

# **Size and Factor-Endowment Effects on Comparative Advantage in a Gravity Approach**

by

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## Abstract

*Policy makers in "small" countries facing trade liberalisation have become concerned with the potential loss of manufacturing employment and output to "large" economies in the presence of economies of scale in production and international transport costs. This paper offers a methodology to estimate the "home market" effect for numerous industries, after accounting for traditional comparative advantage effects arising from differences in factor endowment. The empirical results suggest significant home-market effects for differentiated goods in many manufacturing industries which may be capital intensive or labour intensive.*

Key words: Home-market effect, comparative advantage, bilateral trade, factor endowment, gravity model

JEL classification: F 12

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## I. Introduction

Integrating the gravity hypothesis into the factor-proportions theory of international trade Bergstrand (1989) derived a generalised gravity-type equation at the industry level. The equation predicts that the exports of a good in bilateral trade depend on the traditional “gravity variables”, i.e. on the total income of the two countries and the distance between them and, additionally, on the capital endowment of the exporting country and the per-capita income of the importing country. Bergstrand shows that the capital-endowment elasticity can be used to identify capital-intensive versus labour-intensive goods whereas the per-capita-income elasticity can be used to distinguish between necessities and luxuries in consumption. He does not give, however, an interpretation of the coefficients which refer to *total income* of the two countries.

The main contribution of the paper is that we suggest an interpretation for the total-income elasticities in Bergstrand’s gravity equation. We show that for the empirical specification of the gravity equation as done in Bergstrand (1989), these coefficients could be used in order to measure the home-market effect explaining net exports of large countries in differentiated goods. Interestingly enough, there are a number of studies (e.g. Feenstra et al. 1998 and 2001, Hanson and Xiang 2002) which use a gravity-type equation to measure the home-market effect. These studies, however, do not include other important variables which take account of comparative advantage arising from factor endowment and which are present in the generalised gravity equation. Hence our paper bridges the two literature strains, Bergstrand (1989), on the one hand, and Feenstra et al. (1998 and 2001), on the other.

The second contribution of the paper is that we estimate the home-market effect at the 3-digit level according to the International Standard Industrial Classification. Observe that this disaggregation is more detailed than the one employed in the highly aggregated analysis of Feenstra et al. (1998 and 2001) and more comprehensive than the selected industries covered in Hanson and Xiang (2002). It is similar to the sectoral breakdown in Davis and Weinstein (2003) who use, however, a different methodology to test for the existence of a home-market effect.

Our main result is that the home-market effect appears for differentiated goods and can be found in a large number of manufacturing industries which may be capital intensive or labour intensive.

The remainder of the paper is organised as follows. Section II summarises the microeconomic foundations of the “gravity equation” at the level of product groups and the empirical evi-

dence on the home-market effect so far available within this framework. Section III shows that the gravity-type approach implies a nonlinear relationship between the industry export/import ratio in bilateral trade, on one hand, and the ratios of total income, capital endowment and per-capita income on the other. It also shows that the home-market effect arises for differentiated products which have a low elasticity of transformation among markets because the costs of marketing and tailoring the products to any foreign market are high. Section IV provides empirical results at the level of three-digit industries of the International Standard Industrial Classification (ISIC Rev.2). Section V concludes.

## II. Theoretical Foundations of the Gravity Equation and Empirical Evidence

The gravity model, first advanced by Tinbergen (1962) and Linnemann (1966), assumes that bilateral trade is positively related to the two countries' incomes and negatively related to the distance between them. It proved successful in explaining empirically regional patterns of aggregated trade. In recent years, the gravity approach has gained new favour in the analysis of regionalisation trends in world trade<sup>1</sup> and in estimating potential trade flows with eastern Europe after the political and economic changes occurred in the region.<sup>2</sup>

The gravity equation is derived theoretically as a reduced form from a general equilibrium model of international trade in final goods. Total income of the two countries are interpreted as their production and absorption capacities, respectively. Distance between them is taken as a proxy of trade costs. Formal analysis was provided by Anderson (1979), Bergstrand (1985) and Helpman and Krugman (1985) linking trade flows to exporter and importer incomes multiplicatively in models with differentiated goods. Feenstra et al. (1998 and 2001) derived a gravity equation from a reciprocal-dumping model of trade with homogeneous goods and Deardorff (1998) showed that the gravity hypothesis is consistent with Heckscher-Ohlin trade in homogeneous goods and perfect competition. Baier and Bergstrand (2001) give an overview of the various theoretical foundations and show that they are complementary and special cases of a more general model.<sup>3</sup>

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<sup>1</sup> E.g. Frankel 1993, Saxonhouse 1993, Dhar and Panagariya 1994.

<sup>2</sup> Several studies consider trade at the aggregate level (e.g. Winters and Wang 1994, Baldwin 1994, Piazolo 1997), while others also provide analyses at the level of product groups (e.g. Festoc 1995, Vittas and Mauro 1997, Schumacher 1997, Fidrmuc 1998).

<sup>3</sup> "Specialization – and not new or old trade theory – generates the force of gravity." (Grossman 1998: 29). The reason for specialisation may be different, however, and may be related to product differentiation by country of origin (Armington-type import demand), economies of scale or factor endowment differences (Feenstra et al. 2001: 431). Evenett and Keller (2001) try empirically to separate between Heckscher-Ohlin theory and the In-

Integrating the gravity hypothesis into the factor-proportions theory of trade, Bergstrand (1989) extended the microeconomic foundations to include exporter and importer per capita incomes. He shows that the gravity equation is the reduced form of a general equilibrium model of bilateral trade among  $N$  countries with two differentiated-products industries, with increasing returns to scale and monopolistic competition, and two factors of production. Each firm's output is assumed to be distributed among domestic and foreign markets according to the constant-elasticity-of-transformation (CET) function. "Intuitively, each firm's behavior can be considered as a two-stage process. First, each firm *produces* a uniquely differentiated commodity under increasing returns to scale. In the second stage, each firm *distributes* its product to  $N$  markets (including the home market) under diminishing returns, similar to Krugman (1987)" (Bergstrand 1989, 145). The coefficients of the resulting gravity equation are determined by the parameters of the demand and supply functions. They are negative for transport costs and protectionist measures and positive for GNP in the importing country and, if the elasticity of substitution in consumption exceeds one, for GNP in the exporting country. The exporter per capita income is taken as a proxy for capital endowment, its coefficient is positive for goods which are capital intensive in production and negative for labour-intensive goods.<sup>4</sup> The importer per capita income coefficient is positive for goods which are "luxury" in consumption and negative for "necessities". Thus, the industries can be ranked (i) by their capital intensity in production using the coefficients of the per capita GNP of the exporting country and (ii) by their characteristics in import demand using the coefficients of the per capita GNP of the importing country. Bergstrand gives no interpretation, however, of the coefficients of the exporter and importer total incomes.

This paper shows that in a gravity model with monopolistic competition in the spirit of Bergstrand (1989) there is also a home-market effect arising from differences in total income besides the comparative advantage effect arising from differences in factor endowment and per capita income. Including total income, capital endowment and per capita income we can distinguish between the home-market effect and traditional comparative advantage effects. Thus, the paper also contributes to the present discussion on the sources of trade represented by the gravity equation (Harrigan 2001, Evenett and Keller 2001).

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creasing Returns trade theory as driving forces behind the success of the gravity equation. Their analysis is not disaggregated by industries, but by groups of countries.

<sup>4</sup> This strictly holds for two goods; in the multi-industry case "a weak inference of the relative factor intensity of the industry can be made using exporter per capita income coefficient estimates from a gravity equation" (Bergstrand 1989: 146, referring to Deardorff 1982 who provided a "weak" generalisation of the Heckscher-Ohlin theorem by proving that countries tend to export those goods which use intensively their abundant factor).

The home-market effect is an important common feature of “economic geography models” with trade costs and monopolistic competition under increasing returns to scale.<sup>5</sup> It appears as an elasticity of exports with respect to domestic income which exceeds the importing country’s income elasticity. In a two-sector-model with trade costs and product differentiation, Krugman (1980) showed that large countries tend to be net exporters in the sector with monopolistic competition and economies of scale. Feenstra et al. (1998 and 2001) arrived at similar results using a different approach, showing that the home-market effect also characterises a homogeneous-product sector with free entry. The effect is reversed if homogeneous goods have greater barriers to entry (e.g. due to resource-dependency). Applying a gravity-type specification for a classification of goods suggested by Rauch (1999),<sup>6</sup> Feenstra et al. (1998 and 2001) found a home-market effect for differentiated goods, the reverse is true for homogeneous goods likely to be resource based and to have large entry barriers, and goods with reference prices are lying between the two extremes. Hanson and Xiang (2002) derived and tested a different specification explaining relative exports of two countries to a third country by relative income and distance of the exporting countries. Their results for selected industries suggest that the home-market effect varies systematically with characteristics of the industries, national market size determining national exports for industries with very high transport costs.<sup>7</sup> Head, Mayer and Ries (2002) explore theoretically more general conditions for the existence of a home-market effect.

The existing literature on the home-market effect in a gravity-type approach, theoretical as well as empirical, concentrates on total income and neglects factor endowment and per capita income.<sup>8</sup> Moreover, the existing literature analyses the impact on exports whereas we emphasise the impact on the ratio of exports to imports. Our approach is described in the next section.

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<sup>5</sup> Models with increasing returns and trade costs have come to be known as “economic geography”, the phenomenon of unusually strong demand leading a good to be exported in a world of economic geography is known as the “home market effect” (Davis and Weinstein 1998: 1/2). Davis (1998) shows that the relative trade costs for differentiated and homogeneous goods are crucial for the home-market effect and that it disappears when the two kinds of goods have identical transport costs.

<sup>6</sup>He classified the goods as to whether they are (i) traded in an organised exchange, and therefore treated as “homogeneous”, (ii) not traded in an organised exchange, but having some quoted “reference price”, and (iii) not having any quoted prices, and therefore treated as “differentiated”.

<sup>7</sup> Other studies compare industry supply and industry demand across countries or regions. They identify a home-market effect if increases in a country’s or region’s share of demand cause disproportionate increases in its share of output. Such studies include Davis and Weinstein 1999 and 2003, Head and Ries 2001, Trionfetti 2001 and Weder 2003.

<sup>8</sup> Hanson and Xiang (2002) reduce the problem by comparing countries which belong to a common preferential trade area and have relatively similar average income and assuming that these countries have similar production costs such that comparative advantage plays a small role.

### III. The Model

The gravity equation in log-form is given by

$$\ln X_{ajj} = \beta_0^a + \beta_1^a \ln Y_i + \beta_2^a \ln c_i + \beta_3^a \ln Y_j + \beta_4^a \ln y_j + \beta_5^a \ln D_{ij} + \sum_{k=6}^K \beta_k^a Z_{kij} \quad (1)$$

$X_{ajj}$  is the value of the trade flow in industry  $a$  from country  $i$  to country  $j$  ( $i, j = 1, \dots, N$ ).  $Y_i$  is  $i$ 's national output. Following the interpretation in Bergstrand (1989), it is expressed in terms of units of capital. It represents the supply capacity of the exporting country in terms of capital stock and is proxied by GNP.  $c_i$  is  $i$ 's capital-labour endowment ratio.  $Y_j$  and  $y_j$  are  $j$ 's GNP and GNP per capita, respectively, and represent the demand side. The bilateral trade costs are represented by distance  $D_{ij}$  between the economic centers of the respective countries, supplemented by a dummy for adjacency. The other dummy variables  $Z_{kij}$  are proxies for trade policy measures and other factors which may be important for market access such as membership in preference zones, common language or historical ties.

The intersectoral division of labour in bilateral trade can be determined by comparing the exports and imports given by the gravity approach. Equation (1) simultaneously determines exports and imports in bilateral trade.  $X_{ajj}$  represents the value of exports in industry  $a$  from country  $i$  to country  $j$ . The reverse flow, i.e. the imports of industry  $a$ 's goods by country  $i$  from country  $j$ , is given by the same equation replacing  $i$  by  $j$  and vice versa:

$\ln M_{ajj} = \ln X_{aji}$  and

$$\ln X_{aji} = \beta_0^a + \beta_1^a \ln Y_j + \beta_2^a \ln c_j + \beta_3^a \ln Y_i + \beta_4^a \ln y_i + \beta_5^a \ln D_{ji} + \sum_{k=6}^K \beta_k^a Z_{kji} \quad (2)$$

Subtracting (2) from (1) gives the log-form of the export/import ratio in bilateral trade of good  $a$ . Because  $D_{ji} = D_{ij}$  and if  $Z_{kji} = Z_{kij}$ <sup>9</sup>, the log difference between exports and imports is

$$\ln X_{ajj} - \ln X_{aji} = (\beta_1^a - \beta_3^a)(\ln Y_i - \ln Y_j) + \beta_2^a (\ln c_i - \ln c_j) + \beta_4^a (\ln y_j - \ln y_i) \quad (3a)$$

or, in non-log form, the export/import ratio is

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<sup>9</sup> Considering country specific trade barriers we would have a third effect on the export/import ratios arising from trade policy, i.e. a comparative advantage effect of relative levels of protection in terms of tariffs or non-tariff barriers. We only consider "symmetric" trade policy measures such as the existence of Free Trade Areas which, however, may have different effects depending on the product group.

$$\frac{X_{ajj}}{X_{aji}} = \left( \frac{Y_i}{Y_j} \right)^{\beta_1^a - \beta_3^a} \left( \frac{c_i}{c_j} \right)^{\beta_2^a} \left( \frac{y_i}{y_j} \right)^{-\beta_4^a} \quad (3b)$$

and depends on the ratio of the two GNPs, the relative capital endowment and the ratio of the two per capita incomes. Distance and dummy variables representing trade preferences among selected countries, in this approach, do not affect the ratio of exports to imports. According to equations (1) and (2), they are relevant for the volume of bilateral trade and affect the commodity structure of trade because the elasticities may vary among industries. As they have the same effect on the exports and imports in a given industry they do not, however, have an impact on the relative sectoral trade volumes.

The different sources shaping the pattern of sectoral export/import ratios can be identified as follows:

(i) If the two countries  $i$  and  $j$  have the same capital-labour endowment ratio and the same per capita income, the export/import ratio only depends on *relative size*. The export/import ratio in equation (3a) or (3b) increases with higher  $\beta_1^a$  and lower  $\beta_3^a$  indicating a positive effect arising from the large size of a country as compared to smaller countries. The difference

$$\beta_1^a - \beta_3^a \quad (4)$$

gives the elasticity of good  $a$ 's bilateral export/import ratio with respect to the relative total income of the exporting country. A positive value of (4) indicates a home-market effect which may arise because producers can exploit higher economies of scale in the larger market.

In the model (Bergstrand 1989: 146), the exporter income elasticity is

$$\beta_1^a = (\sigma^a - 1) / (\gamma^a + \sigma^a) \quad (5)$$

and the importer income elasticity is

$$\beta_3^a = (\gamma^a + 1) / (\gamma^a + \sigma^a) \quad (6)$$

$\sigma^a$  is the elasticity of substitution in consumption among supplies from different countries according to the import demand functions and may range from 1 to infinity,  $\gamma^a$  is the elasticity of transformation in production among supplies to the home market and different export markets and may range from zero to infinity.<sup>10</sup>

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<sup>10</sup> The reason for the assumption that the allocation of output to different markets follows a CET function is that output of a firm in a differentiated-product industry is not likely to be substituted without cost between foreign markets. For details on the CET concept see Baier and Bergstrand (2001:8).

A home-market effect  $\beta_1^a > \beta_3^a$  requires  $\gamma^a < \sigma^a - 2$ , i.e. the elasticity of transformation in production must be small for any given elasticity of substitution in consumption. The degree of transformability or substitutability of production among markets is small if the costs of distributing, marketing and tailoring a product to any foreign market are high. This will be true the more the goods are specific and tailored to the needs of certain markets, i.e. for more differentiated manufactures. On the other hand, the degree of transformability is infinity if the output is perfectly substitutable across home and foreign markets which is true for more homogeneous goods such as primary commodities. Here, the home-market effect would be reversed. These are the same hypotheses which follow from Krugman (1980) and Feenstra et al. (1998 and 2001) suggesting that the size of the exporting country will be more important than the size of the importing country for differentiated goods in manufacturing whereas the opposite will hold for homogeneous goods such as raw materials or resource-intensive products.<sup>11</sup>

(ii) If the two countries have the same economic size, the pattern of sectoral export/import ratios in bilateral trade is shaped by supply and demand conditions which are *related to capital endowment and per capita income*. The pattern is more pronounced, the larger the divergence between the two countries in terms of capital endowment or per capita income, respectively, describing the *traditional comparative advantage effects*. The export/import ratio in equation (3a) or (3b) is larger the larger  $\beta_2^a$  and the smaller  $\beta_4^a$ , i.e. the more the respective good is capital intensive in production and the more it is necessity in consumption, and it is smaller the smaller  $\beta_2^a$  and the larger  $\beta_4^a$ , i.e. the more the respective good is labour intensive in production and the more it is luxury in consumption.

In sum, the model allows to distinguish between different sources shaping the export-import position in bilateral trade at the industry level. On one hand,  $\beta_1^a - \beta_3^a$  gives the effect arising from different size and identifies a home-market effect if it is positive. It is an indicator of the level of product differentiation because it is larger the lower the degree of transformability of production among markets. On the other hand,  $\beta_2^a$  and  $\beta_4^a$  give the traditional comparative advantage effects arising from different relative factor endowment and from different demand conditions related to per capita income. The values of  $\beta_2^a$  are an indicator of the capital versus labour intensity of industries while the values of  $\beta_4^a$  are an indicator of the degree of

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<sup>11</sup> If the elasticity of transformation among markets is smaller than infinity a home-market effect  $\beta_1^a > \beta_3^a$  also appears in the gravity model of Baier and Bergstrand (2001). Evenett and Keller (2001) cannot take account of a

luxury versus necessity in consumption. The home-market effect is strengthened by the traditional comparative advantage effects if goods are capital intensive and/or necessities, it is mitigated if they are labour intensive and/or luxuries.

#### IV. Empirical Results

We apply equation (1) to explain the bilateral shipments among 22 OECD countries,<sup>12</sup> as well as equations (3a) to determine the effects of relative total income, relative capital endowment and relative per capita income on the export/import ratio by industries. The regressions are calculated for the average annual trade flows of the years 1988 to 1990 (in US-\$ million) for all products combined, agriculture, mining and quarrying, manufacturing products as a whole and broken down by 25 three-digit ISIC Rev.2 industries.<sup>13</sup> For this purpose the OECD foreign trade figures are appropriately recoded from the original SITC categories.<sup>14</sup>

As to the explanatory variables the data on GNP (in US-\$ million) and GNP per capita (in US-\$) are taken from World Bank publications and refer to 1989.<sup>15</sup> The capital-labour endowment ratio is alternatively proxied by the mean years of schooling of the population, the enrollment ratio in secondary education and the GNP per capita.<sup>16</sup> The distance  $D_{ij}$  (in miles) between the countries  $i$  and  $j$  is calculated as the shortest line between their economic centres  $EC_i$  and  $EC_j$  by latitudinal and longitudinal position<sup>17</sup>. The dummy variables cover

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home-market effect because they assume  $\beta_1^a = \beta_3^a = 1$ . Both studies analyse trade at the aggregated level.

<sup>12</sup> Member countries in 1993, excluding Iceland and taking Belgium/Luxembourg together.

<sup>13</sup> For estimating the regression coefficients, we apply an OLS procedure on the log-linear form of the gravity equations taking account for heteroscedasticity. Zero trade flows are replaced by a very small figure (0.001 US-\$ million which is the smallest unit recorded in international trade statistics). Zero values, in general, do not occur in trade among OECD countries at the aggregate level. A number of bilateral trade flows are, however, zero if the figures are disaggregated by product groups.

<sup>14</sup> Similar regressions and the data are also described in Schumacher (1997) which gives empirical results for all goods, as well as manufacturing products as a whole and broken down by high, medium and low-tech products.

<sup>15</sup> World Development Indicators. GNP figures are calculated by multiplying GNP per capita and population figures. All values are at current prices and exchange rates.

<sup>16</sup> "Capital" in our context includes tangible and intangible assets. Human capital endowment is highly correlated with GNP per capita and, next to natural resources, it is the decisive factor in determining the sectoral structure of a country's comparative advantage (Wood 1994a and 1994b). This holds particularly for the division of labour between industrial and developing countries, but also for the intersectoral division of labour among industrial countries (e.g. Schumacher 1992).

<sup>17</sup> In principle, the national capitals were taken as the economic centre (EC) except for Canada (Montreal), the United States (Kansas City as a geographical compromise between the centres of the East and West Coasts), Australia (Sydney), and West Germany (Frankfurt/Main). The formulae are:

- adjacency ( $ADJ_{ij}$ )
- membership in a preference area: European Union, European Free Trade Agreement, Free Trade Agreement between the USA and Canada and Asia-Pacific Economic Cooperation,
- ties by language and
- historical ties.

The value of the dummy variable is 1, if the two countries  $i$  and  $j$  have a common land border, belong to the respective preference zone, or have the same language<sup>18</sup> or historical ties.<sup>19</sup> Otherwise the value of the variable is zero.

The regressions describing the bilateral trade flows among OECD countries were calculated for export statistics and for import statistics. Both statistics represent the same flows, the values are, however, different, but the results are very similar. This is also true with respect to the alternative proxies of the capital endowment variable. The results presented here refer to mean years of schooling and import statistics.<sup>20</sup>

The explanatory power of the model is strong as it is common for gravity equations for total trade. By and large, the results show the expected pattern with regard to sign and significance of the coefficients. The higher the national product of countries and the smaller the geographical distance between them, the greater the merchandise flows between them. Membership of APEC and of the EU in general has a positive impact on trade. The same is true for relationships in terms of language and historical ties. The impact of a common border too, is mostly positive as might be expected; it is, however, less significant than in other studies.

The differences  $\beta_1^a - \beta_3^a$  between exporter and importer *income elasticities* give the impact of relative size on the bilateral export/import ratio and are presented in Figure 1, ranking the sectors from positive to negative values. For all goods combined the difference is zero, i.e. a home-market effect can be found only at the industry level. The difference is negative in food, mining goods, non-ferrous metals and agricultural products, i.e. primary or resource-intensive goods confirming the results of Feenstra et al. (1998 and 2001). It is positive for most manu-

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$$\cos D_{ij} = \sin \varphi_i \sin \varphi_j + \cos \varphi_i \cos \varphi_j \cos (\lambda_j - \lambda_i)$$

$$D_{ij} = \arccos (\cos D_{ij}) \square 3962.07 \text{ miles}$$

for  $EC_i = (\varphi_i; \lambda_i)$  and  $EC_j = (\varphi_j; \lambda_j)$  with  $\varphi$  = latitude,  $\lambda$  = longitude.

<sup>18</sup> 0.5 for second languages.

<sup>19</sup> 0.5 for ties until 1914.

<sup>20</sup> The complete results of the regressions are available from the authors on request.

factures indicating a significant home-market effect. We also find a home-market effect for labour-intensive goods such as footwear, pottery and wearing apparel. The effect is largest for transport equipment, rubber and footwear.

Alternative regressions similar to Feenstra et al. (1998 and 2001) concentrating on total income and excluding factor endowment and per capita income give a different picture (Figure 2). Here the impact of income on the export/import ratio is negative in food, wearing apparel, mining, agriculture and textiles. It is again zero for all goods combined and positive for most manufacturing products. The values, however, now are highest for capital-intensive sectors such as transport equipment, non-electrical and electrical machinery and precision engineering whereas the effects in labour-intensive industries such as wearing apparel, footwear and leather goods tend to be smaller than before or even negative. These findings show that the income elasticities in an approach excluding factor endowment are not necessarily due to total income alone. They may partly reflect the impact of factor endowment reinforcing the effect in capital-intensive industries and diminishing the effect in labour-intensive industries. This is confirmed by a significant positive correlation between the ranking of industries by the home-market effect calculated in the reduced approach and the ranking by capital intensity calculated in the enlarged approach. In our enlarged approach, there is no correlation between the rankings by home-market effect and by capital intensity.

Figure 3 presents the *elasticities of relative capital endowment*. They indicate that paper, precision engineering goods, wood products, non-ferrous metals, machinery, chemicals, plastic products, printing, transport equipment, electrical goods, other manufactured goods and food are capital intensive in production ( $\beta_2^a > 0$ ). On the other hand, wearing apparel, footwear, pottery, structural clay products, glass, textiles and agricultural products tend to be labour intensive ( $\beta_2^a < 0$ ). The same result holds for petroleum products, which does not seem to be reliable. As for the characteristics of demand the *per capita income elasticities* in Figure 4 indicate that wearing apparel, furniture, footwear, printing, other manufactures, plastic products, pottery, wood and glass products are luxuries ( $\beta_4^a > 0$ ), whereas industrial chemicals as well as iron and steel tend to be necessities in consumption ( $\beta_4^a < 0$ ).<sup>21</sup>

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<sup>21</sup> These results may be compared with those from Bergstrand (1989) and Fidrmuc (1998) for one-digit SITC groups, in Vittas and Mauro (1997) and Festoc (1995) for selected two-digit SITC categories. The studies refer to trade among EU member countries or to a larger sample of OECD countries. The results differ, depending on the year and the sample of countries. All in all, the values of the exporter per capita income elasticities as a proxy for capital endowment suggest that machinery and transport equipment, chemicals, raw materials and fuels are capital intensive in production whereas miscellaneous manufactured articles, in particular clothing, are labour

From the point of view of a capital-rich and high-income country, both high capital endowment and high per capita income contribute to comparative advantage in industrial chemicals (capital-intensive necessities), both supply and demand side contribute to comparative disadvantage in wearing apparel, footwear, pottery and glass (labour-intensive luxuries). For wood and plastic products the positive effect of capital intensity on comparative advantage is diminished by demand characteristics of a high per capita income, in furniture the net effect is even negative because the demand side outweighs the supply side (capital-intensive luxuries). There is no significant correlation between the ranking of sectors by production and demand characteristics. All in all, the traditional comparative advantage effects in trade among OECD countries are determined more by production characteristics than by demand conditions.

The empirical results of our approach are summarised in Table 1. It presents the industries which have a home-market effect, ranked according to the size of that effect, and it shows (i) whether their products are capital or labour intensive and (ii) whether the goods are luxuries or necessities. The compilation suggests that the home-market effect surfaces in numerous manufacturing industries which may be capital intensive or labour intensive and which tend to produce luxuries. The conclusions are confirmed by rank correlations including all manufacturing sectors. The rank correlation coefficient between  $\beta_1^a - \beta_3^a$  and  $\beta_2^a$  is zero or slightly negative, i.e. the differentiation of products measured by the size of the home-market effect is not positively correlated with the capital intensity of production as it is often assumed, e.g. in Helpman and Krugman (1985) or Lawrence and Spiller (1986). On the other hand, the home-market effect tends to be larger the more the goods are luxury ( $r$  between  $\beta_1^a - \beta_3^a$  and  $\beta_4^a$  is positive, the significance varies depending on the variant).

To sum up, the ranking of industries according to their degree of differentiation as measured by the home-market effect does not correspond to their capital versus labour intensity. This is in line with Bergstrand (1990: 1223) assuming that product differentiation is not linked to factor intensity and confirms the empirical examination of Evenett and Keller (2001: 10) who did not find a correlation between the capital intensity of products and various proxies of the degree of differentiation. On the other hand, our results give limited support to the assumption that differentiated goods are luxuries (Bergstrand 1990:1223).

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intensive. The importer per capita income elasticities suggest that miscellaneous manufactured articles, manufactured goods classified chiefly by material and food tend to be luxuries in consumption whereas chemicals, raw materials and fuels tend to be necessities.

Table 1

**Characteristics of industries which have a home-market effect**

<u>Home-market effect</u>	<u>Factor intensity</u>	<u>Luxury versus necessity</u>
384 Transport equipment	capital intensive	.
355 Rubber products	labour intensive	luxury
324 Footwear	labour intensive	luxury
361 Pottery, china earthenware	labour intensive	luxury
342 Printing and publishing	capital intensive	luxury
362 Glass and glass products	labour intensive	.
383 Electrical machinery	capital intensive	.
382 Machinery	capital intensive	.
352 Other chemical products	capital intensive	.
356 Plastic products	capital intensive	luxury
322 Wearing apparel	labour intensive	luxury
390 Other manufacturing	capital intensive	luxury
381 Fabricated metal products	.	.
369 Structural clay products	labour intensive	.
385 Measuring, fotogr., optical etc.	capital intensive	.
<u>332 Furniture</u>	<u>capital intensive</u>	<u>luxury</u>

Source: Authors' calculations (based on import statistics for trade among 22 OECD countries, capital endowment proxied by mean years of schooling).

**V. Summary and Conclusions**

We showed that the home-market effect also surfaces in a model of monopolistic competition with differentiated products under increasing returns to scale and transport costs which accounts for traditional comparative advantage effects. The model in the spirit of Bergstrand (1989) assumes a constant elasticity of transformation of supplies among domestic and foreign markets and suggests that large countries tend to have a positive export/import ratio in

differentiated manufactures which are not likely to be substituted without considerable costs between individual markets. This is the same conclusion which follows from models such as Krugman (1980) and Feenstra et al. (1998 and 2001) which do not account for traditional comparative advantage effects. Estimating the home-market effect without accounting for the comparative advantage effect arising from differences in factor endowment may distort the results in the sense that they partly reflect the factor intensity of the product.

Our approach implies an explanation of the sectoral export/import ratios in bilateral trade as a nonlinear function of income, capital endowment and per capita income of the two countries concerned. Total income represents the market size which has a positive effect on the export/import ratio in most manufacturing industries whereas it has no or even a negative effect in raw materials and in resource-intensive goods. This finding largely confirms the results of other studies on the home-market effect using a gravity-type approach. In a specification concentrating on total income the results are biased at the advantage of capital-intensive industries, in our specification considering factor endowment separately we also find a home-market effect for labour-intensive industries. Davis and Weinstein (2003) applying a different methodology also find a home-market effect for many manufacturing industries which are, however, different from our list. They find that effect only for a “home market” including nearby countries whereas we find a home-market effect for the national market size.

In sum, the empirical evidence shows that the home-market effect appears in a large number of manufacturing industries which may be capital intensive or labour intensive, i.e. in most industries the “revealed comparative advantage” measured by the export/import ratios from trade statistics is shaped by both the home-market effect and factor endowment. Thus, the comparative advantage of low income countries arising from relative factor endowment, in several labour-intensive industries can be partly offset by the larger economic size of high income countries. On the other hand, the traditional comparative advantage of high income countries, in several capital-intensive industries can be strengthened by their economic size. The importance of the home-market effect, however, varies across industries. It is largest in transport equipment, rubber products and footwear.

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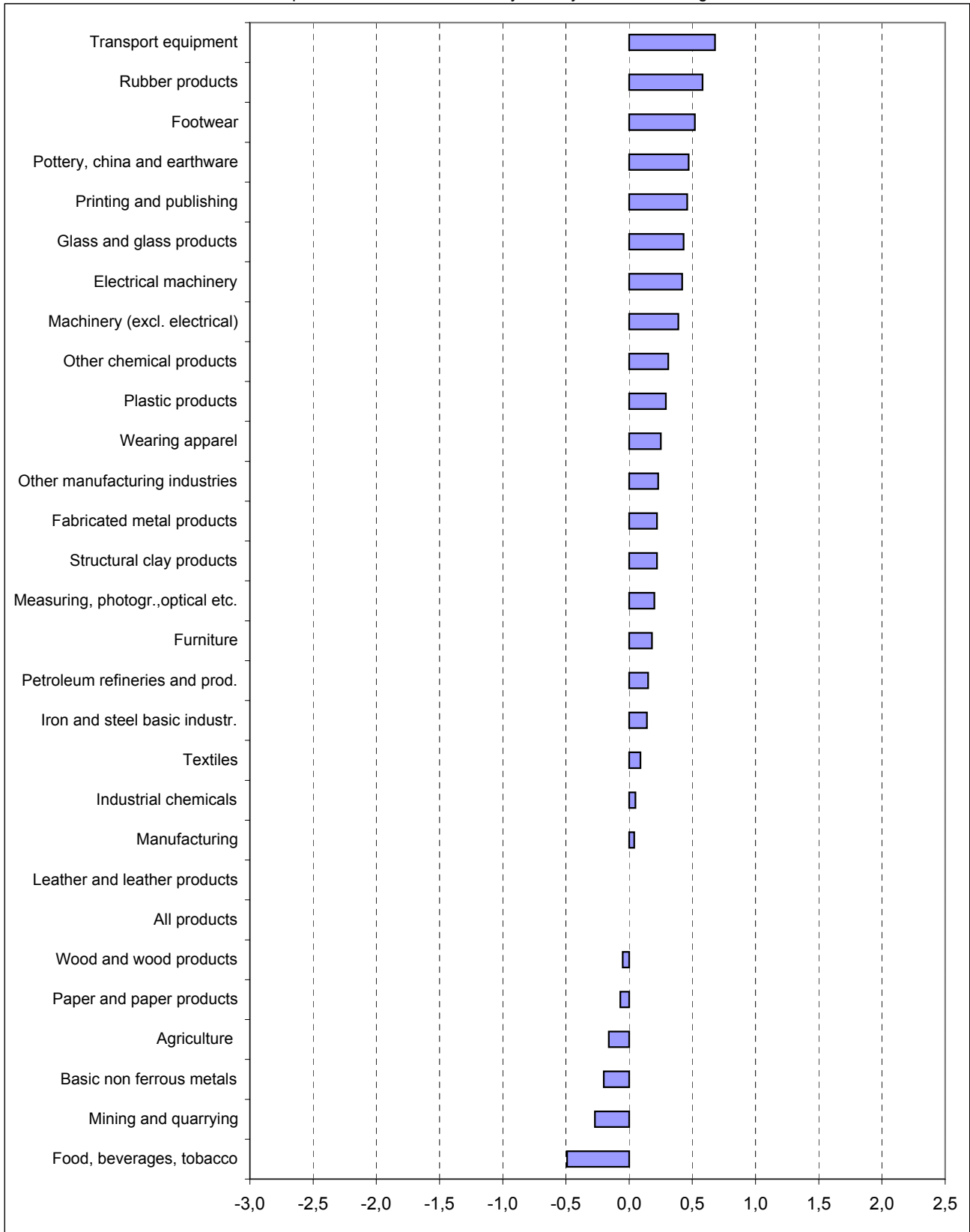
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Figure 1

Effect of relative size on the export / import ratio ( $\beta_1^\alpha - \beta_3^\alpha$ )  
 Import statistics for trade among 22 OECD countries  
 Capital endowment measured by mean years of schooling

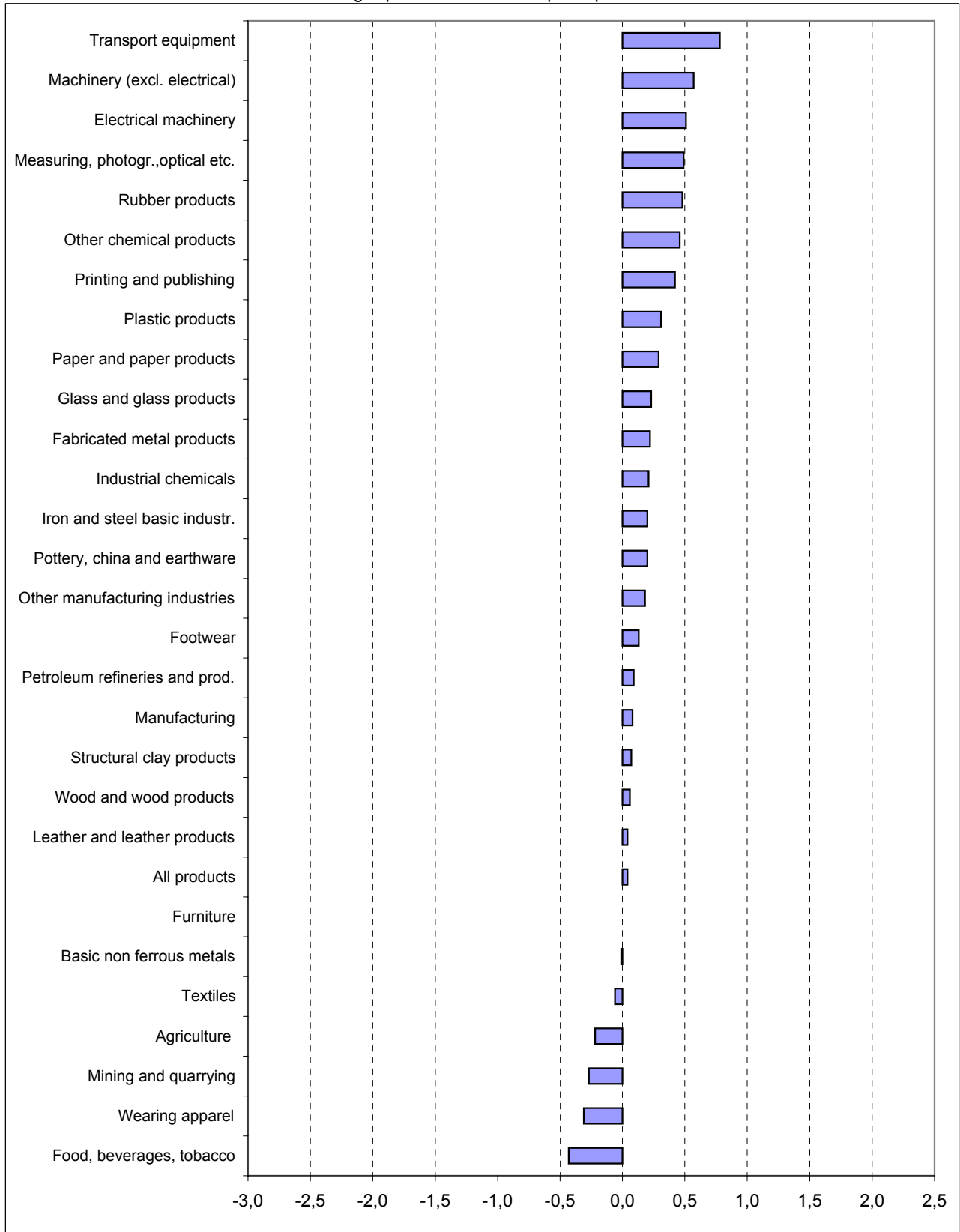


Source: Authors' calculations, for method see text.

Figure 2

Effect of relative size on the export / import ratio ( $\beta_1^\alpha - \beta_3^\alpha$ )

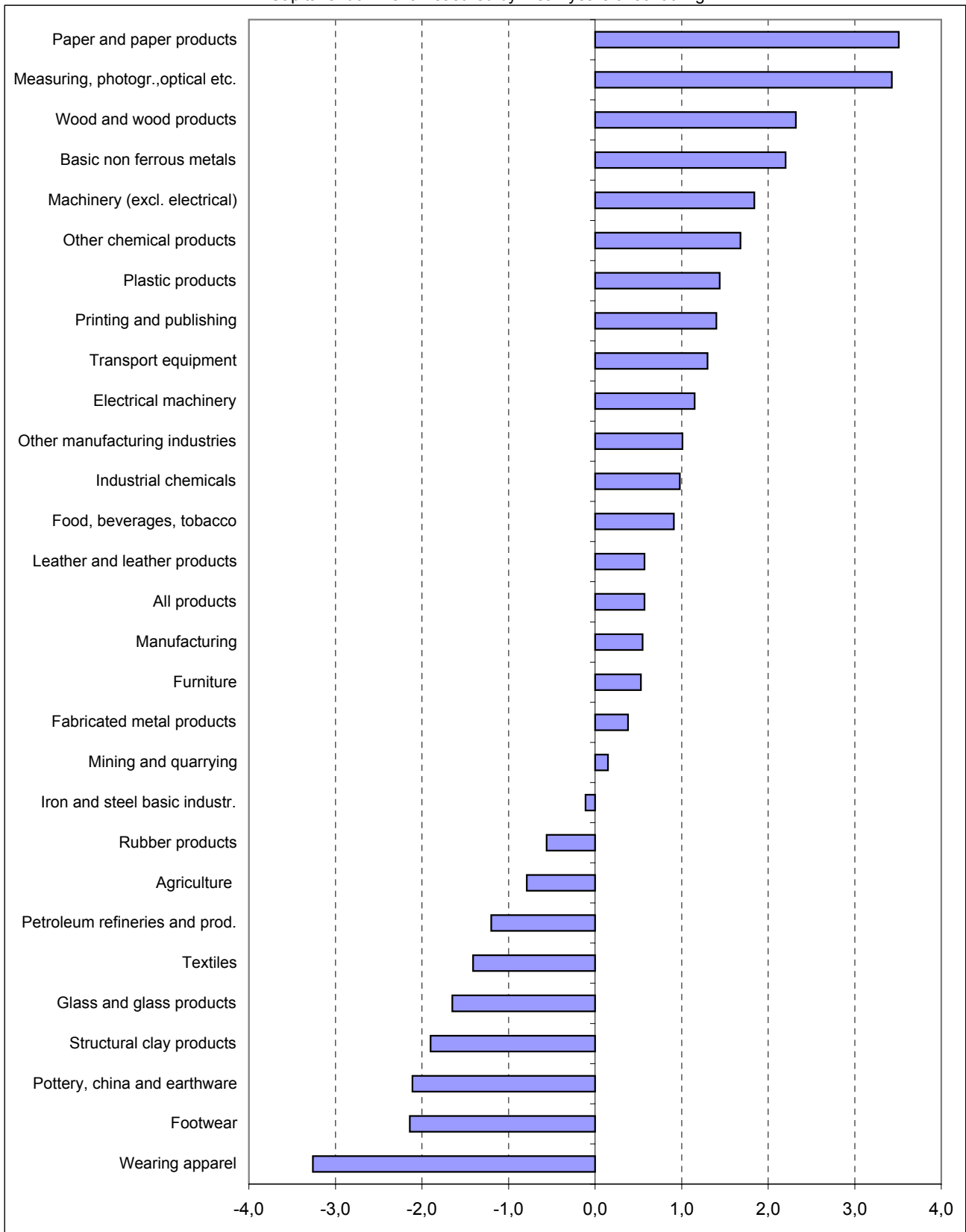
Import statistics for trade among 22 OECD countries  
excluding capital endowment and per capita income



Source: Authors' calculations, for method see text.

Figure 3

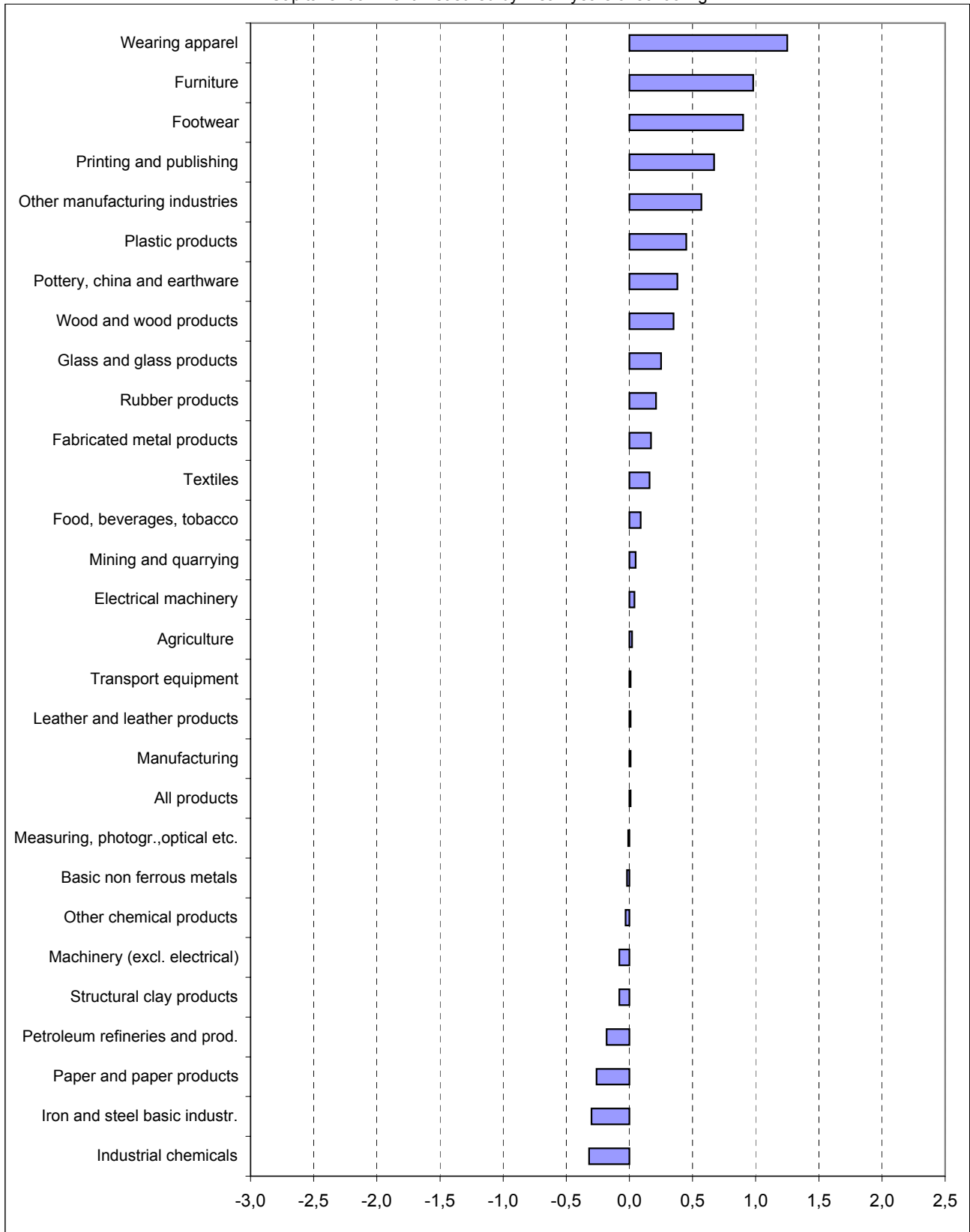
Effect of relative factor endowment on the export / import ratio ( $\beta_2$ )  
 Import statistics for trade among 22 OECD countries  
 Capital endowment measured by mean years of schooling



Source: Authors' calculations, for method see text.

Figure 4

Effect of per capita income on the export / import ratio ( $\beta_4$ )  
 Import statistics for trade among 22 OECD countries  
 Capital endowment measured by mean years of schooling



Source: Authors' calculations, for method see text.