank *World Development Indicators* table 4.3. The data for columns (5)–(8) are from Nicita and Olarreaga (2001).

***Notes*:** Data in all columns are based on the definition of manufactures used in trade statistics, except the data in columns (3) and (4) which are based on the definition used in industrial statistics. However, calculating the share in world manufactured exports based on the definition used in industrial statistics yields very similar results for countries for which comprehensive data are available.

[a] Excluding China. [b] 1984. [c] 1999. [d] 1997.

International Standard Industrial Classification (ISIC). However, calculating the share in world exports of manufactures based on the definition used in industrial statistics yields very similar results for countries for which comprehensive data are available. The four columns on the right-hand side of table 1 make the same comparison for the 34-country sample regarding 1980 and 1998. All data in these four columns refer to the definition of manufactures used in trade statistics.[5]

The first two columns of table 1 show that the share of developing countries in world exports of manufactures has risen, while that of developed countries has fallen. This supports the prediction that manufactured exports have risen more from developing than from developed countries. Columns (3) and (4) show that the share of both developed and developing countries in world manufactured value added has risen by about eight percentage points. This increase contrasts with the strong decline in the absolute share of countries in Eastern Europe and the former Soviet Union. Hence, looking only at the relationship between developed and developing countries, the increase in the share of developing countries has proportionally been much stronger. This result broadly supports the prediction that manufacturing value added has declined in developed and risen in developing countries and that the bulk of manufactured value added has remained in developed countries.

Comparing the evidence across columns (1)–(4) reveals that growth in a country's share in world exports of manufactures does not necessarily imply a corresponding increase in its share in world manufacturing income. While the share of developed countries in world exports of manufactures fell between 1980 and the late 1990s, their share in world manufacturing income rose significantly. Thus, in relative terms, developed countries seem to be trading less but earning more in manufacturing activity. Developing economies' shares both in world manufacturing exports and income strongly rose during the same period, but growth in exports was much stronger than in income. This supports the prediction that developing countries have increased their manufactured exports by much more than manufacturing value added.

Columns (5)–(8) of table 1 show the same general pattern suggesting that changes within the 34-country sample can be used as an approximation for changes in the world economy. The one major difference compared to the results on the left-hand side of the table is that columns (7) and (8) show a slight decrease in the share of developed countries in total manufacturing value added. However, this comes as no surprise given that developed countries are over-represented and – due to limitations on data availability – countries in Eastern Europe and the former Soviet Union are under-represented in the 34-country sample compared to their actual share in world manufacturing value added (in particular at the beginning of the sample period). However, the results that refer to the percentage shares of country groups within the 34-country sample as reported in columns (7) and (8) mirror the percentage shares in world total manufacturing value added at constant 1990 prices, as reported by UNIDO (2002:32). These results strengthen empirical support for the above findings that refer to changes in the relative shares of developed and developing countries in the world economy as a whole.

Turning to country-specific evidence, there appears to be little correlation between the growth of manufactured exports and manufacturing value added for any of the developing economies. All Asian economies in table 1 increased their shares in world exports of manufactures; in Latin America this was true only for Mexico, while the other major economies in Latin America, notably Argentina and

[5] The data in the original dataset of Nicita and Olarreaga (2001) refers to the definition of manufactures used in industrial statistics. For the difference between the definition of manufactures in trade and industrial statistics and the corresponding adjustments made to the original dataset see Appendix 1.

Brazil, have been unable to increase their shares in world exports of manufactures. Similarly, with the exception of Hong Kong (China) and the Philippines, all East Asian countries increased their shares in world manufacturing value added, but none in Latin America was able to do so. This gives empirical support to one of the key implications of new economic geography models, namely that the move of industrial activity away from developed countries does not benefit all developing countries at the same time or in the same way.

V. LOCATIONAL GINI COEFFICIENTS

Given that the intensity of intermediate input use differs across industrial sectors, the prediction that the spread of industry from developed to developing countries affects neither all developing countries nor all industrial sectors at the same time or to the same extent would be reflected in a difference between specialization trends in trade and those in production at both the sectoral and country levels.

Looking at country-specific evidence first, table 2 reports the Gini coefficients for exports of manufactures calculated as two- or three-year averages around the dates indicated for each of the 34 countries and as unweighted averages for selected country groups. The coefficients have fallen for most countries suggesting a more equal spread of trading activities in manufactures in the world economy and a decrease in countries' specialization. The decline in the Gini coefficient is particularly strong for developing countries, for which the average fell from 0.65 in 1980 to 0.52 in 1998, while it remained unchanged for the group of developed countries. Regarding individual countries, the Gini coefficient declined most for Malaysia, Mexico, the Republic of Korea, and Taiwan Province of China.

By contrast, the locational Gini coefficients for manufacturing value added have fallen for a much smaller number of countries, (table 3).[6] Moreover, the unweighted average of the coefficients remained unchanged for developing countries, while it rose for developed countries during the period 1980–1998, suggesting a less equal spread of manufacturing production in the world economy and an increase in countries' specialization.

Taken together, the country-specific evidence supports the prediction that changes in geographic concentration of economic activity differ across countries. Moreover, the results for manufacturing value added show that little industrial activity has spread to developing countries – the main changes occurring in the Republic of Korea that, followed by Taiwan Province of China, experienced the strongest sustained fall in its Gini coefficient for manufacturing value added – even though a number of developing countries, notably Malaysia and Mexico, experienced a sizable change in their structure of manufactured exports. Thus, a change in a country's structure of manufactured exports does not necessarily imply a corresponding change in its structure of manufacturing income.

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[6] The recent finding by Imbs and Wacziarg (2003) that countries exhibit a U-shaped pattern in their evolution of sectoral concentration (comprising agriculture, manufacturing and services) in relation to the level of per capita income and that this applies also to the manufacturing sector alone, although in a less significant way, calls into question the appropriateness of calculating linear growth rates such as reported in table 3. However, closer analysis suggests that such a U-shaped development cannot be observed for the countries included in the sample used in this paper. Plots of the country-specific developments are available from the author on request.

Table 2

Country Gini coefficients for exports of manufactures

Region/economy	*1980–81*	*1984–86*	*1989–91*	*1994–96*	*1997–98*	*Average annual growth rate (Per cent)*	*t-value*
Developed countries	**0.35**	**0.37**	**0.35**	**0.36**	**0.35**	**-0.2**	
Core developed countries	**0.23**	**0.25**	**0.22**	**0.21**	**0.21**	**-0.8**	
France	0.15	0.16	0.17	0.19	0.18	1.4	6.9
Germany	0.12	0.13	0.13	0.16	0.16	1.6	6.5
Italy	0.29	0.32	0.29	0.30	0.30	-0.1	-0.5
Japan	0.30	0.30	0.28	0.24	0.23	-1.6	-9.6
Netherlands	0.34	0.41	0.29	0.29	0.28	-2.2	-4.8
United Kingdom	0.19	0.20	0.17	0.17	0.15	-1.4	-3.5
United States	0.20	0.22	0.17	0.14	0.13	-2.9	-9.9
European Periphery	**0.46**	**0.49**	**0.49**	**0.48**	**0.47**	**0.3**	
Greece	0.66	0.72	0.72	0.62	0.58	-0.8	-2.6
Ireland	0.35	0.41	0.40	0.44	0.49	1.6	7.1
Portugal	0.55	0.54	0.55	0.51	0.48	-0.5	-2.2
Spain	0.29	0.31	0.30	0.34	0.33	0.8	4.6
Other developed countries	**0.40**	**0.42**	**0.39**	**0.43**	**0.42**	**0.1**	
Austria	0.30	0.28	0.23	0.21	0.21	-2.4	-8.0
Canada	0.46	0.48	0.47	0.46	0.43	-0.4	-2.7
Denmark	0.28	0.31	0.31	0.32	0.31	0.5	3.0
Finland	0.54	0.49	0.50	0.60	0.66	1.3	3.3
Norway	0.32	0.35	0.35	0.52	0.49	2.9	5.9
South Africa	0.58	0.67	0.55	0.58	0.50	-0.9	-2.3
Sweden	0.33	0.32	0.33	0.32	0.32	-0.2	-2.3
Developing countries	**0.65**	**0.62**	**0.58**	**0.54**	**0.52**	**-1.5**	
Latin America	**0.65**	**0.64**	**0.61**	**0.57**	**0.54**	**-1.4**	
Chile	0.77	0.78	0.75	0.71	0.68	-0.9	-6.5
Colombia	0.63	0.63	0.71	0.64	0.57	-0.2	-0.5
Costa Rica	0.67	0.66	0.63	0.61	0.54	-0.9	-2.8
Mexico	0.55	0.35	0.35	0.23	0.27	-4.7	-5.3
Venezuela	0.63	0.77	0.62	0.65	0.66	-0.3	-0.9
South and East Asia	**0.62**	**0.60**	**0.54**	**0.50**	**0.49**	**-1.7**	
NIEs	**0.55**	**0.51**	**0.45**	**0.42**	**0.41**	**-2.0**	
Hong Kong (China)	0.72	0.66	0.54	0.61	0.61	-1.1	-3.4
Republic of Korea	0.54	0.45	0.42	0.33	0.29	-3.3	-14.3
Singapore	0.40	0.41	0.42	0.45	0.45	0.9	6.7
Taiwan Province of China	0.56	0.53	0.40	0.30	0.31	-4.3	-16.4
ASEAN	**0.71**	**0.64**	**0.60**	**0.51**	**0.51**	**-2.1**	
Malaysia	0.71	0.62	0.57	0.49	0.46	-2.6	-23.5
Philippines	0.71	0.65	0.62	0.53	0.56	-1.7	-9.9
China	0.67	0.71	0.62	0.60	0.54	-1.3	-6.9
India	0.66	0.72	0.71	0.69	0.69	0.1	0.5
Turkey	0.82	0.70	0.72	0.67	0.64	-1.0	-4.6
Countries in Eastern Europe	**0.38**	**0.29**	**0.35**	**0.37**	**0.29**	**0.2**	
Hungary	0.45	0.29	0.34	0.29	0.18	-2.2	-2.0
Poland	0.32	0.30	0.37	0.44	0.41	2.5	4.1

Source: Author's calculations based on data from Nicita and Olarreaga (2001).

Table 3

Country Gini coefficients for manufacturing value added

Region/economy	*1980–81*	*1984–86*	*1989–91*	*1994–96*	*1997–98*	*Average annual growth rate (Per cent)*	*t-value*
Developed countries	**0.22**	**0.25**	**0.25**	**0.27**	**0.28**	**1.0**	
Core developed countries	**0.14**	**0.16**	**0.16**	**0.16**	**0.16**	**0.6**	
France	0.11	0.09	0.10	0.12	0.11	1.1	3.2
Germany	0.14	0.16	0.16	0.16	0.16	0.3	1.5
Italy	0.17	0.21	0.21	0.22	0.24	1.2	4.0
Japan	0.10	0.11	0.12	0.08	0.08	-1.6	-2.9
Netherlands	0.28	0.36	0.31	0.26	0.26	-1.2	-2.2
United Kingdom	0.09	0.09	0.10	0.15	0.15	4.0	5.7
United States	0.10	0.11	0.14	0.11	0.10	0.4	0.6
European Periphery	**0.33**	**0.37**	**0.36**	**0.38**	**0.39**	**0.8**	
Greece	0.42	0.47	0.44	0.43	0.42	-0.2	-1.2
Ireland	0.31	0.34	0.34	0.41	0.46	2.2	8.7
Portugal	0.40	0.45	0.45	0.45	0.44	0.7	3.4
Spain	0.21	0.22	0.21	0.22	0.26	0.7	3.1
Other developed countries	**0.24**	**0.26**	**0.27**	**0.32**	**0.33**	**1.5**	
Austria	0.21	0.23	0.24	0.24	0.25	0.5	2.7
Canada	0.22	0.23	0.23	0.26	0.27	1.0	5.7
Denmark	0.21	0.23	0.24	0.24	0.25	1.3	4.4
Finland	0.34	0.33	0.34	0.46	0.49	2.3	4.5
Norway	0.24	0.28	0.29	0.48	0.48	4.4	7.5
South Africa	0.23	0.29	0.30	0.28	0.31	1.3	3.8
Sweden	0.25	0.25	0.25	0.25	0.26	0.1	0.5
Developing countries	**0.42**	**0.43**	**0.41**	**0.42**	**0.42**	**-0.3**	
Latin America	**0.43**	**0.45**	**0.43**	**0.45**	**0.47**	**0.2**	
Chile	0.43	0.52	0.48	0.49	0.49	0.0	0.1
Colombia	0.39	0.41	0.41	0.42	0.45	0.6	4.2
Costa Rica	0.46	0.50	0.48	0.46	0.47	-0.2	-1.0
Mexico	0.53	0.40	0.39	0.44	0.45	-1.0	-1.8
Venezuela	0.34	0.41	0.39	0.43	0.49	1.5	5.4
South and East Asia	**0.42**	**0.42**	**0.39**	**0.40**	**0.39**	**-0.6**	
NIEs	**0.42**	**0.43**	**0.38**	**0.38**	**0.37**	**-1.1**	
Hong Kong (China)	0.62	0.63	0.57	0.55	0.55	-0.9	-8.1
Republic of Korea	0.35	0.30	0.25	0.23	0.21	-2.9	-13.1
Singapore	0.34	0.37	0.35	0.40	0.39	1.0	2.2
Taiwan Province of China	0.38	0.41	0.34	0.33	0.34	-1.4	-5.0
ASEAN	**0.43**	**0.46**	**0.43**	**0.41**	**0.41**	**-0.5**	
Malaysia	0.43	0.45	0.40	0.41	0.40	-0.6	-3.2
Philippines	0.44	0.46	0.46	0.42	0.43	-0.3	-1.4
China	0.41	0.39	0.39	0.46	0.41	0.3	1.1
India	0.40	0.38	0.36	0.39	0.40	0.0	-0.2
Turkey	0.41	0.40	0.41	0.42	0.43	0.2	1.3
Countries in Eastern Europe	**0.26**	**0.26**	**0.25**	**0.24**	**0.25**	**-0.5**	
Hungary	0.25	0.23	0.21	0.21	0.23	-0.7	-2.8
Poland	0.28	0.30	0.29	0.26	0.27	-0.4	-1.5

Source: Author's calculations based on data from Nicita and Olarreaga (2001).

Turning to the sectoral level, table 4 shows that the Gini coefficients for exports of manufactures declined in half of the 22 sectors, indicating a lower geographical concentration of industries. This contrasts with the evidence of table 5 that shows a decline in the Gini coefficients for manufacturing value added in only 7 of the 22 sectors. Taken together, the two tables show that the Gini-coefficients for both exports and value added have changed relatively little in the vast majority of sectors (the growth rate is below 1.5 percentage points in either direction for 19 out of the 22 sectors in exports and 16 out of the 22 sectors for value added). But they also show that there have been relatively pronounced changes in a few sectors. Moreover, in these sectors the coefficients for exports and those for value added have often changed in opposite directions, indicating lower spatial concentration in exports of manufactures and higher spatial concentration in manufacturing value added. This holds in particular for textiles, wearing apparel, footwear, and electrical machinery for the period between the mid-1980s and the late 1990s. This gives support to the prediction that changes in the geographic concentration of economic activity differ across sectors.

Table 4

Sector-specific Gini coefficients for exports of manufactures

Sector description	*1980–81*	*1984–86*	*1989–91*	*1994–96*	*1997–98*	*Average annual growth rate (Per cent)*	*t-value*
Textiles	0.35	0.43	0.45	0.45	0.43	1.16	4.03
Wearing apparel	0.59	0.65	0.60	0.56	0.55	-0.75	-4.52
Leather products	0.46	0.55	0.58	0.64	0.63	1.76	12.60
Footwear	0.70	0.72	0.71	0.67	0.67	-0.37	-4.90
Wood products	0.63	0.64	0.60	0.62	0.60	-0.29	-2.97
Furniture and fixtures	0.46	0.49	0.46	0.48	0.48	0.00	-0.03
Paper & products	0.58	0.56	0.54	0.52	0.50	-0.96	-10.28
Printing & publishing	0.30	0.31	0.31	0.33	0.32	0.41	2.77
Industrial chemicals	0.24	0.27	0.22	0.25	0.25	-0.28	-0.81
Other chemicals	0.27	0.29	0.27	0.33	0.33	1.01	4.43
Rubber products	0.27	0.23	0.24	0.22	0.23	-0.53	-2.44
Plastic products	0.41	0.44	0.39	0.41	0.40	-0.41	-2.23
Pottery, china etc.	0.44	0.43	0.44	0.47	0.47	0.55	6.10
Glass & products	0.30	0.34	0.27	0.23	0.22	-2.51	-7.27
Non-metallic mineral products	0.40	0.41	0.42	0.45	0.44	0.59	3.84
Iron & steel	0.35	0.37	0.32	0.34	0.33	-0.55	-1.71
Fabricated metal products	0.12	0.16	0.20	0.20	0.20	3.08	7.55
Non-electrical machinery	0.20	0.19	0.17	0.19	0.19	-0.58	-2.04
Electrical machinery	0.23	0.26	0.24	0.25	0.23	-0.07	-0.31
Transport equipment	0.21	0.26	0.25	0.28	0.28	1.37	6.98
Professional & scientific equipment	0.24	0.24	0.24	0.24	0.24	-0.03	-0.31
Other manufactured products	0.38	0.42	0.42	0.46	0.46	0.96	6.12

Source: Author's calculations based on data from Nicita and Olarreaga (2001).

Table 5
Sector-specific Gini coefficients for manufacturing value added

Sector description	*1980–81*	*1984–86*	*1989–91*	*1994–96*	*1997–98*	*Average annual growth rate (Per cent)*	*t-value*
Textiles	0.30	0.26	0.24	0.23	0.24	-1.1	-5.58
Wearing apparel	0.23	0.24	0.26	0.28	0.30	1.3	8.62
Leather products	0.28	0.37	0.35	0.47	0.53	3.3	11.29
Footwear	0.37	0.44	0.46	0.48	0.52	1.9	10.42
Wood products	0.22	0.18	0.20	0.21	0.21	0.1	0.39
Furniture and fixtures	0.18	0.16	0.17	0.19	0.21	1.6	4.49
Paper & products	0.21	0.20	0.21	0.18	0.17	-1.1	-4.19
Printing & publishing	0.19	0.21	0.23	0.23	0.21	0.8	4.06
Industrial chemicals	0.12	0.15	0.13	0.16	0.17	1.3	3.09
Other chemicals	0.08	0.08	0.11	0.10	0.11	2.3	4.91
Rubber products	0.15	0.14	0.14	0.12	0.14	-0.9	-1.91
Plastic products	0.13	0.11	0.09	0.08	0.08	-2.8	-9.11
Pottery, china etc.	0.45	0.45	0.45	0.38	0.41	-0.9	-4.38
Glass & products	0.13	0.13	0.13	0.14	0.14	0.3	1.36
Non-metallic mineral products	0.19	0.18	0.19	0.23	0.22	1.2	2.87
Iron & steel	0.18	0.24	0.23	0.25	0.25	1.1	2.34
Fabricated metal products	0.07	0.06	0.10	0.11	0.13	5.1	8.77
Non-electrical machinery	0.11	0.10	0.12	0.12	0.12	1.2	4.01
Electrical machinery	0.11	0.12	0.15	0.14	0.13	1.0	2.31
Transport equipment	0.09	0.10	0.10	0.09	0.09	-0.2	-0.46
Professional & scientific equipment	0.28	0.29	0.38	0.32	0.29	0.6	1.12
Other manufactured products	0.20	0.21	0.19	0.19	0.19	-0.8	-3.12

Source: Author's calculations based on data from Nicita and Olarreaga (2001).

VI. PERIPHERALITY AND INDUSTRIAL LOCATION

Gini coefficients measure the degree of geographic concentration but take no account of the position of countries relative to each other. As such, they cannot give information on one of the principal insights of the new economic geography, namely that a location's market access can be a powerful attractor for increasing-returns activities with a resulting centre-periphery dimension of industrial production and that the balance of centrifugal and centripetal forces that determine the centre-periphery dimension might change over time. This section focuses on the centre-periphery dimension of industrial production and addresses the broad prediction that industries where labour costs or access to natural resources are crucial determinants of production costs as a whole will be less agglomerated in central places than industries where economies of scale or technology play an important role. The classification of industries follows OECD (1992:152).[7]

[7] The technology category used here combines the categories "specialized supplier" and "science-based" that the OECD forms on the basis of ISIC 4-digit headings. Given that the data used in this paper are available only at the level of ISIC 3-digit sectors, the two categories have to be aggregated. There is no such aggregation problem for the other three industry categories.

A country's location in the core-periphery dimension can be defined by its relative market access. Following Brülhart and Traeger (2003), one can calculate a peripherality index that closely corresponds to Harris's market-potential measure and expresses market potential as the inverse-market-access weighted sum of incomes:

$$P_r = \left(1 - \sum_{s=1}^{R} \frac{G_s}{T_{rs}}\right) * 100$$

where G_s denotes a country's GDP (measured in current US dollar) and T_{rs} is a measure of market access. Market access can be calculated simply using the geographical distance between two countries and calculating intra-country transport costs by the formula $dist = 0.33(area/\pi)^{1/2}$ that gives the average distance between two points in a circular country.

Based on these measures of market access, centre-periphery gradients can be estimated for each industrial sector and year as follows:

$$\ln L_{irt} = \phi_{it} + \varphi_{it} P_r + \varepsilon_{irt}$$

where L_{irt} is the locational Gini coefficient (expressed in logarithmic terms to make it symmetric) of country r for sector i in year t, Φ and φ are regression coefficients, and ε is a stochastic error. To assess the statistical significance of changes in $\hat{\varphi}$ between sample years, F tests can be computed on the hypothesis that $\hat{\varphi}_t - \hat{\varphi}_{t-x} = 0$, using seemingly unrelated regression estimates in order to account for cross-equation error correlation.

The results of the centre-periphery regression based on this measure are shown in table 6 for the years 1980, 1990 and 1998. Roughly two-third out of the sixty-six centre-periphery gradients are statistically significant and the vast majority of them have the expected sign, i.e. they are positive (indicating industrial activity in the periphery) for labour and resource-intensive industries and negative (indicating industrial activity in the centre) for the other industrial sectors. The main sectors for which the centre-periphery gradients are statistically significant but have a sign opposite to expectations include those for which the OECD-classification of industrial categories may be debatable. These sectors are rubber products and iron and steel, which are classified as scale-intensive industries but clearly have a strong natural-resource content, and fabricated metal products, which is likely to be the resource-intensive sector that has the highest demand on engineering skills and technology. The coefficients for wearing apparel, which is perhaps the most important labour-intensive sector, have the correct sign but are mostly statistically not significant. This may indicate that the quota regulations and other non-tariff measures that have governed apparel trade for the past few decades have had a stronger impact on the distribution of industrial activity in the world economy than considerations related to factor costs and linkage effects.

Most of the statistically significant changes in the coefficients regard labour-intensive industries. The results show that agglomeration in wearing apparel, leather products, and footwear decreased between 1980 and 1998, but agglomeration in textiles increased during the 1990s. The opposing developments in the textile and apparel sectors are likely to be due to international production fragmentation with activities in the more capital- and technology-intensive textile sector remaining in central areas and activities in the more labour-intensive apparel sector moving to geographically close low-wage countries (see e.g. Gereffi 1999). By contrast, changes in the coefficients are not statistically

Table 6

Regression results for centre-periphery gradients, market access based on geographical distance

	Sector	*Year*	*Coeff on P*100*	*R-sq*	*Chi-square Wald test*			*Sector*	*Year*	*Coeff on P*100*	*R-sq*	*Chi-square Wald test*	
L	Textiles	1980	17.86***	0.26			SC	Printing & publishing	1980	–9.77**	0.10		
		1990	13.75***	0.12	1.82				1990	–12.47**	0.14	0.59	
		1998	8.78	0.04	5.59**	5.45**			1998	–13.98**	0.15	0.01	0.37
L	Wearing apparel	1980	6.75	0.03			SC	Industrial chemicals	1980	–1.22	0.00		
		1990	13.30**	0.10	4.62**				1990	5.88	0.05	2.00	
		1998	12.51	0.06	7.01	3.94**			1998	9.33**	0.11	0.89	2.80*
L	Leather products	1980	7.30	0.05			SC	Other chemicals	1980	8.26**	0.09		
		1990	14.92**	0.12	3.18*				1990	8.58*	0.09	0.61	
		1998	17.14**	0.13	0.00	1.42			1998	3.43	0.01	1.19	1.79
L	Footwear	1980	7.23	0.04			SC	Rubber products	1980	15.64***	0.24		
		1990	16.86**	0.09	5.62**				1990	15.14**	0.16	0.07	
		1998	25.48***	0.15	1.60	6.18**			1998	19.17**	0.23	0.02	0.11
R	Wood products	1980	4.67	0.01			SC	Plastic products	1980	0.49	0.00		
		1990	4.75	0.01	0.03				1990	–3.61	0.03	0.84	
		1998	6.52	0.02	2.09	0.89			1998	–0.52	0.00	1.51	0.06
R	Furniture and fixtures	1980	–12.06*	0.08			SC	Iron & steel	1980	3.11	0.01		
		1990	–10.13	0.05	0.98				1990	12.73*	0.09	2.94*	
		1998	–6.12	0.01	0.37	0.90			1998	23.55**	0.23	1.32	4.24**
R	Paper & products	1980	5.88	0.03			T	Non-electrical machinery	1980	–19.75***	0.31		
		1990	7.37**	0.06	0.03				1990	–20.72***	0.35	0.18	
		1998	8.38*	0.06	0.12	0.10			1998	–22.63***	0.48	0.27	0.52
R	Pottery, china etc.	1980	0.70	0.00			T	Electrical machinery	1980	–9.89***	0.20		
		1990	3.30	0.01	0.46				1990	–9.89***	0.17	0.47	
		1998	16.80	0.10	2.89*	3.76*			1998	–10.34**	0.11	0.01	0.20
R	Glass & products	1980	2.97	0.01			T	Transport equipment	1980	–5.84**	0.07		
		1990	7.73*	0.08	1.00				1990	–7.95**	0.09	1.33	
		1998	12.77***	0.21	2.49	2.86*			1998	–2.66	0.01	0.85	0.00
R	Non-metallic mineral products	1980	5.22*	0.04			T	Professional & scientific equipment	1980	–27.14***	0.27		
		1990	11.63***	0.23	3.78*				1990	–20.05***	0.19	5.14**	
		1998	15.07***	0.36	0.12	2.48			1998	–24.25***	0.33	1.69	0.40
L	Fabricated metal products	1980	–6.73***	0.19			L	Other manufactured products	1980	–4.07	0.01		
		1990	–7.69***	0.19	0.14				1990	–3.26	0.01	1.10	
		1998	–7.24***	0.12	0.00	0.05			1998	–8.82	0.07	1.00	0.00

Notes: L=labor-intenisve, R=resource-intensive, SC=scale-intensive, T=technology-intensive sectors.

significant for electrical machinery (including telecommunications equipment and semi-conductors) and non-electrical machinery (including computers), i.e. sectors for which international production fragmentation is also well documented (e.g. Ernst and Ravenhill 1999) and which are characterized by downstream labour-intensive activities and a high intensity in the use of intermediate inputs that, however, are easily traded. Indeed, these sectors continue to be among those in which value added is agglomerated most strongly in central areas.[8]

To sum, apart from the special case of wearing apparel, the estimation results support the broad predictions that centre-periphery patterns differ across industrial sectors and that labour- or resource-intensive industries are less agglomerated in central places than industries where economies of scale or technology play an important role. Agglomeration has further declined in traditional labour-intensive industries (such as apparel, leather products, and footwear), while there has been no statistically significant decline in agglomeration in electrical or non-electrical machinery, where downstream activities are also more labour intensive than upstream activities but where existing linkages in developing countries may be relatively low because the relatively technology intensive intermediate inputs are mostly imported from developed countries, and the demand for final output is relatively low in developing countries so that the bulk of output is re-exported.

One implication of these findings is that changes in a developing country's structure of manufactured exports may not be accompanied by a corresponding change in the structure of its manufacturing value added. This implication can be further addressed by examining the similarity of industrial structures between countries at different levels of development. Comparing the industry shares for each country with the corresponding shares for other individual countries yields a full matrix of bilateral differences between the industrial structures of pairs of countries and thus provides evidence on whether the income structures of manufacturing show a tendency towards greater uniformity across countries at different levels of development.[9]

The results in table 7 show that among the developing countries listed in the table, the Republic of Korea stands out by having reached a manufacturing value added structure that is by far the most similar one with respect to the leading developed countries. The structure of China, Malaysia, Mexico, and the Philippines became slightly more similar to that of the major developed countries but still diverge significantly. By contrast, changes in the bilateral structural similarity indices for manufactured exports in these four countries were much stronger than in the Republic of Korea. This, again, shows that for developing countries changes in the structure of manufactured exports are often not associated with a corresponding change in its structure of manufacturing value added.

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[8] It is also interesting to note that the size of the coefficient for transport equipment strongly declined during the 1990s and, contrary to the earlier years, was not statistically significant for 1998. In part, this could be due to the fact that some PTAs among developing countries such as Mercosur and the ASEAN Free Trade Area have supported the creation of regionally production networks and boosted the automobile industry in, for example, Argentina, Brazil, and Thailand. However, it seems that this has not significantly reduced agglomeration as the change in the coefficient is statistically not significant.

[9] A table with the full matrix is available on request.

Table 7
Structural similarity indices for exports of manufactures and manufacturing value added for selected developing economies, 1980–1981 and 1997–1998

	United States				*Japan*				*Germany*			
	Exports		*Value added*		*Exports*		*Value added*		*Exports*		*Value added*	
	1980–1981	*1997–1998*	*1980–1981*	*1997–1998*	*1980–1981*	*1997–1998*	*1980–1981*	*1997–1998*	*1980–1981*	*1997–1998*	*1980–1981*	*1997–1998*
Chile	1.33	1.15	0.74	0.82	1.50	1.33	0.69	0.76	1.30	1.08	0.84	0.88
China	1.14	0.89	0.68	0.62	1.31	0.90	0.61	0.57	1.08	0.99	0.60	0.60
Colombia	1.17	1.10	0.69	0.76	1.35	1.27	0.67	0.74	1.16	0.97	0.73	0.85
Costa Rica	1.22	0.86	0.78	0.76	1.29	0.94	0.75	0.79	1.16	0.97	0.82	0.88
Hong Kong (China)	1.26	1.01	0.95	0.73	1.24	1.03	0.94	0.79	1.29	1.17	1.03	0.93
India	1.26	1.27	0.69	0.68	1.34	1.34	0.58	0.63	1.24	1.19	0.61	0.66
Malaysia	1.32	0.71	0.71	0.67	1.19	0.71	0.59	0.68	1.31	0.88	0.72	0.61
Mexico	0.90	0.47	0.91	0.80	0.93	0.45	0.82	0.74	0.91	0.50	0.85	0.73
Philippines	1.30	0.92	0.75	0.67	1.35	0.93	0.77	0.63	1.25	1.05	0.79	0.71
Republic of Korea	1.06	0.53	0.61	0.38	0.90	0.52	0.52	0.36	0.94	0.58	0.59	0.31
Singapore	0.74	0.70	0.47	0.57	0.63	0.36	0.47	0.57	0.72	0.89	0.46	0.51
Taiwan Province of China	1.08	0.57	0.66	0.64	0.97	0.57	0.55	0.55	1.05	0.67	0.59	0.52
Venezuela	0.95	0.93	0.59	0.78	1.06	1.19	0.51	0.73	0.98	0.97	0.63	0.79
Memo item:	Structural similarity with developed countries' average											
Developing countries	0.87	0.57	0.46	0.37								

Source: Author's calculations based on data from Nicita and Olarreaga (2001).

VII. CONCLUSIONS

Changes in the sectoral composition of economic activities regarding trade and production are a key factor of the process of economic development. Focusing on the developmental elements of new economic geography models, the main objective of this paper was to distil and test broad empirical predictions as to how the current process of globalization has affected industrialization in developing countries. The findings support the predictions that the decline in trade barriers has weakened the importance of industrial linkages in developed countries and favoured the spread of industrial activity from developed to geographically close developing countries in sectors that are intensive in immobile primary factors and that are not too heavily dependent on linkages with other firms, i.e. in traditional labour-intensive sectors such as apparel, leather products, and footwear.

By contrast, there is no indication of a significant spread of industry in sectors that would strongly rely on forward and backward linkages in developing countries. This is exemplified best by the electrical and non-electrical machinery sectors that continue to be among those for which agglomeration is strongest. Hence, the recent wave of international production fragmentation in these sectors has not been associated with a strengthening of either forward (e.g. through increased domestic production of intermediate production inputs) or backward linkages (e.g. through increased domestic output demand from either other domestic manufacturing firms or consumers) in developing countries.

There has been a sizable change in both the size and structure of manufactured exports from developing countries but not in their manufacturing value added. The findings also show that the increase in the share of developing countries as a group in world exports of manufactures has not been accompanied by concomitant increases in their share in world manufacturing value added. Similarly, the sectoral structure of manufactured exports from developing countries has become more similar to that of manufactured exports from developed countries, but the sectoral structure of manufacturing value added has not. In other words, the patterns of manufactured exports from developed and developing countries have converged, contrary to the patterns of manufacturing value added.

Perhaps most importantly, the findings point to an important difference in the extent to which the spread of industrial activity benefits the industrialization process in developing countries and suggest that this difference depends on their existing level of industrial development. Developing countries in an early stage of industrialization that attract relocating industrial activity mainly on the basis of factor-price differences, such as probably exemplified best by Malaysia and Mexico, experience a change in their structure of manufactured exports accompanied by little change in their of manufacturing value added. By contrast, developing countries whose well-established industrial base allow them to enjoy linkage-related effects, such as exemplified by the Republic of Korea and Taiwan Province of China, experience a change in the structure of manufacturing value added without necessarily experiencing a concomitant change in their structure of manufactured exports. To the extent that this is the case, a continuation of the observed spread of industry would reinforce existing differences between developing countries with regard to their level of industrial development.

Thus, a major challenge facing developing countries is how to extract from their increasing integration into the international trading system the elements that will promote industrialization and, in particular, how to create the critical mass of linkages that provide pecuniary externalities to industrial firms. Experience of successful countries, such as the Republic of Korea, suggests that this means combining the opportunities offered by world markets with a growth strategy that mobilizes the capabilities of domestic institutions and investors. The accumulation of capital, both human and physical, and the provision of appropriate infrastructure with a view to raising productivity clearly continue to be key factors in this regard. Also important are trade policy measures by developed countries designed to reduce access barriers to imports of high-value goods from developing countries.

While the above findings give support to the broad empirical predictions of new economic geography models, they do not allow favouring one specific theoretical approach over others. This is because the broad predictions come from models presented in a number of different theoretical studies that do not share a uniform and consistent set of assumptions. Moreover, technology transfer and technological change clearly influence the evolution of the aggregate indices on which the empirical analysis of this paper is based. However, technology factors other than those related to transport costs are absent from new economic geography models. Addressing these issues is an important task for future research.

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APPENDIX 1

Country and data coverage

The data set includes 34 countries, i.e. all those countries that had at least US$2 billion worth of manufactured exports in 1998, collectively accounting for 99 percent of world exports of manufactures, and for which comprehensive sectoral data on manufacturing value added are available in Nicita and Olarreaga (2001). The country classification follows the United Nations categories that, unlike some other institutions, classify South Africa as a developed and Turkey as a developing country.

Developed countries (18 countries): Austria, Canada, Denmark, Finland, France, Germany, Greece, Ireland, Italy, Japan, Netherlands, Norway, Portugal, South Africa, Spain, Sweden, United Kingdom, United States.

Developing countries (14 countries); Chile, China, Colombia, Costa Rica, Hong Kong (China), India, Republic of Korea, Malaysia, Mexico, Philippines, Singapore, Taiwan Province of China, Turkey, Venezuela.

Countries in Eastern Europe (2 countries): Hungary, Poland.

The dataset includes 22 sectors, i.e. based on the definition of manufactures used in trade statistics (SITC), all sectors at the 3-digit level of industrial statistics (ISIC, Revision 2), except food products, beverages, tobacco, petroleum refineries, miscellaneous petroleum and coal products, and non-ferrous metals, which SITC defines as primary products. Sector-specific data were not available for the following countries and years:

Wearing apparel	China (all years); Netherlands (1983–87);
Leather products	Mexico (1984–98); Netherlands (1983–87);
Footwear	China (all years);
Industrial chemicals	China (1994–97); Hong Kong (China) (1993–98); Finland (1995–98); Norway (1993–98);
Other chemicals	China (1994–97); Hong Kong (China) (1993–98);
Pottery, china etc	Hong Kong (China) (1992–95); Finland (1995–98); France (1996–98); Norway (1993–95); Singapore (1980–97);
Glass & products	Hong Kong (China) (1994); Netherlands (1981–87); Singapore (1980–97);
Non-met mineral products	Netherlands (1981–87); United Kingdom (1993–94);
Iron and steel	Costa Rica (1985–97); Netherlands (1981–88); Norway (1993–98); United Kingdom (1993–94);
Non-electrical machinery	Finland (1995–98); Norway (1993–98);
Professional & scientific equip.	Costa Rica (all years).

Imputations and other adjustments made to the dataset given by Nicita and Olarreaga (2001):

Chile	Mirrored exports for 1980;
China	Mirrored exports for all years; value added for 1998 from UNIDO (2002);
Hong Kong (China)	Mirrored exports for all years;
Costa Rica	Mirrored exports for 1980; value added for 1998 imputed assuming growth of 8% over 1997 with no sectoral change
France	Value added for 1996–1998 imputed assuming the same overall growth as in the OECD STAN database and constant sectoral proportions with G-4 countries as during 1990–1995;
Germany	Value added for 1994–1998 imputed as for France;
Hungary	Mirrored exports for all years;
Ireland	Value added for 1998 from UNIDO (2002);
Italy	Value added for 1995–1998 from UNIDO (2002);
Korea, Republic of	Value added for 1998 imputed based on UNIDO (2002) growth rates of value added in national currency to exclude impact of short-run exchange-rate changes following the Asian crisis;
Mexico	Mirrored exports for 1980;
Philippines	Value added for 1998 imputed assuming decline by 2% over 1997 with no sectoral change;
Portugal	Value added for 1998 from UNIDO (2002);
Singapore	Value added for 1998 imputed as for the Republic of Korea;
South Africa	Mirrored exports for 1985;
Taiwan Province of China	Value added for 1997–1998 imputed assuming annual growth of 7% and 5%, respectively, with no sectoral change;
Turkey	Mirrored exports for 1980;
United States	Mirrored exports for 1980; value added for 1997–1998 imputed assuming annual growth of 4% and 2%, respectively with no sectoral change.

APPENDIX 2

Centre-periphery gradients based on estimated market access

This appendix discusses the robustness of the results from the centre-periphery regression in section VI. It employs an alternative specification of market access that has the attractive characteristic of being rooted in economic theory (Redding and Venables, 2004a) and calculates market access from a structural model that uses the predicted values of the sum of domestic market access (DMA) and foreign market access (FMA) as parameters:

$$\hat{T}_{rs} = D\hat{M}A_r + F\hat{M}A_r = (\exp(cty_r))^{\hat{\gamma}} dist_{rr}^{\hat{\delta}_1} + \sum_{r \neq s} (\exp(ptn_s))^{\hat{\gamma}} * dist_{rs}^{\hat{\delta}_1} * bord_{rs}^{\hat{\delta}_2}$$

where $dist_{rr} = 0.33(area/\pi)^{1/2}$ to give a country's trading costs on its domestic market and where $\hat{\gamma}$, $\hat{\delta}_1$ and $\hat{\delta}_2$ are the estimated coefficients of a gravity equation of the form:

$$\ln(X_{rs}) = \alpha + \beta D_r + \gamma D_s + \delta_1 \ln(dist_{rs}) + \delta_2 bord_{rs} + u_{rs}$$

where X_{rs} is the value of exports from country r to country s, D_r and D_s are dummy variables for the exporter and importer countries, *dist* is the geographical distance between the main cities of the two countries, *bord* is a dummy variable for whether or not the two countries share a common border, and u is a stochastic error.[10]

The additional advantage of this measure is that it reflects the impact of preferential market access and other trade policy measures that influence a country's industrial activity, as discussed in section II, in addition to geographical distance, which is the focus of the measure in section VI.[11] On the other hand, the fact that the measure is based on export data represents an important drawback for the purpose of this paper. Given that a change in the size or structure a country's exports is not always accompanied by corresponding changes in manufacturing value added, using this measure to assess changes in the distribution of manufacturing value across countries may not be fully appropriate. While there are no a priori reasons to argue that this drawback outweighs the advantages of this measure, the results need to be interpreted with caution.

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[10] See Head and Mayer (2003) for discussion of these measures.

[11] The two measures of market potential have a very low correlation coefficient (0.29) but a very substantial part of the difference between the two measures is due to the difference that they attribute to the United States economy compared to the rest of the sample. This difference is very large in the estimated market access. Excluding the United States from the sample raises the correlation coefficient to 0.51.

The results of the centre-periphery regression based on estimated trade costs are shown in table A1.[12] While the statistical significance of the results is generally lower than for the measure in section VI, they give support to the finding that industries where labour costs or access to natural resources are crucial determinants of production costs are less agglomerated in central places than industries where economies of scale or technology play an important role. By contrast, none of the changes in the coefficients is statistically significant. This would suggest that neither international production fragmentation associated with the decline in communication and transport costs and preferential trading arrangements between developed and developing countries nor PTAs between developing countries fostered the spread of industry to developing countries in a statistically significant way. However, as explained above this result needs to be treated with caution because there is no close correspondence between changes in exports and value added.

[12] The estimated trade costs refer to four-year averages around the specific years.

Table A1

Regression results for centre-periphery gradients, estimated market access

	Sector	*Year*	*Coeff on P*100*	*R-sq*	*Chi-square Wald test*			*Sector*	*Year*	*Coeff on P*100*	*R-sq*	*Chi-square Wald test*	
L	Textiles	1980	1.81***	0.05			SC	Printing & publishing	1980	–1.11***	0.02		
		1990	1.37***	0.02	0.46				1990	–1.51***	0.04	0.08	
		1998	0.65	0.00	1.54	1.37			1998	–1.02***	0.02	0.94	0.05
L	Wearing apparel	1980	1.00	0.01			SC	Industrial chemicals	1980	–0.48	0.01		
		1990	1.26	0.02	0.06				1990	0.13	0.00	0.37	
		1998	1.18	0.01	0.00	0.03			1998	0.42	0.01	0.05	0.32
L	Leather products	1980	1.58***	0.04			SC	Other chemicals	1980	0.04	0.00		
		1990	1.76***	0.03	0.05				1990	–0.09	0.00	0.26	
		1998	1.85***	0.03	0.05	0.08			1998	0.33	0.00	0.17	0.01
L	Footwear	1980	2.30**	0.07			SC	Rubber products	1980	0.75*	0.01		
		1990	2.77***	0.05	0.14				1990	0.17	0.00	0.81	
		1998	2.75***	0.04	0.00	0.09			1998	0.07	0.00	0.02	0.69
R	Wood products	1980	0.87	0.01			SC	Plastic products	1980	0.22	0.00		
		1990	0.41	0.00	0.17				1990	–0.24	0.00	0.49	
		1998	0.21	0.00	0.20	0.27			1998	–0.08	0.00	0.05	0.08
R	Furniture and fixtures	1980	0.34	0.00			SC	Iron & steel	1980	–0.93	0.01		
		1990	0.05	0.00	0.05				1990	0.34	0.00	1.32	
		1998	0.13	0.00	0.01	0.00			1998	0.41	0.00	0.01	0.68
R	Paper & products	1980	–0.16	0.00			T	Non-electrical machinery	1980	–2.21***	0.07		
		1990	0.13	0.00	0.12				1990	–1.55**	0.04	1.36	
		1998	–0.13	0.00	0.14	0.00			1998	–1.79***	0.06	0.20	0.30
R	Pottery, china etc.	1980	2.03***	0.06			T	Electrical machinery	1980	–0.75*	0.02		
		1990	2.09***	0.05	0.01				1990	–0.51	0.01	0.26	
		1998	1.68**	0.02	0.25	0.12			1998	–0.99***	0.02	0.95	0.13
R	Glass & products	1980	0.37	0.00			T	Transport equipment	1980	–1.04***	0.04		
		1990	0.56*	0.01	0.02				1990	–1.64***	0.08	1.08	
		1998	0.99***	0.03	1.09	0.51			1998	–1.04**	0.02	0.52	0.02
R	Non-metallic mineral products	1980	1.08***	0.03			T	Professional & scientific equipment	1980	–3.48***	0.08		
		1990	1.52***	0.07	0.53				1990	–3.60***	0.12	0.02	
		1998	1.49***	0.08	0.00	0.26			1998	–2.88***	0.10	0.59	0.16
L	Fabricated metal products	1980	–0.37**	0.01			L	Other manufactured products	1980	–0.76*	0.01		
		1990	–0.14	0.00	0.29				1990	–0.90**	0.01	0.00	
		1998	0.07	0.00	0.09	0.25			1998	–1.15**	0.03	0.07	0.04

Notes: L=labor-intenisve, R=resource-intensive, SC=scale-intensive, T=technology-intensive sectors.

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