Does Specialization Matter for Growth?

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The question concerning the extent to which the growth performance of an economy is determined by its external relations is a controversial one. There are several approaches which stress the interaction between international factors and domestic growth performance. In the Keynesian tradition, Kaldor and Thirlwall have argued that exports and trade performance are the main determinants of growth. This paper takes different elements from these and other theoretical approaches, and combines them into a framework that stresses the importance of specialization for economic growth. The paper applies a data set on growth and trade in 11 manufacturing sectors, for the period 1965–1988, for the OECD area. The main novelty in the database is the assignment of 75 products in the trade data to the 11 industrial sectors. The relationship between growth and specialization has been tested by running a regression with the sectoral growth of value added as the dependent variable, and several variables, including some measuring specialization as well as other factors, as the independent variables. The regression results presented seem to indicate that specialization does indeed matter for economic growth. However, this impact seems to be gradually wearing off during the 1980s, as is the case for other factors included in the regression analysis.

1. *Introduction*

In the field of economic growth theory, a major question concerns the differences in growth performance between nations. Traditionally, i.e. in the neoclassical growth model due to Solow (1956), growth was viewed as determined by a country's resources. Technological change was seen as exogenous and equally available to all countries. Thus, in this framework,

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growth only depends on the availability of labour and capital. In the long run, all countries converge to an identical steady state, but in the short run, growth rate differentials may arise due to so-called transitory dynamics.

In recent so-called 'new' growth models, e.g. Lucas (1988) and Romer (1990), the purely resource-based point of view is abandoned in favour of technological change as an endogenous phenomenon. Although the extent to which countries invest in technology is still also determined by its resources (in this case human capital), parameters such as technological opportunities and efficiency of the R&D process now enter the analysis. Moreover, a very important role is played in these models by increasing returns to scale due to Marshallian externalities in the R&D process.

A third perspective on economic growth argues that growth is to an important extent determined by the external relations of a country. However, this idea is a controversial one. For example, Krugman (1994) has forcefully argued that the issue of competitiveness, which underlies the idea that growth is determined by the performance in international product markets, does not make sense from a theoretical point of view.

The idea of a relation between trade performance and economic growth is not identified strictly with one type of literature within the field of economic growth. Many of the models in the new growth tradition derive a relationship between trade and growth (e.g. Grossman and Helpman, 1991; Rivera-Batiz and Romer, 1991). Outside the mainstream, there are also several approaches which stress the interaction between international factors and domestic growth performance. In the post-Keynesian tradition, Kaldor (1966, 1970) and Thirlwall (1979) have argued that exports and trade performance are the main determinants of growth (see also Boggio, 1996). Their approaches, which characterize growth as 'export-led', or as 'balance of payments restricted', stress the impact of demand on growth.

As will be argued in the next section, which briefly surveys the literature on growth in open economies, an important issue in this literature is whether or not the specialization pattern of a country has an impact on growth. Thus, the question is whether countries that are specialized in a particular activity have a higher growth potential than other countries. The literature identifies two sources for such a relationship: demand-side sources (e.g. income and price elasticities of demand) and supply-side factors (e.g. technological opportunities).

The aim of this paper is to test the hypothesis that specialization matters for growth at the sectoral level, and confront it with the two other perspectives on growth indicated above (purely resource-based growth and purely technology-based growth). To this end, a new data set will be presented and used in a regression model in which the different sources of growth are modelled. This model will be developed and estimated in Section 3 of the paper. Section 4 summarizes the argument and draws some conclusions on the policy implications of the findings.

2. *Trade, Specialization and Growth*

Growth models in the 'Solow tradition', as well as the so-called 'new growth' models, take a production function as the main determinant of economic growth. Because of the (implicit) assumption of full utilization of factors such as labour and capital, and given the functional form of the production function, growth of production is simply the result of the growth rate of inputs (labour and capital) and their productivity increases.

As summarized in Dowrick (1997), the impact of trade in the traditional models is thus mainly an indirect one, related to the issues of allocation and factor prices. The idea here is that an economy that is opened up to international trade can benefit from a more efficient allocation of its production factors (along the lines of the HOS theory), and the resulting lower consumer prices. Thus, welfare is higher in an open economy as compared to a situation where domestic markets are protected by tariffs or quota. However, typically, so-called CGE models indicate that these welfare effects are relatively small (Dowrick, 1997).[1]

Within the more recent so-called new growth theory, Dowrick (1997) distinguishes between two approaches: the Smithian approach and the Ricardian approach. The Smithian approach, with authors such as Rivera-Batiz and Romer (1991) and Rivera-Batiz and Xie (1993), stresses the importance of 'learning-by-doing' or increasing returns to scale. Opening up to trade enables individual countries to specialize in a narrow range of goods, and thus exploit these increasing returns. The difference relative to the traditional CGE-type models discussed above is that, due to the endogenous growth nature of the models in the Smithian tradition, there will be a long-run effect on growth, rather than just a level effect in terms of welfare.

In the Ricardian type models, different activities are characterized by different rates of growth of productivity, e.g. due to differences in technological opportunities. Thus, countries specializing in activities with higher rates of productivity growth are in a better position to achieve fast overall growth. Grossman and Helpman (1991) is an example of such a model. Note, however, that, as in the Grossman and Helpman model, it is not obvious that

[1] The welfare gains are generally larger in situations where increasing returns to scale characterize the production process, possibly in combination with product differentiation.

a higher rate of productivity growth also implies a higher growth rate of real consumption. However, especially in situations where knowledge does not spill over national borders, there is opportunity for national governments to change the specialization pattern of its economy, and hence the growth path.

As acknowledged by Dowrick (1997), the idea of a relation between trade and growth is not new. The dynamic analysis of Keynesian models, long before new growth theory, established the idea that trade matters for growth. As in the recent neoclassical models discussed above, the argument comes in two flavours here (e.g. McCombie and Thirlwall, 1995). First, there is the export-led growth theory, which, following Kaldor (1966, 1970), argues that the economy is not constrained by supply-side factors, because the main production factor, capital, must be seen as an endogenous factor. Should capital constrain economic growth in the short run, so it is argued, increased profits will solve this constraint in the medium to long run. Thus, only natural resources (which are indeed exogenous) are accepted as a possible supply-side factor constraining economic growth (McCombie and Thirlwall, 1995, p. 392).[2] Seen in this way, the only truly exogenous factor to the domestic economy is foreign demand (domestic demand is endogenous to the extent that it is determined by savings behaviour and wages).

The second variety of the post-Keynesian theory on trade and growth is mainly due to Thirlwall. Thirlwall (1979), although operating in the same post-Keynesian theoretical framework as Kaldor, argued that the 'simple' export-led growth theory does not take into account the role of the balance of payments. For example, in the model by Dixon and Thirlwall (1975), export growth, and thus output growth, is not constrained at all, even if the balance of payments, which is not explicitly modelled, grows without bounds. Viewed from the balance of payments point of view, demand elements (domestic demand for imports as a fraction of domestic GDP, and domestic exports as a function of foreign GDP) are again the main determinants of growth.

McCombie and Thirlwall (1995, p. 392) set out a model of balance of payments restricted growth, which implies that a non-zero growth rate differential between the domestic economy and the rest of the world may arise as a result of long-run differences in the rate of inflation, as well as differences in the income elasticities of demand for the countries' exports. The proposition made by Thirlwall (1979) is that the long-run effect of differences in

[2] Kaldor (1966) also forcefully argued that labour must be seen as an endogenous factor, due to labour reserves contained in the primary sector of the economy, which, by the nature of industrialization, is contracting, and therefore 'hides' labour available for industry.

inflation is small, so that differences in the income elasticities of demand are the main reason for growth rate differentials.

As was argued by Fagerberg (1988), the main problem with Thirlwall's theory is that it does not provide an endogenous explanation of the differences between the two income elasticities. Fagerberg argued that one might explain these differences by drawing on 'evolutionary' inspired theories of growth, which stresses the impact of factors such as product quality and R&D efforts.[3] In the 'evolutionary' literature on economic growth, (stochastic) technological change plays an important role. For example, in evolutionary models by Verspagen (1993) or Dosi *et al.* (1994) technological competitiveness of a country determines the growth of its export market shares. Differential rates of growth of the total market size in different sectors, under the influence of income elasticities, as in Pasinetti (1981), imply that different sectors grow at different rates, such that specialization matters for growth.

Boggio (1996) rightfully argues that the evolutionary models, in many important respects, resemble the early and later post-Keynesian models that were discussed above. He argues, however, against a strict interpretation of the concept of balance of payments constrained growth, and shows that in models of national growth partly based on 'evolutionary notions', trade balance disequilibrium may indeed be related to rapid growth in a Kaldor–Verdoorn framework. One important difference between the 'evolutionary' growth model by Verspagen (1993) and the work in the post-Keynesian tradition outlined in this section, however, is that the latter does not attach much importance to the issue of specialization. In the export-led growth theory, specialization does not play a large role, as is illustrated, for example, by Dixon and Thirlwall (1975), who present a one-sector model, which by definition excludes specialization from the analysis. In the literature on balance of payments constrained growth, specialization patterns may be seen as entering the growth equation indirectly, through the elasticities of imports and exports. But this is at best only one of the many interpretations that can be given to the differences in elasticities, and a more elaborate empirical analysis, as done by Fagerberg (1988) with respect to product quality and technological factors, is necessary to establish the empirical importance of this argument.

How does all this relate to the question as to what is the relationship between economic growth and specialization? The common conclusion from the literature discussed in this section seems to be that this relationship takes two forms. First, as is argued by both the new growth theorists ('Smithians') and the Kaldorian export-led theory, specialization, by opening up possi-

[3] These factors, which at the time were typical for 'evolutionary theories', have now been incorporated also into new growth models.

bilities for increased specialization, leads to higher productivity growth in the form of learning. In this argument, the emphasis is not so much on what a country specializes in, but rather whether it specializes, irrespective of the nature of the specialization.

Second, some activities might provide larger growth opportunities than others, and therefore it matters in which activities a country is specialized (the 'Ricardian' view). The reasons for this might be supply-side related (e.g. differential technological opportunities between activities) or demand-side related (e.g. differential income elasticities between activities). In the neo-classical (or new growth) version of this argument, an additional complication is formed by the interrelatedness of the economy in the form of general equilibrium. An exact modelling of the result of specialization on growth thus not only requires the modelling of learning, but also of the evolution of factor prices and the resulting allocation.

The next section will take as its point of departure the Ricardian view that the growth rate of an economy depends, at least partly, on what it is the country is specialized in. This point of view will be incorporated into a regression model which tests the 'Ricardian hypothesis' jointly with the hypotheses that growth depends on resources and technology.

3. *Growth and Specialization: Regression Analysis*

The hypothesis we derive from the discussion in Section 2 is that there are some 'activities' that are more conducive for growth than others. What we mean by 'activities' will be specified below. An alternative hypothesis is that economic growth is solely determined by resources (labour and investment, as in the Solow model) or technological change (as in new growth models of endogenous R&D).

In order to test these hypotheses, we set up a model that we derive from the general set-up that is often used in cross-country growth regressions (e.g. Barro and Sala-i-Martin, 1995, ch. 12). This specifies the growth rate of output as follows:

$$q = f\left(y_0, \beta x\right)$$

Here, q is the growth rate of output, y_0 is initial productivity, β is a parameter vector and x is a set of (exogenous) variables determining the steady-state (or long-run) growth rate.[4] βx is thus the expression for the long-run growth rate,

[4] Note that it is more common to use GDP per capita in the LHS of the equation. However, we will include the growth rate of inputs, including labour, in x, so that our specification encompasses the common one.

while y_0 measures the initial deviation from the long-run path. In other words, we assume that growth is influenced on the one hand by a set of variables with a long-run impact, and on the other hand by 'transitory dynamics'. Note that these transitory dynamics can be interpreted in many different ways. For example, it may indicate 'catching-up' based growth (see Fagerberg, 1994), as well as convergence in a Solow-based model.

The variables associated with our hypotheses are assumed to be included in the vector x, and (apart from the specialization variable) can be said to be standard variables in cross-country growth regression models (Levine and Renelt, 1992; Fagerberg, 1994).[5] The model is then made operational in the following way:

$$\hat{Q}_{ijt} = \alpha_{jt}\hat{L}_{ijt} + \beta_{jt}\hat{K} + \gamma_{jt}T_{ijt} + \delta_{jt}U_{ijt} + s_{jt}S_{ijt} \tag{1}$$

In this equation, Q is value added (in fixed prices), L is labour input, K is capital input, T is a proxy for technology investment, U is a variable related to international technology diffusion, S is a vector of specialization variables to be defined more precisely below, α, β, γ, δ and s are parameters, and the subscripts i, j and t indicate a country, sector and time period respectively. Hats indicate proportionate growth rates. L and K capture the effect of purely resource-driven growth. T captures the effect of active technology investment as it is found in new growth theory (e.g. Romer, 1990). U is a variable related to technological catch-up or convergence, i.e. it captures the effect of a country's growth path deviating from its long-run path (steady state). Our preferred interpretation of this variable is that countries with an initially backward position may be expected to grow relatively fast due to international diffusion of technology (see, for example, Fagerberg, 1994, for an overview of theories on catch-up), but, as argued above, it may also be interpreted as 'Solowian' convergence.

S is the variable of main interest for our chief hypothesis. In order to explain this variable, we need to specify what we mean by 'activities'. The national accounts framework usually divides economic activities into sectors. At the usual level of aggregation (say 20 sectors within manufacturing), these sectors are still made up of rather heterogenous activities. For example, in a sector 'transport equipment', one would find both the manufacturing of bicycles and aeroplanes, while in 'office machines', one would find photocopiers and computers. In order to capture this heterogeneity, we use a database on export

[5] It should be pointed out that the specification of the model is not strictly consistent with the post-Keynesian theories, discussed in Section 2, as factors of production are seen as being endogenous within this approach.

values for 75 products, each of which can be assigned to one of 11 manufacturing sectors. These trade data are taken from the IKE trade database (main source: OECD).

We interpret the 75 product classes as homogenous 'activities'. Thus, when we speak about a country being specialized in a certain activity, we mean that it scores a high value on the specialization index (to be defined below) for that particular product class. Because of the assignment of the 75 product classes to the 11 industrial sectors, we are able to say something on specialization within those sectors.

In setting up the 75 product groups, our aim was to establish relatively homogenous groups. Thus, in some cases (where the sector itself is already relatively homogenous) we get a relatively small number of products (e.g. wood and wooden products). In case of a more heterogenous sector we define a larger number of products, like in the case of 'transport equipment', where we have 11 products within one sector. The breakdown of the 11 sectors into activities (product classes) is documented in the appendix tables.

The variable S is measured using the trade data for the 75 product classes. The first step in this measurement procedure is to define a sectoral specialization index, for which we use the well-known *revealed comparative advantage* (RCA) index. In raw form, this index is written as

$$RCA_{ip}^{j} = \frac{X_{ip} / X_{p}}{X_{ij} / X_{j}} \tag{2}$$

where X is the value of exports, the superscript j indicates within-sector j RCA, and the subscript p is a product group belonging to sector j (i, as before, indicates a country). Thus, the RCA index for product p in country i and sector j is defined as i's share in total exports of p divided by i's share in total exports of sector j. Because the RCA index is not symmetric (values for negative specialization are squeezed into the interval $[0,1\rangle$, while values for positive specialization are in $\langle 1,\infty]$), we apply the transformation RCA* = (RCA − 1)/(RCA + 1). This yields values in $[-1,0\rangle$ for negative specialization, and values in $\langle 0,1]$ for positive specialization. Neutral specialization corresponds to a zero value. In summary, a positive (negative) value for product p indicates that the corresponding sector j in the country is specialized (despecialized) in that particular product.[6]

In principle, one could define S simply as the vector of product-wise

[6] Note that within each sector, a country is always specialized in some products. Thus, even if a country is despecialized in the sector taken as a whole, it will be specialized in some of the product classes.

specialization indices, in which case S would have as many elements as there are product classes in a sector. This procedure has the major disadvantage, however, that in many cases there are many product classes as compared to the number of countries in our data set. In other words, using such a procedure, the number of degrees of freedom would become quite low.

We therefore implement a second step in our procedure of measuring S by applying principal components analysis to the data for RCA^{j*} for four key years: 1965, 1973, 1979 and 1988. These years all (roughly) correspond to peaks in the business and trade cycles, so that our data are not over-influenced by cyclical variations in export market shares or exchange rates. Principal components analysis, a form of factor analysis, is a technique aimed at data reduction; it estimates linear combinations of the underlying variables, in this case the specialization indices, which 'explain' the highest possible fraction of the remaining variance in the data set. Thus, the first principal component is estimated to explain the highest possible fraction of the total variance, the second principal component the highest possible fraction of the variance not explained by the first principal component, etc. By maximizing the 'explained residual variance' in each round, the first m principal components will explain a relatively large proportion of the total variance, which is why the technique is used for data reduction.

The result of this procedure is a number of variables (usually two or three) for each sector, which give a 'synthetic' impression of differences in specialization patterns per country. The value of each variable itself does not have a direct interpretation, because they are a linear combination of the underlying RCA values. The coefficients of this linear combination (the so-called factor loadings) are documented in the appendix tables. The next section will make use of the signs of these factor loadings in combination with the estimated regression coefficients. In this section, it is only the question whether or not the estimated regression coefficients are significant which interests us, not the numerical value or sign of the estimated coefficients.

The regression analysis makes use of data for the period 1965–1988, and 20 OECD countries {Austria, Belgium, Canada, The Netherlands, Portugal, Spain, France, Germany (West), Switzerland, Denmark, Sweden, Norway, Finland, Japan, the United Kingdom, the United States, Greece, Turkey, Ireland, Italy}. We estimate separate equations for three periods: 1965–1973, 1973–1979 and 1979–1988. The breakpoints between these periods correspond to the peaks of the international business cycle. All our variables, except those related to specialization and catch-up, are simple means over the complete period, with growth rates defined as annual compound rates. Besides the specialization variables, equation (1) includes four other variables:

the growth rate of employment (*GL*, measured in persons, rather than hours), the investment-output ratio (*I*, as a proxy for the growth rate of capital), the number of patents granted in the United States per employee (*P*) as an indicator of investment in technical change, and the ratio of value added per employee in the country/sector relative to the maximum value for the sector in the 20 countries sample (*CU*). The latter variable is measured for the initial year of the period for which growth rates are measured. Given the interpretation of this variable as a catch-up variable, we would expect a negative sign for it in the regressions. The signs for the other non-specialization variables are all expected to be positive.

The patent data we use are taken from the US patent office, and concern patent grants, dated by the year of grant. The attribution of patents to countries and industrial sectors is done by the patent office. Whenever a patent is attributed to more than one, say *m*, sector, the patent is counted as 1/*m* in each of these. We choose to work with US patents because, rather than patent statistics from each of the national patent offices, these are subject to a common institutional system (novelty requirements, etc.), and, moreover, the United States, for most of the period under consideration, constituted the largest 'technology market' in the world. Because we would expect US firms to have relatively much patents due to a 'home-market' effect, we include a dummy for the United States in the regressions (DUSA). The data for the growth rates of value added, *CU*, *GL*, *I* and the employees data used in *P* is taken from the UNIDO Industrial Statistics Database.

As equation (1) specifies, we expect the value of parameters to be estimated to differ between sectors. Given the limited number of observations within each sector, however, we choose to pool our data in the cross-section dimension, allowing for two broad classes of sectors: so-called *high-tech* sectors (defined as chemicals, machines, electrical goods, transport equipment and instruments) and *low-tech* sectors (all other sectors). This broad classification has proven to be useful in estimating production structures and the impact of R&D on productivity in an earlier paper (Verspagen, 1995).

The resulting data set is one in which we have 11 sectors (no patent data are available for two other sectors, i.e. wood and other manufacturing), and 20 countries, leading, in principle, to 220 data points for each period. Due to missing values in some of the data, however, we have a smaller number of observations in each case. For the first period, this problem is worst, with only 98 data points available. We estimate the impact of the variables *I*, *GL*, *CU* and *P* separately for the two groups of sectors, and denote this by the variable symbol together with '-high' or '-low'.

The specialization indices are defined meaningfully only at the sectoral level, so we estimate their impact for each sector separately. We included up to three of the principal components in the final estimates presented below, although we experimented with more in some sectors. The resulting setup is one in which the principal components included in the regression pick up at least 60% of the total variance of the specialization data (see appendix Table A2). Including the fourth, sometimes fifth, principal component did not change the results in a major way. We denote the principal components by F*i*–s*A*, where *A* is the number of the sector, and *i* is the *i*th principal component.

We would expect that the impact of specialization on the growth performance of large countries may be smaller than in the case of small countries. The reason for this expectation is that smaller countries might be more dependent on their external relations, and because small countries are in general more specialized than large countries (Balassa, 1965; Dosi *et al.*, 1990). Hence, an additional variable is included for all of the three principal components included in the regressions, defined as F*i*–s*A***DL*, where *DL* is a dummy variable set to 1 for large countries.[7] Note that this variable, because it is entered in the equation in an additive manner, is only meaningful if the sectoral specialization variables all enter the regression equation with the same sign. However, because of the way the specialization variables are constructed, we do not have *a priori* expectations on this sign. In order to ensure the meaningfulness of the large countries specialization variable, we started with an initial regression including all specialization variables with their original sign. In the next step, we multiplied all specialization variables with a negative sign in the regression by –1, thus expecting that they would turn up with a positive sign.[8] This yields a regression in which we would expect the large country specialization variable to turn up with a negative sign. However, in order to allow for a direct comparison between Table 1 and appendix Table A1 (see the next section), Table 1 presents those factors that were multiplied by –1 with a negative sign.

Table 1 documents the regression outcomes for the three periods. We discuss the outcomes for the non-specialization variables first. The growth rate of labour input is highly significant and positive in all cases. The values of the coefficients for this variable differ between periods and sectors, with the highest value found in low-tech sectors during the period 1965–1973 (this value is indeed quite high if one would reason in a neoclassical framework). In the period 1973–1979, the value for these coefficients are relatively low.

[7] France, Germany, Japan, the United Kingdom, the United States and Italy are defined as large countries.

[8] In no cases did this procedure change our conclusions about the significance levels of any of the variables in the regressions.

TABLE 1. Regression Results for the Specialization–Growth Relationship

	1965–1973		1973–1979		1979–1988	
R^2-adj	0.67		0.47		0.22	
N	98		158		164	
Variable	Estimate	t-value	Estimate	t-value	estimate	t-value
GL-low	**1.269**	6.73	**0.587**	7.14	**0.764**	5.85
GL-high	**0.532**	5.95	**0.583**	3.29	**0.817**	3.51
I-low	**0.215**	2.73	–0.012	–0.32	**0.072**	1.63
I-high	**0.388**	6.29	**0.248**	3.52	**0.223**	2.92
DUSA	**–0.025**	–1.83	**0.022**	2.58	**0.018**	1.91
Pat-low	–5.179	–0.83	–4.704	–1.10	**–13.157**	–1.84
Pat-high	**6.482**	3.83	**2.446**	1.80	4.643	1.23
CU-low	**–1.990**	–5.00	**–0.632**	–3.40	–0.092	–0.41
CU-high	**–2.780**	–8.18	**–1.596**	–4.47	–0.566	–1.53
F1–s1	**–0.011**	1.89	–0.002	0.30	0.006	0.68
F1–s2	0.004	0.53	0.001	0.22	0.004	0.96
F1–s4	**0.029**	1.91	**–0.023**	2.16	–0.007	1.07
F1–s5	–0.008	1.19	0.000	0.09	–0.007	1.58
F1–s6	**0.008**	2.74	0.000	0.19	–0.003	0.90
F1–s7	–0.006	0.67	0.007	1.17	–0.004	0.53
F1–s8	**–0.017**	2.51	**0.008**	3.25	–0.001	0.08
F1–s9	–0.007	1.05	**0.024**	3.53	–0.009	0.95
F1–s10	–0.007	0.79	–0.006	1.46	**–0.013**	1.62
F1–s11	**–0.014**	3.16	–0.001	0.08	–0.005	0.61
F1–s12	**0.011**	1.74	0.013	1.55	0.012	1.12
F1-large	–0.007	–1.28	**–0.016**	–3.41	–0.009	–1.21
F2–s1	**–0.015**	1.98	–0.001	0.16	**0.013**	1.81
F2–s2	–0.003	0.57	–0.005	1.31	–0.002	0.45
F2–s4	**–0.022**	4.68	**–0.027**	4.40	–0.008	1.21
F2–s5	–0.002	0.14	**–0.010**	1.60	**–0.010**	1.85
F2–s6	**–0.010**	3.17	**–0.010**	2.63	**–0.013**	2.63
F2–s7	–0.005	0.53	–0.008	1.38	–0.006	1.14
F2–s8	–0.001	0.21	–0.002	0.49	**–0.010**	2.02
F2–s9	0.016	1.54	–0.007	0.58	–0.017	1.34
F2–s10	–0.001	0.18	0.003	0.44	–0.006	0.74
F2–s11	**0.010**	2.60	–0.014	1.28	**0.012**	1.62
F2–s12	**0.026**	5.03	**–0.023**	1.83	**–0.024**	2.52
F2–large	–0.003	–0.46	0.002	0.34	0.009	1.22
F3–s1	–0.006	1.10	0.002	0.31	**0.012**	2.34
F3–s4	**–0.022**	3.51	**0.028**	3.88	0.002	0.69
F3–s7	0.005	0.78	–0.001	0.07	–0.005	0.71
F3–s8	0.011	1.31	**0.009**	1.60	–0.002	0.22
F3–s9	–0.001	0.27	**–0.028**	2.67	0.005	0.74
F3–s10	**–0.018**	1.84	–0.006	1.02	0.000	0.04
F3–s11	**–0.015**	4.23	**0.022**	2.37	–0.006	0.56
F3-large	0.005	1.02	0.004	0.76	–0.004	–0.93
C	**0.066**	7.47	**0.030**	4.44	**0.025**	2.37

Cells with coefficients significant at a level >10% in a two-tailed t-test are printed in bold.

The coefficients for the investment–output ratio are significant in all but one case. The one exception is low-tech industries during the period 1973–1979. For all three periods, the value of this coefficient is higher for the high-tech sectors, while the value of the coefficients tends to fall over time. The patents variable is significant and positive, as expected, in only two cases: high tech industries during 1965–1973 and 1973–1979. For low-tech industries, this variable is always negative, during the last period even significantly so, a result that is hard to explain. The variable reflecting catch-up has the right (negative) sign in all three periods. However, it is becoming of less importance over time—to the extent that it becomes insignificant in the period 1979–1988. This result is at odds with the stylized fact that convergence in terms of income per capita has more or less come to an end after 1973 (Abramowitz, 1986). The US dummy is negative during the first period, in line with our expectations about the 'home market' effect for US firms in the patents variable, but it is perfectly conceivable that this variable also picks up other influences specific to the United States.[9] For the other two periods, the US dummy is positive and significant.

Overall, the regressions tend to explain a decreasing fraction of the total variance as time increases. The adjusted R^2 falls from roughly two-thirds in the first period to slightly less than one-half in the second, to barely one-fifth of the total variance in the last period.

With regard to the specialization variables, which are the crucial part of our argument, we do indeed find many significant variables. Only in textiles (2) and basic metals (7) are none of the specialization variables significant. For the other nine sectors, there is at least one, but often more, principal component for one time period that is significant. In the first period, roughly half of all of the specialization variables are significant (14 out of 29), for the second period this is slightly less (11 out of 29), and for the last period it is even less (8 out of 29). We thus conclude that there is indeed some evidence that sectoral growth rates of production are related to within-sector specialization patterns of international trade, although the impact seems to become weaker over time.

We can only speculate as to why the specialization variables are becoming less important over time as a factor explaining growth. It might be related to the fact that our sample is not a balanced one (some observations in the sample for the last period are not present in the early period), thus reducing the phenomenon at least partly to an artificial one. It might also be the case

[9] We have also experimented with dummy variables for other countries, but in no cases did these prove to influence the results in the table in an important way, even if some of the country dummies were statistically significant for some periods.

that a 'real' phenomena, such as trade liberalization, the increased importance of FDI, or technological developments underlying the production structure have a role in this. For the time being, we will not discuss this part of our findings from a statistical point of view, but instead focus on a more 'qualitative' interpretation of our regression results in the next section.

4. *Interpretations, Conclusions and Policy Issues*

The regression results presented in the previous section seem to indicate that specialization does indeed matter for economic growth. Compared to a model in which a combination of resource-based and technology-based explanations of growth are offered, the specialization factor adds explanatory power. The theoretical frameworks that were discussed in Section 2 suggest that there are various factors that may account for these results. On the supply-side, there are factors such as the learning opportunities offered by various activities or products, while from the demand-side, income elasticities are important.

The result that the variables such as technology (as measured by patents), specialization and catching-up potential all show a weaker impact on growth during the 1980s suggests that there might be an interaction between them. For example, one hypothesis would be that catching-up in the 1960s and 1970s was mainly due to a non-activity-specific rapid learning of relatively backward economies, while in the 1980s, catching-up became an activity-specific phenomena. Some activities provide 'windows of opportunity' for catch-up, while others, e.g. due to their relatively cumulative technological nature, provide more opportunities for relatively advanced countries. This would imply that neither the general catch-up variable, nor the general specialization variable would turn up significantly in the regressions. It has to be stressed, however, that such an interpretation is rather speculative, and more research would be necessary to substantiate these ideas. We can only present some 'impressionistic' evidence based on our regressions to explore the implications of the speculations.

In order to obtain a more precise notion of which activities have had a 'positive' impact on growth, the methodology can be taken one step further. If the factor loadings from appendix Table A1 (numerically above 0.5, admittedly an arbitrary value) are combined with the regression results in Table 1, it is possible to analyse the impact of intra-sectoral specialization patterns on sectoral growth, i.e. to obtain a positive or negative impact on growth. The results of this exercise are documented in Table 2. It should, however, be kept in mind that the data reduction, itself a central aim of the principal components methodology, by definition leaves out some of the underlying information. Therefore such specific conclusions at the product level should be interpreted with caution. It should also be stressed that the specialization patterns referred to are calculated at the intra-sectoral level—the weighted average of the specialization indicator sums to zero for each of the sectors.

Applying this procedure yields a number of products which have a 'significant' impact on sectoral growth in each of the three periods. Such a procedure shows that the interpretation of our regression results is indeed one that involves a rather complex set of interacting supply- and demand-side factors. From the theoretical discussion in Section 2, it could be concluded that specialization in activities offering high levels of technological opportunity and/or in areas with high income elasticities are expected to have a positive impact on growth. From Table 2 it can be seen that in some cases (again it should be kept in mind that the principal components methodology leaves out information) this 'prediction' holds. The high demand for ships in the 1960s; high learning opportunities in drugs in the 1970s; low demand for cars in the 1970s; and the high learning opportunities/high demand for telecommunications equipment in the 1980s are all examples of cases where high technological opportunities and/or high income elasticity seem to be intuitively plausible characteristics.

However, there are also a number of cases in which the intuition is less clear. From Table 2, it can be seen, for example, that within the electrical goods sector, specialization in semiconductors in 1979 turns out to have had a negative impact on real growth in value added (of the electrical goods sector) 1979–1988, in spite of high growth of the value of international trade in semiconductors over that period.[10] Inspection of underlying data shows that only a few countries are specialized in semiconductors, including 'established' technology leaders such as Japan, the Unites States and The Netherlands (Philips), as well as less advanced countries such as Austria (where Philips has many of its production facilities) and Portugal (which has a relatively low export volume in electrical goods). Although these countries (perhaps with the exception of Portugal) have seen the volume of their semiconductor exports increase significantly over the period, they have also experienced increasing competition by catching-up nations, which have been growing rapidly, but only in selected product-segments, like telecommunications equipment.

This result seems to suggest that what we know from theory concerning

[10] The fact that plastics had a negative impact on growth within chemicals, as well as the negative impact of cars within transport in the 1960s, are other results that do not square with what was expected from a theoretical point of view.

TABLE 2. The Impact of Intra-sectoral Specialization Patterns on Growth, 1965–1988

Sector	Positive impact on growth	Negative impact on growth
1965–1973		
food, beverages, tobacco	fish, alcoholic beverages	meat, cereals, non-alcoholic beverages, tobacco, other, animal food, oils
textiles, clothes, leather		
chemicals	inorganic, other	dyeing, drugs, plastic, organic
rubber and plastic products		
glass, clay, etc.	building materials	sanitary, glass, pottery, other
basic metals		
simple metal products	scrap metal	hand tools, stoves, furniture
machines		
electrical goods	other	white goods, medical
transport equipment	ships	auto engines, locomotives, other railway, cars, trucks, auto parts, non-motor
instruments	measuring, photo	medical, clocks
1973–1979		
food, beverages, tobacco		
textiles, clothes, leather		
chemicals	organic, dyeing, drugs, oils	inorganic, fertilizers, plastic, other
rubber and plastic products		other
glass, clay, etc.	glass	pottery
basic metals		
simple metal products	stoves, furniture	wires, screws, scrap
machines	specialized, other	computers, office machines, metal working, textiles, firearms
electrical goods		
transport equipment	non-motor	cars
instruments	photo	optical
1979–1988		
food, beverages, tobacco	alcoholic beverages	cereals, vegetables, non-alcoholic beverages, fish, animal food, oils
textiles, clothes, leather		
chemicals		
rubber and plastic products		other
glass, clay, etc.	sanitary	pottery
basic metals		
simple metal products	hand tools	scrap
machines		
electrical goods	telecom, white goods	tv etc., semiconductors
transport equipment	aero engines, auto engines, non-motor, ships	trucks
instruments	medical	optical

Product groups with positive (negative) impact are those for which the principal component is significant in Table A1, and the product group has a factor loading >0.5 (<–0.5). Factor loadings for principal components which enter the equations in Table A1 with a negative sign have been multiplied by –1.

the characteristics of the activities being conducive to growth in terms of high levels of technological opportunities and/or high income elasticities is not enough *per se*. We need to take into account appropriability conditions as well. Specifically, our interpretation of the negative impact of semiconductor specialization on growth in electrical goods production is based on the above-mentioned hypothesis that in the 1980s catching-up is highly activity specific. In the semiconductor segment of the electrical goods industry, the 'technology leaders' are in the best position, due to, for example, the short product lifecycle and high investments in this sector. The appropriability conditions in semiconductors seem to foster considerable barriers to entry. Other segments of the electrical goods industry, however, seem to provide a 'window of opportunity' for catching-up for relatively backward nations, which implies that catching-up related rapid growth in the industry as a whole is correlated with negative specialization in semiconductors.[11] Or, in other words, the capability to use (imported) semiconductors in a wide array of products may be of far more importance for economic growth than the capability to produce and export the semiconductors.

This example (others could be mentioned) indeed brings out the complicated nature of the causal relationship between specialization and growth. Demand-related mechanisms (e.g. the high income elasticities of semiconductors) may not always work in the same direction as supply-side effects (e.g. the limited opportunity for catching-up in semiconductors), and the net result is rather unpredictable from the theories that we have discussed in Section 2. Hence, this part of our conclusions calls for better theories, taking into account this kind of interaction.

Perhaps more interesting is the mixed pattern that emerges when we compare the impact of one product group across periods. In 29 cases, a single product group appears with a similar impact (negative or positive) for different periods. However, in 35 cases, the same product group appears with different impacts for different periods.[12] This seems to indicate that the stickiness with regard to the sign of the impact of specialization on growth is not very large.

Where does this leave policy-makers who want to 'steer' the economy into a high-growth specialization path? First, it has to be noted that the opportunities for such policies are probably low. Dalum *et al.* (1998) find that, within the group of OECD countries, specialization patterns tend to be sticky over the 1965–1992 period, although their conclusion is not for intra-sectoral

[11] One might thus call the negative correlation a 'statistical artefact'.

[12] These numbers are 'double-counted', i.e. if a product group appears twice with the same impact, we counted it twice.

specialization as in the present analysis. On the other hand, in terms of the 5–10 year periods that we have considered in the analysis, changes with regard to the sign of the impact of specialization on growth are quite common. Thus, the relative stability of the factor loadings in appendix Table A1 and other efforts to measure long-term change of export specialization patterns imply some degree of tension: the 'reaction speed' of specialization patterns might simply be too low to allow for an active policy. Moreover, our finding that both supply- and demand-side factors matter calls for a cautious mix of different policies: e.g. technology policies aimed at increasing the rate of innovation and learning; industrial policies aimed at changing the specialization patterns of the economy; and, within international rules, trade policies aimed at stimulating exports. It is obvious that if policies aimed at stimulating growth by specializing in the 'right' kind activities are to be successful, policy-makers must be prepared to aim at a high degree of interaction between their various instruments, as well as be willing to risk unsuccessful attempts, and admit these at an early enough stage. Enhancing growth by steering specialization patterns seems a quite risky 'art' rather than a well-established 'science' without major uncertainty.

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TABLE A1. Factor Loadings, Principal Components Analysis of Within-sector Specialization Patterns of Export Values, 1965–1979[a]

	Principal component 1			Principal component 2			Principal component 3		
	1979	1973	1965	1979	1973	1965	1979	1973	1965
1. Food, beverages and tobacco									
1 Meat	**0.85**	**0.78**	**0.55**	0.21	0.04	0.21	0.22	0.45	**0.71**
2 Fish	**–0.54**	**–0.51**	**–0.52**	0.37	0.16	–0.10	**–0.50**	–0.19	–0.31
3 Cereals	–0.00	**0.50**	**0.52**	**–0.86**	–0.06	0.17	–0.23	**–0.63**	**–0.61**
4 Vegetables	**–0.58**	–0.48	–0.17	**–0.63**	–0.34	–0.38	0.19	–0.42	**–0.59**
5 Animal-food	0.39	0.06	–0.21	0.02	**0.82**	**0.70**	**–0.66**	0.04	–0.12
6 Oils	**–0.51**	–0.47	–0.42	–0.18	**0.54**	**0.65**	**–0.69**	**–0.55**	**–0.55**
7 Non-alco	**0.51**	**0.67**	**0.80**	–0.71	–0.44	–0.23	–0.04	–0.48	–0.25

TABLE A1. *Continued*

	Principal component 1			Principal component 2			Principal component 3		
	1979	1973	1965	1979	1973	1965	1979	1973	1965
8 Alco	–0.19	–0.12	0.33	–0.15	**–0.78**	**–0.77**	**0.68**	0.11	–0.28
9 Tobacco	**0.74**	**0.77**	**0.74**	0.02	0.28	0.43	–0.21	0.02	–0.21
10 Other	**0.78**	**0.84**	**0.84**	–0.17	0.12	0.27	–0.18	–0.33	–0.16
2. Textiles, clothes and leather									
11 Raw	**0.69**	**0.64**	0.26	0.06	0.41	**0.87**	**0.72**	**0.65**	0.41
12 Yarn	**0.92**	**0.91**	**–0.92**	0.03	–0.21	0.27	–0.27	–0.24	–0.16
13 Leather	**–0.81**	**–0.65**	**0.92**	–0.46	**0.72**	–0.27	0.25	–0.12	–0.14
14 Clothing	**–0.55**	**–0.69**	–0.31	**0.82**	**–0.58**	**–0.86**	0.10	0.40	0.41
3. Wood and wooden products									
15 Products	0.35	**0.67**	**0.74**	**0.93**	**0.72**	**0.66**	0.09	0.14	0.12
16 Raw	**–0.97**	**–0.97**	**–0.97**	–0.02	0.03	0.06	0.22	0.26	0.25
17 Furniture[b]	**0.90**	**0.79**	**0.84**	–0.39	**–0.58**	**–0.51**	0.21	0.19	0.18
4. Chemicals									
20 Plastic[b]	0.32	0.13	0.35	0.02	**0.90**	**0.83**	**0.82**	0.14	0.10
21 Organic	**–0.54**	**–0.52**	–0.05	0.48	0.30	0.44	**0.54**	0.41	**0.86**
22 Inorganic	**0.80**	**0.91**	**0.80**	–0.42	–0.09	–0.25	–0.19	0.04	0.23
23 Other	–0.14	–0.24	–0.21	**0.80**	0.23	0.45	–0.36	**–0.88**	–0.72
24 Dyeing	**–0.80**	**–0.69**	**–0.54**	0.25	0.20	**0.61**	–0.19	–0.24	0.08
25 Fertilizers	**0.64**	**0.70**	0.25	0.41	–0.29	0.22	–0.45	–0.23	0.08
26 Drugs	**–0.82**	**–0.87**	**–0.94**	–0.32	–0.32	0.02	–0.21	0.02	0.15
27 Oils	**–0.57**	–0.40	**–0.57**	**–0.64**	**–0.61**	**–0.57**	–0.16	–0.09	0.27
5. Rubber and plastic products									
28 Other	0.19	0.09	**0.69**	**0.98**	**0.99**	**0.73**	0.02	0.04	0.03
29 Rubber	**–0.96**	**0.97**	**0.90**	0.13	0.04	–0.31	–0.24	–0.23	0.29
30 Plastic	**0.97**	**–0.96**	**–0.92**	–0.07	0.14	0.24	–0.24	–0.23	0.31
6. Glass, clay, etc.									
31 Pottery	0.30	0.38	0.05	**0.85**	**0.81**	**0.77**	0.03	0.36	**0.54**
32 Sanitary	0.48	**0.60**	**–0.57**	**–0.71**	–0.16	**0.68**	0.23	**0.53**	0.04
33 Glass	**0.78**	**0.70**	**–0.93**	–0.12	**–0.57**	–0.23	**–0.57**	0.06	0.03
34 Building	**–0.95**	**–0.95**	**–0.87**	–0.08	–0.05	0.19	0.10	0.08	–0.02
35 Other	**0.74**	**0.60**	–0.06	0.14	0.24	**0.53**	**0.57**	**–0.69**	**–0.69**
7. Basic metals									
36 Steel	**0.90**	**0.88**	**0.91**	0.23	0.16	0.09	0.01	0.15	0.29
37 Wires	0.23	0.34	**0.58**	**0.69**	**–0.73**	–0.02	0.16	0.14	–0.31
38 Aluminum	**–0.55**	**–0.54**	–0.49	**–0.66**	**0.68**	**0.67**	0.37	–0.21	0.27
39 Uranium	–0.08	–0.19	0.46	0.47	0.36	0.07	**0.83**	**0.78**	**–0.57**
40 Silver	**–0.73**	–0.48	–0.04	0.29	–0.17	**0.64**	0.07	**0.62**	**–0.53**
41 Copper	–0.48	**–0.70**	–0.49	**0.74**	**–0.57**	**–0.56**	–0.34	**–0.06**	**–0.60**
42 Other	**–0.72**	**–0.86**	–0.03	0.17	–0.08	**0.76**	–0.16	–0.12	–0.22

TABLE A1. *Continued*

	Principal component 1			Principal component 2			Principal component 3		
	1979	1973	1965	1979	1973	1965	1979	1973	1965
8. Simple metal products									
43 Structural	0.07	0.31	0.31	0.38	0.49	0.61	0.48	0.05	0.57
44 Wires, screws	0.44	–0.88	0.44	–0.54	–0.06	0.74	–0.53	–0.15	–0.14
45 Hand tools	0.06	–0.45	0.64	0.76	–0.76	–0.51	–0.52	–0.14	–0.28
46 Stoves	–0.85	0.92	0.66	–0.37	–0.17	–0.41	0.21	–0.08	0.31
47 Furniture	–0.57	0.07	0.66	0.56	–0.42	0.44	–0.19	0.89	–0.48
48 Scrap	0.70	–0.55	–0.88	0.25	0.65	0.24	0.43	0.34	–0.20
9. Machines									
49 Agriculture	**0.55**	0.11	**0.58**	0.02	**0.77**	0.48	0.40	0.46	0.24
50 Turbines	**0.70**	–0.38	**0.65**	0.35	**0.59**	0.23	0.32	0.17	–0.43
51 Computers	**0.51**	**–0.62**	**0.71**	**0.65**	**0.63**	0.48	–0.44	–0.17	–0.15
52 Office	–0.04	**–0.69**	**0.69**	**0.76**	0.19	–0.28	0.04	–0.38	–0.12
53 Metal working	–0.39	**–0.72**	**0.79**	0.43	–0.05	–0.48	**0.73**	0.42	–0.02
54 Textile	**–0.62**	**–0.52**	0.47	0.44	**–0.71**	**–0.74**	**0.55**	–0.04	–0.05
55 Specialized	**0.52**	**0.69**	0.12	–0.46	0.18	0.38	**0.61**	0.37	–0.76
56 Other	–0.13	**0.85**	**–0.82**	**–0.67**	0.08	0.09	0.21	–0.30	–0.22
57 Firearms	**–0.68**	–0.11	0.42	–0.04	**–0.55**	0.42	–0.18	**0.60**	**0.68**
10. Electrical goods, excluding computers									
58 TV, etc	**0.72**	**0.63**	0.49	0.18	0.04	0.06	0.29	0.08	**0.80**
59 Generating	0.29	0.03	0.33	–0.23	**0.71**	–0.45	**–0.87**	**0.50**	–0.04
60 Telecom	**–0.59**	0.18	0.24	–0.38	**–0.89**	**0.73**	0.24	0.16	**–0.52**
61 White goods	**–0.74**	**–0.88**	**0.78**	0.09	0.05	–0.34	0.26	0.23	–0.23
62 Medical	0.07	0.34	**0.86**	**–0.85**	–0.21	0.17	0.31	**0.85**	–0.16
63 Other	0.40	0.42	**–0.88**	**–0.70**	0.30	0.19	–0.00	–0.01	0.05
64 Semicond.	**0.71**	**0.67**	0.33	0.16	0.16	**0.71**	0.49	–0.27	0.35
11. Transport equipment									
65 Aero engines	**0.53**	**0.69**	**0.55**	**0.56**	0.39	**0.73**	0.38	0.36	0.12
66 Auto engines	0.44	**0.50**	**0.71**	**0.51**	0.04	–0.25	–0.27	0.41	**0.51**
67 Non-motor	0.06	–0.10	0.27	**0.75**	–0.38	**–0.67**	0.01	**0.80**	**0.56**
68 Locomotives	**0.74**	0.39	**0.54**	–0.37	**–0.66**	–0.24	–0.05	–0.18	–0.21
69 Other railway	**0.61**	0.36	**0.58**	–0.27	**–0.75**	**–0.74**	–0.42	0.23	0.03
70 Cars	**0.52**	**0.54**	**0.53**	–0.45	0.03	–0.02	0.28	**–0.64**	–0.47
71 Trucks	–0.28	0.22	0.76	**–0.58**	–0.12	–0.19	–0.34	–0.03	–0.36
72 Auto parts	**0.83**	**0.87**	**0.84**	0.01	0.04	0.31	0.06	–0.31	–0.10
73 Motorcycles	0.03	–0.03	0.32	0.11	**–0.82**	**–0.79**	**–0.89**	–0.20	–0.25
74 Aircraft	**0.77**	**0.78**	**0.69**	0.27	0.21	**0.53**	–0.22	0.29	0.23
75 Ships	**–0.50**	**–0.87**	**–0.86**	**0.56**	0.03	–0.35	–0.23	0.02	–0.05
12. Instruments									
76 Measuring	**0.89**	**0.86**	**0.77**	0.27	0.25	0.43	0.11	0.06	0.27
77 Medical	0.04	**0.66**	**–0.73**	**–0.84**	–0.45	0.28	–0.33	–0.16	–0.11
78 Optical	–0.62	–0.23	0.39	**0.51**	**–0.53**	–0.17	0.28	**0.81**	**–0.89**

TABLE A1. *Continued*

	Principal component 1			Principal component 2			Principal component 3		
	1979	1973	1965	1979	1973	1965	1979	1973	1965
79 Photo	**–0.57**	–0.11	**0.79**	–0.46	**0.82**	–0.11	**0.57**	0.39	0.08
80 Clocks	**–0.59**	**–0.89**	–0.02	0.27	–0.06	**–0.93**	**–0.69**	–0.32	0.24
13. Other manufacturing									
81 Pearls	**0.87**	**0.93**	**0.92**	0.34	0.24	0.28	0.05	0.03	0.16
82 Music	–0.31	–0.29	–0.53	**0.87**	**0.95**	**0.71**	–0.37	–0.12	–0.46
83 Toys, sports	**–0.74**	**–0.84**	**–0.63**	0.48	–0.14	0.40	0.46	–0.48	**0.66**
84 Other	**–0.84**	**–0.79**	**–0.87**	–0.39	0.07	–0.43	–0.22	**0.59**	–0.03

[a]Factor loadings with absolute values > 0.5 are in bold.
[b]We have two more products groups for the sector 'printing and publishing', however, for two product groups it does not make sense to calculate principal components, so the numbering in the table is non-consecutive.

TABLE A2. Cumulative R^2 Values for Subsequent Principal Components

Sector	1979			1973			1965		
	F1	F2	F3	F1	F2	F3	F1	F2	F3
1 Food etc.	0.32	0.51	0.70	0.33	0.53	0.68	0.31	0.52	0.70
2 Textiles, etc.	0.57	0.79	0.96	0.53	0.80	0.96	0.46	0.87	0.96
3 Wood, etc.	0.63	0.97	1.00	0.67	0.96	1.00	0.73	0.96	1.00
4 Chemicals	0.39	0.61	0.79	0.38	0.58	0.71	0.30	0.53	0.71
5 Rubber and plastic	0.63	0.96	1.00	0.63	0.96	1.00	0.71	0.94	1.00
6 Glass, etc.	0.48	0.73	0.87	0.45	0.67	0.85	0.39	0.67	0.87
7 Basic metal	0.35	0.61	0.75	0.38	0.60	0.75	0.27	0.52	0.70
8 Simple metal	0.29	0.55	0.72	0.37	0.61	0.77	0.39	0.65	0.79
9 Machines	0.26	0.50	0.69	0.34	0.58	0.71	0.38	0.57	0.72
10 Electrical	0.31	0.52	0.71	0.28	0.48	0.65	0.38	0.58	0.74
11 Transport	0.30	0.51	0.64	0.32	0.50	0.65	0.40	0.65	0.75
12 Instruments	0.37	0.63	0.83	0.41	0.65	0.84	0.38	0.62	0.81
13 Other	0.53	0.84	0.94	0.57	0.82	0.96	0.57	0.81	0.97