Structural Change in OECD Export Specialisation Patterns: de-specialisation and 'stickiness'

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ABSTRACT *This paper examines whether the OECD countries are characterised by a high degree of stability of their export specialisation patterns at the country level or not. Furthermore, we test whether the countries have become more or less specialised. In this context we distinguish between specialisation (or de-specialisation) in trade patterns on the one hand, and divergence (or, on the contrary, convergence) on the other. A specialisation process refers to a process in which specialisation intra-country becomes more dispersed (and counter-wise for de-specialisation). In contrast, a divergence process refers to a process in which countries become more different in terms of specialisation in a particular sector, across countries (and counter-wise for convergence). We examine the sensitivity for the level of aggregation, and we apply a period of nearly three decades from 1965 to 1992. Twenty OECD countries are considered. The intra-country results show that the national specialisation patterns are rather sticky, although there is a tendency for countries to de-specialise in the medium to long term. The sector-wise results display convergence both in terms of β- and σ-convergence. In conclusion, we discuss the results (de-specialisation in particular) in the context of economic integration, and furthermore we contrast the findings with similar exercises conducted on structural change in technological specialisation.*

1. Introduction

One of the main conclusions of the literature on convergence–divergence of growth patterns is that convergence has been the dominant feature among the OECD countries in the postwar period. In addition, Archibugi & Pianta (1992) and Archibugi & Pianta (1994) found convergence in aggregate (national-level) Science & Technology (S&T) indicators such as R&D intensity, patent intensity and in bibliometric indicators, in their comprehensive study of international specialisation in S&T among the advanced countries. However, at the sectoral level they found increasing technological specialisation. Also Cantwell (1989, 1991) generally found increasing technological specialisation patterns among most of the countries examined. We are going to examine three related issues, which concern trade specialisation, rather than technological specialisation. First, we want to assess whether the OECD countries are characterised by a high degree of stability of their export specialisation patterns at the country level. Secondly, we want to

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cast light on whether the 20 relatively advanced countries have become more or less specialised in terms of trade specialisation in the period in question. Finally, we want to analyse the extent to which export specialisation patterns tend to converge or diverge. The countries examined are 20 OECD countries during a period of nearly three decades from 1965 to 1992.

In this context, we will distinguish between specialisation (or de-specialisation) in trade patterns on the one hand, and divergence (or convergence) in trade patterns on the other. A specialisation process refers to a process in which specialisation *intra-country* becomes more dispersed (and counter-wise for de-specialisation). On the contrary, a divergence process refers to a process in which countries become more different in terms of specialisation in a particular sector, *across countries* (and counter-wise for convergence). This distinction is an important one, since the two kinds of processes might not, in all cases, move in the same direction, and are probably going to take place at different speeds. Thus we will discuss these differences further—in the empirical section—and test for the rate and direction of both kinds of processes.

Some theoretical considerations are presented in the following section, while Section 3 deals with the statistical methodology involved in measuring stability of specialisation patterns and whether these tend to become more or less dispersed over time. Section 4 contains the core empirical part of the paper in terms of our stability tests of export specialisation and Section 5 contains the conclusions, including a discussion of some implications for the issue of economic integration. We also discuss why the degree of technological and trade specialisation might not move in the same direction.

2. Theoretical Considerations

The contribution of this paper is mainly empirical; thus we do not have exact expectations on all our results. However, as a tool for interpretation, we will present some theoretical considerations on the forces determining the development of export specialisation patterns. As outlined in Section 1, this paper has made a distinction between an analysis conducted country-wise across sectors, and an analysis conducted sector-wise, across countries. Since these two types of analysis have got more or less different theoretical contexts and implications, we will discuss theoretical considerations with respect to the two kinds of analysis separately. Thus, Section 2.1 is more closely related to the country-wise analysis, while Section 2.2 is more closely related to the sector-wise analysis.

2.1. The Stability of Trade Patterns

In evolutionary economics it is recognised that important aspects of technology are mainly specific and tacit in nature, since it is, to a large extent, embodied in persons and in institutions, in addition to being cumulative over time. Given such a set of assumptions, firms produce things that are technically different from the things other firms produce, on the basis of in-house technology, but with some contributions from other firms and from public institutions and public knowledge (Dosi *et al.*, 1990, p. 8). In this model, firms are not likely to improve their technology, by making a survey of the complete stock of knowledge, before making technical choices. Rather, given the differentiated nature of technology, firms will try to improve and diversify their technology, by searching in zones that enable them to build on their existing technology base. Thus, technological and organisational change is a cumulative process, constraining firms in the possibilities of what they can do, by what they have done in the past (i.e. path dependency). When such a perception of technology is recognised, its development over time ceases to be random, but is constrained by the set of existing activities (Dosi *et al.* 1990, p. 8). Thus, if trade specialisation is closely related to technological specialisation at the level of the country (Soete, 1981) one should expect that specialisation patterns remain stable at the national level over long time periods.

In addition to the inherent characteristics of technology described above, vertical innovative linkages (or user–producer relationships) are likely to influence export specialisation patterns to be stable as well, given that such relationships are usually durable (Lundvall, 1988). On the other hand, a country's specialisation pattern might change incrementally due to technology based diversification (Teece, 1988), or due to the creation of new 'backward and forward linkages', possibly to the extent of the creation of new 'development blocks' (Dahmén, 1988).

From a neoclassical point of view, Krugman (1987) presents a model that predicts stability in the specialisation pattern of countries, given the presence of economies of scale. In the model, the productivity of resources in each sector, in each country, depends on an index of cumulative experience ('learning-by-doing'), creating economies of scale at the level of the industry. Thus, once a pattern of specialisation is established (e.g. by chance) in the model, it remains unchanged with changes in relative productivity acting to lock the pattern in further.

2.2. Overall Growth Performance and Divergence/Convergence in Trade Specialisation Patterns

Dosi *et al.* (1990) describe how divergence/convergence in trade specialisation patterns might be related to overall growth performance. The basic idea is that, if divergence in overall growth performance prevails, this is seen as a result of cumulative innovation, being reflected in divergence in trade specialisation patterns. If, on the other hand, convergence in growth performance is the dominant feature, then this is mainly the result of diffusion of technology, which is in turn reflected in converging trade specialisation patterns.

If the 'cumulativeness' in technological progress is not only present at the company level, but also at the level of the country, virtuous and vicious circles might arise in the pattern of international advantages and disadvantages in trade, which in turn might affect national economic performance. Thus, in this situation, economic and technological forces interact in a cumulative way.

However, despite the forces in international trade which tend to reinforce strength and weaknesses in terms of growth and trade performance, there are forces enabling backward countries to catch up. According to Dosi *et al.* (1990, p. 129) the following channels of technology transfer tend to induce convergence and the international diffusion of technology: (a) the 'free' international diffusion of codified knowledge, e.g. patents and publications; (b) processes of technological imitation, e.g. reverse engineering by late-coming companies and countries; (c) traded transfers of technology (licensing, transfer of know-how etc); (d) foreign direct investment in late-coming countries, by companies which own, among their company-specific advantages, differential technological capabilities, and (e) international trade in capital goods and intermediate components.

However, while these are all channels of knowledge and rent spill-overs, which might assist in explaining catching up, the catching up has not been unconditional, since an absorptive capacity is also required. Such a capacity has been termed 'social capability' by Abramowitz (1986), and can be described as the level of education and institutions created for the purpose of absorbing knowledge diffused internationally. Thus, rather than automatically capturing technology spill-overs, countries have to invest in the capacity to do so.

Beelen & Verspagen (1994) suggest that the catching up process involves (at least) two different, but complementary, modes. The first is by means of the mechanism of knowledge spill-overs, while the other is by means of structural change. While the first mechanism is pretty straightforward, the latter deserves further description. The latter mechanism reverses the arguments of Pasinetti (1981), who argued that the extent to which the specialisation structure of a country is similar to that of the countries operating at the technological frontier, determines the degree to which this country can catch up. The reverse argument states that, in order to catch up, a country must change its production structure in order to become more adapted to catch technology spill-overs. Furthermore, high-technology industries (or alternatively the areas of specialisation of the leading countries) generally seem to yield higher value added per unit of production. Thus, there is an incentive for followers to develop activities in high-technology sectors. From the demand-side, Pasinetti shows that the emergence of a fundamental structural change is unavoidable for an economy with increasing per capita income, since income elasticities change with the value of per capita income itself. With the level of per capita income growing, the importance of luxury goods becomes higher, and thus there will be an incentive for the firms of countries catching up to produce these goods domestically rather than importing them.

Thus, in relation to this paper one would expect trade specialisation patterns to converge in the OECD countries, given that convergence in per capita income has been a dominant feature in the postwar period, until 1973. However, since 1973, convergence has slowed down and has now nearly stopped. Nevertheless, Beelen & Verspagen (1994) argue that convergence in trade patterns will not slow down as fast as levels of per capita income, since the two modes of catching up are not likely to be synchronised in time. Accordingly, the follower country must first catch up in terms of competitiveness before convergence in patterns of specialisation can take place. Therefore, the authors argue that technology spill-overs are likely to be most important initially. Once the catching up process has gained momentum, a convergence trend with regard to specialisation structures sets in.

3. Stability of Specialisation Patterns: methodological issues

Most empirical studies of international specialisation patterns use, as a central indicator, Balassa's so-called Revealed Comparative Advantage index (Balassa, 1965), originally developed for analysis of specialisation in international trade but later also used in studies of specialisation in S&T, based on R&D, bibliometric data or patents (the latter also known as RTA—relative technological advantage). In a trade context the algebra can be set up as follows:

$$RCA_{ij} = \frac{X_{ij}/\sum_i X_{ij}}{\sum_j X_{ij}/\sum_i \sum_j X_{ij}} \tag{1}$$

The numerator represents the percentage share of a given sector in national exports—X_{ij} are exports of sector i from country j. The denominator represents the percentage share of a given sector in OECD exports. The RCA index thus contains a comparison of the national export structure (the numerator) with the OECD export structure (the denominator). When RCA equals 1 for a given sector in a given country, the percentage share of that sector is identical to the OECD average. Where RCA is above 1 the country is said to be specialised in that sector, and vice versa where RCA is below 1.

The work of Pavitt (1989) paved the way for empirical studies of the stability characteristics of technological specialisation patterns at the country level. He found positive and significant correlations between the RTA distributions, country by country, in nine out of ten OECD countries—i.e. relative stability of the RTA patterns. Such stability is interpreted as the statistical reflection of the cumulative and path dependent character of technological change at the micro level. When firms have gained some kind of competitive advantage in one field they tend to strengthen that advantage further (or go bankrupt). For the same reasons, diversification often occurs only in fields that are close to the core competence of firms.

In the present paper we are going to present a statistical test of the stability of the national export specialisation patterns. For testing purposes the Balassa measure has, however, the disadvantage of an inherent risk of lack of normality because it takes values between zero and infinity with a (weighted) average of 1.0. A skewed distribution violates the assumption of normality of the error term in regression analysis, thus not producing reliable t-statistics. In addition, the use of the RCA in regression analysis gives much more weight to values above one, when compared with observations below one. Cantwell (1989, pp. 31–32) solved the problem rather pragmatically by testing for skewness and kurtosis of his data sample. He found the distribution of the data set used to be approximately normal. However, it does not seem to hold for the export data sets used in this paper, as shown below.

Some procedures to alleviate the skewness problems have, however, been proposed, of which the logarithmic transformation of the Balassa measure is the most common (see, for example, Soete & Verspagen, 1994). A methodological problem arises when, for example, ln(RCA) is used as the basis for statistical tests—small RCA values are transformed to high negative ln(RCA) values. A change in a RCA from say 0.01 to 0.02 or vice versa has the same impact as a change from 50 to 100. A different measure (RCA − 1)/(RCA + 1), under the label 'Revealed Symmetric Comparative Advantage', RSCA, has been chosen in the present paper.[1] The RSCAs fall between + 1.0 and − 1.0 and avoid the problem of zero values, which occur in the logarithmic transformation (when an arbitrary constant is not added to the RCA). The method has the advantage of attributing *changes* below unity (zero in this case) the same weight as changes above unity. Further, the measure is the best of the alternatives discussed with respect to normality. The null hypothesis that the residuals from the regressions below are a random sample taken from a normal distribution, can be rejected, for example, for 7 out of 20 estimations for the long term period using the RSCA, case for 18 estimations for the 'pure' RCA, according to the Jarque–Bera test, and applying a 10% level.

The methodology for testing whether countries are stable across sectors and whether they tend to become more or less specialised intra-country on the one hand and the test of whether countries tend to converge within the same sector on the other hand are analogous. However, we will start off by describing the methodology to be used for the intra-country, cross-sectoral analyses. We are going to employ a method first used in the context of specialisation by John Cantwell (1989). His basic source of inspiration was a 'Galtonian' regression model presented by Hart & Prais (1956). Stability (and specialisation trends) is tested by means of the following regression equation (country by country), bearing in mind that nothing can be said on these grounds about the determinants of the initial export specialisation pattern:

$$RSCA_{ij}^{t2} = \alpha_i + \beta_i RSCA_{ij}^{t1} + \varepsilon_{ij} \qquad (2)$$

The superscripts t_1 and t_2 refer to the initial year and the final year, respectively. The dependent variable, RSCA at time t_2 for sector i, is tested against the independent variable which is the value of the RSCA in the previous year t_1. α and β are standard linear regression parameters and ε is a residual term. It should be pointed out that the method is one of comparing two cross-sections at two points in time; i.e. there is no element of time in the observations.

The idea behind the regression is that $\beta = 1$ corresponds to an unchanged pattern from t_1 to t_2. If $\beta > 1$ the country tends to become more specialised in sectors where it is already specialised, and less specialised where initial specialisation is low—i.e. the existing pattern of specialisation is strengthened. If one makes an analogy to the convergence literature, $\beta > 1$ might be termed *β-specialisation*. Similarly, $0 < \beta < 1$ can be termed *β-de-specialisation*, i.e. *on average*, sectors with initial low RSCAs increase over time while sectors with initial high RSCAs decrease their values. The magnitude of $(1 - \beta)$ therefore measures the size of what has been termed as the 'regression effect', and this is the interpretation placed on the estimated coefficient of β in the empirical section of the present paper. In the special case where $\beta < 0$ the ranking of sectors has been reversed. Those RSCAs initially below the country average are, in the final year, above average and vice versa. Given the above listed line of reasoning, the test of cumulativeness (or 'stickiness') is whether $\hat{\beta}$ is significantly greater than zero. If $\hat{\beta} \leq 0$, it cannot be rejected that the development of the trade specialisation pattern of a country is either reversed or random, contrary to the hypothesis of cumulativeness.

Another feature emerging from the regression analysis is a test of whether the degree of specialisation changes. Following Cantwell (1989, pp. 31–32) it can be deduced that $\beta > 1$ is not a necessary condition for an increase in the overall national specialisation pattern. With reference to Hart (1976) it can be shown that:

$$\sigma_i^{2t2} / \sigma_i^{2t2i} = \beta_i^2 / R_i^2 \qquad (3a)$$

Thus,

$$\sigma_i^{t2} / \sigma_i^{t1} = |\beta_i| / |R_i| \qquad (3b)$$

It follows that the dispersion of a given distribution is unchanged when $\beta = R$. If $\beta > R$ (equivalent to an increase in the dispersion) the degree of specialisation has increased. Thus, making the same kind of analogies as above, one might term this as *σ-specialisation*. If $\beta < R$ (equivalent to a decrease in the dispersion) the degree of specialisation has decreased. Likewise, such a situation can be described as *σ-de-specialisation*. Whether countries tend to specialise or de-specialise is, to our mind, an empirical question. However, the outcomes have important implications. We shall discuss these implications in the conclusion.

The estimated Pearson correlation coefficient is a measure of the mobility of sectors up and down the RSCA distribution. A high level of the coefficient indicates that the relative position of sectors is little changed, while a low value indicates that some sectors are moving closer together and others further apart, quite possibly to the extent that the ranking of sectors changes. The value of $(1 - R)$ measures what has been described as the 'mobility effect'. It may well be that, even where the 'regression effect' $(1 - \beta)$ suggests a fall in the degree of specialisation due to a proportional change in sectors towards the average $(\beta < 1)$, this is outweighed by the mobility effect, due to changes in the proportional position between sectors $(\beta > R)$. Following Cantwell's vocabulary we can also characterise an increase in the dispersion as a change towards a more 'narrow' specialisation pattern; and a decrease in the dispersion as a change towards a more 'broad' pattern.

The latter interpretation should, however, be treated with care. In general, the R^2 is a decomposition of the variance (σ^2) of the dependent variable, the RSCA in the final year t_2, into the sum of the variance of the independent variables—i.e. the sum of the variance of the initial RSCA and the error term ε. The combination of $\beta < 1$ and $\beta > R$, which is identical to an increased variance of the RSCAs over time, is thus to some extent caused by the variance of the residual term ε. The mechanism causing increased standard deviation (dispersion) of the final RSCAs, in the case of $\beta < 1$, is the existence of a positive variance of the residual term—i.e. the increased standard deviation of the final RSCAs is partly caused by the residual and therefore not by a recognisable economic explanation (such as cumulativeness).[1] These problems of interpretation have their parallel in the discussion of 'new growth' analysis of β- versus σ-convergence of per capita incomes, as introduced by Barro and Sala-i-Martin (1991).

We will now turn to the sector-wise methodology, which is used to test whether specialisation patterns tend to *converge* across countries, within the same sector:

$$RSCA_{ij}^{t_2} = \alpha_j + \beta_j RSCA_{ij}^{t_1} + \varepsilon_{ij}. \tag{4}$$

As in the case of the country-wise analysis, the idea behind the regression is that $\beta = 1$ corresponds to an unchanged pattern from t_1 to t_2. If $\beta > 1$ the countries which are (heavily) specialised in the sector in question tend to become increasingly specialised in this sector while countries that are under-specialised in the sector in question tend to become even less specialised in this sector. Such a movement can be termed *β-divergence* in trade patterns. If $0 < \beta < 1$ the existing specialisation pattern changes, i.e. *on average* countries with initial low RSCAs increase over time, while countries with initial high RSCAs decrease their values. The situation in which $0 < \beta < 1$ can be termed *β-convergence*. In the special case where $\beta < 0$, the ranking of countries has changed fundamentally, so that those RSCAs initially below the OECD average are, in the final year, above average and vice versa.

As in the case of specialisation/de-specialisation it can be shown for divergence/convergence that:

$$\sigma_j^{t_2}/\sigma_j^{t_1} = |\beta_j|/|R_j| \tag{5}$$

From above it follows that the dispersion of a given distribution is unchanged when $\beta = R$. If $\beta > R$ the degree of divergence has increased. Thus, one can term this situation as *σ-divergence*. If $\beta < R$ the countries have converged in their trade patterns, which in turn can be described as *σ-convergence*.

4 The Characteristics of OECD Export Specialisation Patterns

4.1 The Country-wise Specialisation Patterns

In the country-wise category of studies of stability of export specialisation we are only aware of the study by Amendola *et al.* (1992) and the study by Papagni (1992). Amendola *et al.* follow Cantwell's methodology and compare the development of RCAs and RTAs for three periods. In slightly more than 50% of their estimated equations the hypothesis of 'constant' specialisation ($\beta = 1$) could not be rejected and the R^2s are generally high. On this basis they conclude that both trade and technological specialisation patterns have been remarkably stable in the medium term, although to a decreasing degree in the long term. The normality problem with the RCAs as well as the RTAs is, however, neglected.

The Papagni study confirms the stability of trade specialisation patterns for high-technology goods, using three-mode principal components analysis. However, the study only considers seven individual countries and a rather limited time-period (1981–87), and contains no analysis of the development of the specialisation patterns.

Our analysis is conducted across 60 sectors (described in the Appendix, Table A1) for 20 OECD countries. More detailed characteristics of the data set used are documented in the Appendix. It should be stressed that the selection criteria for the data has been *search for 'peak' years*. The aim has been to avoid the effects of short term fluctuations in trade patterns in the cross-section analyses. Data for 1992 were chosen, since they was the most recent data available at the time of writing. The results of our tests are summarised in Table 1, which shows the values for $\hat{\beta}$, $\hat{R}$ and $\hat{\beta}/\hat{R}$ for the period 1965–92 ('long' term) and for two sub-periods 1965–79 and 1979–92 (both 'medium' term). In the long term perspective (1965–92), the results show a general decrease in the dispersion of export specialisation, implying a trend towards a decrease in specialisation (so-called σ de-specialisation). The exceptions are Greece, Italy, Japan and the US, which become more specialised.

The decomposition of the dispersion in a 'regression' effect $(1 - \beta)$, and a 'mobility' effect $(1 - R)$, reveals two features. On the one side, the $\hat{\beta}$-values are significantly different from zero and significantly below unity at the 1% level for all 20 countries, meaning that the hypothesis of reverse or random patterns can be rejected. Trade patterns do not change 'overnight' and do not change fundamentally even over three decades. Put differently, this feature points to a general tendency for increases in industries where countries have been relatively less specialised and decreases in industries where they have been highly specialised.

A few 'stylised' features in the specialisation patterns between various groups of countries seem to emerge from the analysis. The *catching up OECD countries* generally show high regression effects (low $\hat{\beta}$) and high mobility effects (low $\hat{R}$), implying a stronger tendency towards a decrease in initially advantaged industries and an increase in disadvantaged industries. Most of the small high-income

Table 1. Country-wise stability and development of OECD export specialisation patterns in the long term (1992 on 1965)

Country	1965–92				1965–79				1979–92			
	$\hat{\alpha}$	$\hat{\beta}$	$\hat{R}$	$\hat{\beta}/\hat{R}$	$\hat{\alpha}$	$\hat{\beta}$	$\hat{R}$	$\hat{\beta}/\hat{R}$	$\hat{\alpha}$	$\hat{\beta}$	$\hat{R}$	$\hat{\beta}/\hat{R}$
United States	− 0.01	0.75*†	0.74	1.01	− 0.02	0.97*†	0.80	1.21	0.00	0.79*†	0.94	0.84
Japan	− 0.12**	0.62*	0.58	1.07	− 0.05	0.77*†	0.74	1.04	− 0.04	0.95*†	0.93	1.03
Germany	− 0.02	0.52*	0.73	0.70	− 0.02	0.67*†	0.85	0.79	− 0.01	0.77*†	0.86	0.89
France	− 0.04	0.37*	0.40	0.94	− 0.03	0.60*	0.63	0.94	− 0.01	0.78*†	0.78	1.00
Italy	− 0.07***	0.59*	0.55	1.06	− 0.04	0.87*†	0.84	1.04	− 0.03	0.78*†	0.76	1.02
United Kingdom	− 0.03	0.57*	0.71	0.80	− 0.02	0.72*†	0.87	0.84	− 0.02	0.76*†	0.80	0.95
Belgium-Lux	− 0.02	0.66*†	0.69	0.96	− 0.04	0.68*†	0.76	0.89	0.02	0.97*†	0.91	1.07
Canada	− 0.01	0.72*†	0.82	0.88	− 0.03	0.77*†	0.84	0.92	− 0.01	0.83*†	0.87	0.96
Denmark	0.07**	0.78*†	0.88	0.88	0.08*	0.89*†	0.95	0.93	0.00	0.86*†	0.91	0.94
Finland	0.07	0.61*	0.68	0.90	0.08	0.79*†	0.82	0.97	0.01	0.78*†	0.84	0.93
Netherlands	− 0.02	0.61*	0.64	0.94	− 0.04	0.79*†	0.79	0.99	0.02	0.84*†	0.89	0.94
Norway	− 0.18*	0.74*†	0.80	0.92	− 0.10*	0.85*†	0.89	0.95	− 0.08*	0.91*†	0.94	0.97
Austria	0.01	0.67*†	0.76	0.89	0.00	0.69*†	0.77	0.90	− 0.02	0.79*†	0.81	0.98
Switzerland	− 0.02	0.86*†	0.90	0.96	0.02	0.96*†	0.95	1.01	− 0.03***	0.92*†	0.97	0.95
Sweden	0.01	0.70*†	0.76	0.91	0.04	0.84*†	0.90	0.94	− 0.01	0.89*†	0.91	0.97
Greece	0.04	0.63*	0.58	1.10	0.01	0.71*†	0.63	1.12	0.03	0.87*†	0.89	0.98
Ireland	− 0.05	0.37*	0.39	0.95	0.00	0.46*	0.50	0.93	− 0.04	0.85*†	0.84	1.02
Portugal	− 0.10	0.54*	0.64	0.84	− 0.04	0.69*†	0.73	0.94	− 0.11**	0.64*†	0.72	0.89
Spain	− 0.06	0.29*	0.51	0.57	0.01	0.52*	0.68	0.77	− 0.06**	0.59*	0.79	0.74
Turkey	− 0.15**	0.36*	0.43	0.83	− 0.11	0.72*†	0.73	0.99	− 0.02	0.64*†	0.76	0.84
Mean (unweighted)		0.60	0.66	0.91		0.75	0.78	0.96		0.81	0.86	0.95

Note: *, **, *** denote significantly different from zero at the 1%; 5%; and 10% levels, respectively (*t*-test).
† denotes higher and significantly different from 0.5 at the 10% level (*t*-test).

countries show low regression effects (high $\hat{\beta}$) and low mobility effects (high $\hat{R}$). This point is illustrated by the fact that all catching up countries (Japan, Finland, Greece, Ireland, Italy, Portugal, Spain and Turkey) have $\hat{\beta}$ values either significantly lower than 0.5 (10% level), or values not significantly different from 0.5, while nearly all *smaller high-income countries* have indeed very sticky specialisation patterns, in the sense that they all (Belgium, Canada, Denmark, Norway, Austria, Switzerland and Sweden), except the Netherlands, display $\hat{\beta}$ values significantly higher than 0.5. Also, the United States displays a very stable pattern as the $\hat{\beta}$ value is significantly higher than 0.5. Furthermore, there are some *high-income countries* (but slow growing in terms of economic growth) with relatively low $\hat{\beta}$ values; namely France, the UK, and the Netherlands. This might well imply that relatively low stability in terms of the export specialisation pattern is not associated with economic growth *per se*—especially not for initially rich countries. However, the third largest economic power in the OECD, Germany, has a $\hat{\beta}$ value not significantly different from 0.5, but this development has been associated with relatively strong 'broadening out' of the specialisation pattern, as measured by the relatively low $\hat{\beta}/\hat{R}$. In this context, an example may be useful.

A comparison of Japan and Germany shows that both countries have high regression effects, but Japan clearly has a higher mobility effect. In fact, the mobility effect has outweighed the regression effect in the Japanese case—in 1992 the dispersion of export specialisation was slightly higher compared to 1965. A high mobility in relation to an unchanged or even an increased dispersion indicates a shift in the pattern of export specialisation. In 1965 Japan was highly specialised in fish, textile fabrics, clothing, consumer electronics, and ships. In 1992, the high specialisation industries were consumer electronics, semiconductors, telecommunications equipment, ships, and photographical, optical goods and watches. Thus, an important change in the ranking has taken place without changing the dispersion of the RSCAs. In contrast, Germany displays no radical change despite the relatively low $\hat{\beta}/\hat{R}$ value. Germany remains specialised in sectors that were already strong (but to a smaller degree), such as various chemical products as well as in different types of machinery. In addition, Germany tends to increase specialisation in areas where weak (but despite this, Germany remains weak in these areas), such as meat products; cereals and cereal preparations; beverages and tobacco; and clothing.

Concerning the medium term of 1965–79 and 1979–92, it should be noted that the unweighted mean of the dispersions increase slightly, with $\hat{\beta}/\hat{R}$ equal to 0.91 in 1965–79 and 0.96 in 1979–92, indicating a stronger σ-de-specialisation in the first period. During 1965–79, σ-specialisation can be found in five countries—the same as in 1979–92. The unweighted β-de-specialisation measure was 0.75 and 0.74, respectively—indicating a lower degree of ('explained') β-de-specialisation compared with the long term period 1961–92. The estimated 'regression' effects $(1 - \hat{\beta})$ as well as the 'mobility' effects $(1 - \hat{R})$ are, thus, generally lower (equivalent to larger values of $\hat{\beta}$ and $\hat{R}$) for the two medium term sub-periods, implying the long term changes have evolved gradually.

How sensible are the data with respect to the level and kind of aggregation? And does the inclusion of primary goods influence the results? In order to answer these questions we did a similar analysis based on the categorical aggregation—at the 2-digit and 3-digit SITC levels, respectively. However, the levels of aggregation do not seem to affect our conclusion based on the 60-sectors aggregation. On average, both for 2 and 3-digit SITC the same kind of slow trend towards de-specialisation appears. Only three countries show $\hat{\beta}/\hat{R}$-values above unity. Secondly, concerning the scope of the analysis it could be argued that the inclusion of primary goods would automatically produce lower $\hat{\beta}/\hat{R}$-values since the process of industrialisation is followed by a broadening in the production and export structure. In fact, our conclusions would not change if we limit the analysis to manufacturing. In this case only five countries (compared to four for the whole economy) seem to become more specialised (Italy, Switzerland, Japan, the UK and the US). The unweighted mean for $\hat{\beta}/\hat{R}$ 1965–92 is slightly smaller (0.89 versus 0.91).

The picture of de-specialisation as well as path-dependent change is further underlined by the data for the six 'short' term periods presented in Appendix Table A2. Compared with the medium term periods, the short term $\hat{\beta}$-and $\hat{R}$-values are generally found to be at a higher level, as would be expected. Only in the case of the US in 1969–73, could statistically significant β-specialisation be registered.

4.2 The Sector-wise Specialisation Patterns

The empirical results reported in the literature of the sector-wise category of studies point in different directions. Soete & Verspagen (1994) analysed a sample of 22 manufacturing industries across countries in the period 1970–90. The specification was similar to our sector-wise specification (β-convergence) the only difference being that they estimated a restricted model assuming no intercept. Soete & Verspagen concluded that convergence was predominant in every sector except food (non-significant convergence) and textiles (significant divergence).

Dollar & Wolff (1993, chapter 7) report, however, that the trade specialisation patterns of 11 OECD countries 1970–86 did not become more similar, also based on an sector-wise approach. They use a slightly simpler methodology based on comparing coefficients of variation of the RCAs over time; six sectors show increasing dispersion and the other six show a decrease. The study however, uses the non-modified RCAs and does not take the problems of normality into account.

The general results from Table 2 have much in common with the country-wise findings of Table 1. For all sectors we find β-convergence and, in all cases, $\hat{\beta}$ is significantly below unity (and above 0). Further, we find σ-convergence for all sectors except five; i.e. the dispersion of specialisation in almost all sectors has decreased. Put differently, the countries that have been under-specialised in given sectors tend to increase specialisation in these sectors, and/or countries that are specialised in given sectors tend to decrease specialisation in these sectors. This β-convergence appears marginally stronger compared with the country-wise σ-de-specialisation when the level of disaggregation shown in Appendix Table A1 is used.

While Section 4.1 above showed that the overall de-specialisation trends were not sensitive to the different levels of disaggregation tested, the interpretation of the detailed sector-wise results of Table 2 demands some further comments on the specific kind of disaggregation used. As well as the inherent problems of missing values in foreign trade data, mainly at the 4-and 5-digit SITC levels, the basic idea behind the chosen list of 60 sectors—aggregated to five main sectors—is to get a slightly more richly faceted division than the standard two main sectors of manufacturing versus 'raw materials'. The first main sector (so-called natural-resource-based products) consists of raw materials and highly resource-based

Table 2. Sector-wise stability and development of OECD export specialisation patterns in the long term (1992 on 1965)

No.	Sector	1965–92 $\hat{\alpha}$	$\hat{\beta}$	$\hat{R}$	$\hat{\beta}/\hat{R}$	No.	Sector	1965–92 $\hat{\alpha}$	$\hat{\beta}$	$\hat{R}$	$\hat{\beta}/\hat{R}$
1	Meat & meat preparations	– 0.07	0.82*†	0.85	0.96	31	Agricul. & food proces. mach.	0.07	0.57*	0.69	0.83
2	Dairy products	– 0.13	0.70*	0.75	0.94	32	Textile & sewing machines	– 0.08	0.83*†	0.88	0.94
3	Fish & fish preparations	– 0.04	0.65*	0.79	0.82	33	Paper & pulp machinery	0.10**	0.87*†	0.94	0.93
4	Cereals & cereal preparations	0.17	0.65*	0.62	1.04	34	Mach. for other spec. industries/processes	0.08	0.81*†	0.83	0.99
5	Feeding-stuff for animals	– 0.19***	0.35**	0.45	0.77	35	Heating & cooling equipment	0.00	0.45*	0.68	0.67
6	Other food products	0.01	0.72*†	0.88	0.83	36	Metalworking machinery	0.00	0.77*†	0.87	0.89
7	Beverages & tobacco	– 0.05	0.70*†	0.90	0.79	37	Power generating machinery	– 0.01	0.58*	0.69	0.85
8	Animal & vegetable oil & fats	0.05	0.84*†	0.76	1.10	38	Pumps & centrifuges	– 0.01	0.63*	0.85	0.74
9	Cut flowers, bulbs, & oth. plants	– 0.24*	0.62*	0.73	0.86	39	Typewriters & office mach.	– 0.08	0.57**	0.55	1.04
10	Seeds & spores for planting	– 0.14***	0.73*†	0.83	0.89	40	Computers & peripherals	– 0.21	0.20	0.23	0.87
11	Skins & leather manufactures	– 0.08	0.51**	0.53	0.97	41	Semiconductors	– 0.18	0.54*	0.64	0.84
12	Wood & wood manufactures	0.02	0.76*†	0.84	0.91	42	Telecommunications equipment	– 0.09	0.40**	0.53	0.76
13	Pulp & paper	0.11	0.69*†	0.90	0.77	43	Mach. for prod. & dist. of electricity	– 0.02	0.24***	0.39	0.60
14	Textile fibres	– 0.18	0.58*	0.74	0.79	44	Consumer electronics	– 0.19	0.39***	0.41	0.96
15	Textile yearn, fabrics, etc.	0.03**	0.48**	0.56	0.87	45	Domestic electrical equipment	– 0.02	0.36**	0.48	0.75
16	Iron ore	– 0.27*	0.82*†	0.90	0.91	46	Electromedical equipment	– 0.10	0.58*	0.65	0.89
17	Iron, steel & ferro-alloys	0.06*	0.33**	0.44	0.76	47	Non-elec. medical equipment	0.04	0.54*	0.61	0.89
18	Aluminium	0.04	0.48*	0.62	0.77	48	Measuring & control. instrum.	– 0.03	0.60*	0.78	0.77
19	Non-ferrous ores & metals	0.04	0.58*	0.76	0.77	49	Photograhic & optical goods, watches	0.01	0.73*†	0.90	0.81
20	Crude fertilizers, crude minerals & coal	– 0.12**	0.63*	0.78	0.80	50	Railway vehicles	– 0.06	0.53*	0.60	0.88
21	Non-metallic minerals	0.05	0.40**	0.50	0.81	51	Road motor vehicles	0.01	0.69*	0.73	0.95
22	Rest: rubber; electr. energy	– 0.06	0.37**	0.50	0.75	52	Aircraft	– 0.13	0.67*	0.70	0.95
23	Oil & gas	– 0.09	0.32	0.30	1.10	53	Ships and boats (& oilrigs)	– 0.03	0.60*	0.72	0.84
24	Organic chemicals	0.00	0.46*	0.58	0.80	54	Other non-electrical equipm.	0.03	0.72*†	0.90	0.80
25	Inorganic chemicals	– 0.03	0.22	0.33	0.65	55	Other electrical equipment	0.00	0.73*†	0.90	0.81
26	Dyestuffs, colouring materials	0.03	0.57*	0.75	0.76	56	Manufactures of metal	0.03	0.37*	0.57	0.66
27	Pharmaceuticals	0.06	0.69*	0.73	0.94	57	Furniture	– 0.02	0.52*	0.62	0.83
28	Fertilizers, manufactured	– 0.07	0.20	0.28	0.69	58	Clothing	– 0.04	0.05	0.04	1.18
29	Plastic materials	– 0.01	0.34*	0.59	0.57	59	Orthopaed. eq. & hearing aids	0.00	0.60*	0.68	0.88
30	Other chemicals	– 0.05	0.42**	0.56	0.76	60	Industrial products, n.e.s.	0.01	0.63*	0.78	0.81
	Mean (unweighted)								0.56	0.66	0.85

Note: *, **, *** denote significantly different from zero at the 1%; 5%; and 10% levels, respectively (*t*-test).
† denotes higher and significantly different from 0.5 at the 10% level (*t*-test).

semi-manufactures. Oil and gas is treated as a main sector on its own, while chemicals is identical to SITC 5. The main sector of 'other industrial products' (or 'traditional industries') contains the more labour intensive (and low skilled) parts of manufacturing, while the fourth main sector contains engineering, electronics and transport equipment. In a non-rigorously defined sense, the natural-resource-based main sector, and of course also oil and gas, to a certain extent, reflects the natural endowments of a country. On the other hand the 'traditional industries' appears to be pretty well characterised as labour intensive (low-skilled) sectors. Chemicals and engineering, electronics and transport equipment contain the more R&D and/or capital intensive areas.

Sectors with low $\hat{\beta}$ s usually reveal a high mobility effect ($1 - \hat{R}$) indicating a major shift in the ranking of the country specialisation in the specific sector. However, Table 2 points at important differences in the level of $\hat{\beta}$ (and $\hat{R}$) across sectors. As should be somehow expected the components of the natural-resource-based main sector (numbers 1–22) have generally high $\hat{\beta}$s (many significantly higher than 0.5) and low mobility.[2] The 'traditional industries' (numbers 56–60) show high β-convergence and high mobility consistent with a conception of these areas as characterised by the importance of relative factor intensities, more in line with the standard Hechscher–Ohlin type of explanation.

Within chemicals as well as engineering, electronics and transport equipment there are quite evident differences in the degree of β-convergence. The machinery oriented sectors (numbers 31–38: agricultural and food processing machinery, textile and sewing machines, paper and pulp machinery, metalworking machinery, machinery for other special industries and processes, power generating machinery, and pumps and centrifuges) all display mobility below the average (the unweighted mean). This observation is further underlined by the fact that four of these industries show a $\hat{\beta}$ significantly higher than 0.5. On the other hand, sectors like computers, consumer electronics, telecommunications equipment, and domestic electrical equipment show much stronger β-convergence and a much higher mobility. These sectors it may be argued are to a certain degree dominated by multinational companies capable of exploiting economies of scale and scope worldwide in their production and foreign trade pattern (but not necessarily so in their technological development patterns). Other parts of electronics, such as semiconductors, electromedical equipment, and measuring and control instruments display lower than average β-convergence, indicating that these fields are less 'footloose' in their foreign trade pattern.

These more intuitive and preliminary indications of potentially systematic sector specificities in the stability characteristics of international specialisation may act as a complement to the more widespread analyses of country-wise patterns (see also Yeats, 1985). The country-wise and sector-wise results are more or less by definition two sides of the same coin. Countries with relatively high $\hat{\beta}$s in their country-wise specialisation patterns tend to be specialised in those sectors that display a fairly low degree of β-convergence (high $\hat{\beta}$s) in their sector-wise patterns.

5. Conclusion and Discussion

In the present paper we have made a distinction between the two concepts of β- and σ-specialisation on the one hand and β- and σ-convergence/divergence on the other; the latter introduced to the growth literature by Barro & Sala-i-Martin (1991). We shall deal with the analysis of the results using these concepts in turn.

In terms of the *stability* of each of the national export specialisation patterns, the long term perspective of 1965–92 shows that the hypothesis of reverse or random patterns can be rejected. Since the $\hat{\beta}$-values are significantly smaller than one (and significantly greater than zero), the development can be characterised as β-de-specialisation, i.e. *on average*, sectors with initial low RSCAs increase over time while sectors with initial high RSCAs decrease their values, for each country. From this observation, it can also be concluded that national export specialisation patterns are quite stubborn or sticky. These findings are in line with evolutionary theorising, as well as with the neoclassical model of Krugman (1987). However, it should be mentioned that Krugman's model cannot (endogenously) account for the observed incremental changes of the specialisation pattern.

In terms of the process of specialisation versus de-specialisation (measured by σ-specialisation) the results display a process of de-specialisation. The unweighted mean for $\hat{\beta}/\hat{R}$ 1965–92 is 0.91. β-de-specialisation has apparently been more outspoken than σ-de-specialisation. It should be noted that the results were not, *in general*, sensitive to the level of aggregation used. Furthermore, a few 'stylised' features in the specialisation patterns between various groups of countries should be noted. The less developed 'catching up' OECD countries generally show high regression effects (low $\hat{\beta}$) and high mobility effects (low $\hat{R}$), whereas most of the small high-income countries show low regression effects (high $\hat{\beta}$) and low mobility effects (high $\hat{R}$). Slow growing high-income countries usually show higher regression effects (lower $\hat{\beta}$-values) implying a stronger tendency towards a decrease in initially advantaged industries and an increase in disadvantaged industries.

In the sector-wise (i.e. *convergence versus divergence*) results we find, for all sectors, β-convergence and, in all cases, $\hat{\beta}$ is significantly below unity (and above 0). Further, we find σ-convergence for all sectors except five; i.e. the dispersion of specialisation in almost all sectors has decreased.

An observation emerging from this paper is that, while European integration has been ongoing throughout the period (for documentation of growing intra EU trade, see Ben-David, 1991), there has been a tendency for European countries to de-specialise, and across the OECD countries (among which the EU countries dominate in numbers) a tendency to converge in the same sectors. Standard trade theory (Hechscher–Ohlin) would predict increasing specialisation—all other things being equal—if trade barriers are being reduced, given different factor endowments in various countries. Seen in that light, our findings may seem surprising. However, it appears to be a fact that intra-industry trade (IIT) grows in a period of economic integration (Stone & Lee, 1995; OECD, 1997). This observation appears to be true even at a quite detailed level of aggregation (182 industries).

Hence, the findings are more in line with theoretical models allowing for increasing returns and differentiated products, such as the model made by Grossman & Helpman (1989). It can be noted that the model of Grossman & Helpman concerns horizontally differentiated products, which might be more important for trade between developed countries, while vertically differentiated (possibly imitated) products might be more important for catching up countries. The main point is that such models allow countries to specialise increasingly according to consumer preferences (within the same industries), rather than specialising increasingly in different industries. It should however, be pointed out that, from a theoretical point of view, the structural *change* associated with the catching up process is not well understood, as the only explanation appears to be an exogenous change in the stock of human capital. From a policy perspective it is especially interesting that initially poorer countries increase intra-industry trade above average rather than relying on static comparative advantages while they catch up.

This paper has shown that it is a stylised fact that international trade specialisation in the OECD countries has decreased slightly in the nearby 30 year period, 1965–92 as opposed to the general findings concerning technological specialisation. An important explanation is that patents do only represent potential economic assets—not necessarily realised assets. According to, for example, Patel & Pavitt (1991), the patenting activity of the large multinationals is still heavily concentrated in their perceived home countries. In addition, there seems to be evidence that multinationals—in their research activities—'plug into' the science and technology system in countries where 'centres of excellence' are present (Cantwell & Janne, 1997). In doing so, the firms tend to enhance the technological profile of the host country. The internationalisation of production may thus have taken place at a higher speed than the internationalisation of the capability of developing new technologies.

Notes

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1. Another very similar measure has been applied by Hariolf Grupp in various publications (see e.g. Grupp, 1994).
2. We are grateful to Bart Verspagen who pointed this out.
3. The low $\hat{\beta}$ and low mobility for oil and gas may be a reflection of the geographical division between oil drilling and oil refinery which may cross national borders.

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Appendix: The IKE Trade Database

The trade data are based on the taped version of OECD's *Trade by Commodities, Series C*, which has been published annually since 1961. The data consist of trade by 'visible' goods in current US $. Trade in services ('invisibles') are not included. The OECD tapes consist of exports from and imports to 23 OECD countries. The data are delivered at their most detailed level according to the Standard International Trade Classification (SITC).

The IKE trade database at the Department of Business Studies, Aalborg University was initiated in the early 1980s for studies of long term structural features of OECD trade. Construction of comparable time series data has been the major analytical aim from the beginning. The database contains a selection of years 1961–92. As far as possible, the selection criterion has been 'peak years' in world trade/'average' OECD business cycles. The following years have been used in the present paper (1961), 1965, 1969, 1973, 1979, 1984, 1988 and 1992.

Given the long term focus mentioned, all data have been converted from the two more recent versions of the SITC to SITC, Revision 1. In 1961–77 the OECD reported the data in Revision 1. But in 1978–87 the data have been published according to SITC, Revision 2. The latter has been converted to the previous classification in order to construct comparable time series. From 1988 the data are published according to SITC, Revision 3.

The first step of handling the data consists of aggregating the 'raw' tapes to country matrices with 625 rows (the number of commodity groups at the 4-digit SITC, Revision 1 level) and 33 columns (23 OECD countries, the World, OECD, the Nordic countries and seven groups of non-OECD countries, including for example the former Soviet Union, the OPEC countries, a group of Newly Industrialised Countries). Then follow several steps of checking for confidentiality clauses in the tapes, whether at the commodity or the country level. The tapes, thus, contain a large amount of so-called alphanumeric codes (instead of the usual numeric SITC codes) for which the trade information is omitted *at the given level of disaggregation*. This information is, however, included in the SITC codes at a more aggregate level.

The data have then been aggregated to 60 commodity groups and then further to five main sectors as shown in Appendix Table A1.

The data for Japan and Finland for 1961 are not available in the OECD tapes and have been reconstructed from national statistical sources—with some approximation for Finland, but rather precisely for Japan.

Table A1. Sectoral classification

Products based on natural resources		Engineering, electronics and transport equipm.	
1. Meat & meat preparations	00, 01, 091.3, 411.3	31. Agricul. & food proces. mach.	712, 718.3
2. Dairy products	02	32. Textile & sewing machines	717.1, 717,3
3. Fish & fish preparations	03, 411.1	33. Paper & pulp machinery	718.1
4. Cereals & cereal preparations	04	34. Machinery for other special industries or processes	717.2, 718.2, 718.4–5, 719.3, 719.5, 719.8
5. Feeding-stuff for animals	08	35. Heating & cooling equipment	719.1
6. Other food products	05, 06, 07, 091.4, 099	36. Metalworking machinery	715
7. Beverages & tobacco	11, 12	37. Power generating machinery	711
8. Animal & vegetable oil & fats	22, 42, 43	38. Pumps & centrifuges	719.2
9. Cut flowers, bulbs, & oth. plants	292.1–4, 292.6–9	39. Typewriters & office mach.	714.1, 714.9
10. Seeds & spores for planting	292.5	40. Computers & peripherals	714.2, 714.3
11. Skins & leather manufactures	21, 61, 291	41. Semiconductors	729.3
12. Wood & wood manufactures	24, 63	42. Telecommunications equipment	724.9
13. Pulp & paper	25, 64	43. Machinery for production & distribution of electricity	722, 723
14. Textile fibres	26		
15. Textile yearn, fabrics, etc.	65	44. Consumer electronics	724.1, 724.2, 891.1
16. Iron ore	281	45. Domestic electrical equipment	725
17. Iron, steel & ferro-alloys	67	46. Electromedical equipment	726
18. Aluminium	684	47. Non-elec. medical equipment	861.7
19. Non-ferrous ores & metals	282–86, 681–83, 685–89	48. Measuring & control. instrum.	729.5
20. Crude fertilizers, crude minerals & coal	27, 32	49. Photographic & optical goods, watches	861.1–6, 861.8–9, 862, 864
21. Non-metallic minerals (cement, bricks, ceramics, glass, etc.)	66	50. Railway vehicles	731
22. Rest: rubber; electr. energy	23, 62, 35	51. Road motor vehicles	732
		52. Aircraft	734
		53. Ships and boats (& oilrigs)	735
		54. Other non-electrical equipm.	719.6–7,719.9, 733
		55. Other non-electrical equipment	729.1–2, 729.4, 729.6–7, 729.9
Oil and gas			
23. Oil & gas	33, 34	Other industrial products ('traditional industries')	
Chemicals		56. Manufactures of metal	69, 719.4, 812.1, 812.3
		57. Furniture	82
24. Organic chemicals	512	58. Clothing	84
25. Inorganic chemicals	513, 514	59. Orthopaed. eq. & hearing aids	899.6
26. Dyestuffs, colouring materials	53	60. Industrial products, n.e.s.	812.2, 812.4, 83, 85, 863, 891.2–9, 892–97, 899.1–5, 899.9, 9
27. Pharmaceuticals	54		
28. Fertilizers, manufactured	56		
29. Plastic materials	581.1, 581.2		
30. Other chemicals	515, 52, 55, 57, 581.3, 581.9, 59		

Table A2. Country-wise stability and development of OECD export specialisation patterns for six sub-periods.

	1965–69			1969–73			1973–79			1979–84			1984–88			1988–92		
	β	R	β/R	β	R	β/R	β	R	β/R	β	R	β/R	β	R	β/R	β	R	β/R
United States	0.90	0.91	0.98	**1.12**	0.95	1.17	0.91	0.93	0.98	0.97	0.97	1.00	0.92	0.95	0.97	0.82	0.96	0.86
Japan	**0.87**	0.93	0.94	1.02	0.93	1.09	0.97	0.95	1.03	1.02	0.97	1.05	0.96	0.98	0.98	0.98	0.98	1.00
Germany	**0.89**	0.94	0.94	0.94	0.97	0.97	**0.85**	0.94	0.90	**0.91**	0.94	0.97	0.95	0.97	0.98	**0.90**	0.96	0.94
France	0.90	0.91	0.99	**0.83**	0.90	0.92	0.89	0.88	1.01	0.99	0.91	1.09	**0.86**	0.91	0.95	0.92	0.95	0.97
Italy	0.91	0.92	1.00	0.98	0.96	1.02	0.92	0.92	1.00	0.95	0.92	1.03	**0.87**	0.95	0.92	0.98	0.91	1.08
United Kingdom	0.98	0.97	1.01	**0.86**	0.95	0.91	**0.84**	0.93	0.91	0.94	0.93	1.01	**0.89**	0.90	0.99	**0.81**	0.85	0.95
Belgium-Lux	0.92	0.94	0.98	**0.88**	0.93	0.95	**0.87**	0.92	0.94	1.01	0.92	1.10	0.94	0.96	0.98	0.98	0.99	0.99
Canada	**0.91**	0.95	0.96	0.95	0.97	0.98	0.90	0.92	0.98	**0.89**	0.95	0.94	0.98	0.93	1.05	0.95	0.97	0.98
Denmark	0.95	0.93	1.02	0.99	0.97	1.01	**0.91**	0.97	0.95	0.95	0.96	0.99	0.94	0.98	0.96	0.96	0.97	0.99
Finland	**0.85**	0.85	1.00	0.91	0.92	0.99	0.97	0.95	1.01	0.93	0.96	0.97	0.94	0.91	1.03	**0.82**	0.88	0.93
Netherlands	**0.91**	0.94	0.97	0.92	0.95	0.97	0.96	0.93	1.03	0.94	0.91	1.03	**0.89**	0.96	0.92	0.98	0.98	1.00
Norway	0.93	0.94	0.99	0.95	0.97	0.98	0.90	0.92	0.98	**0.94**	0.98	0.96	0.98	0.98	1.00	0.98	0.98	1.00
Austria	0.97	0.97	1.01	0.94	0.95	0.99	**0.79**	0.83	0.96	0.96	0.95	1.01	**0.84**	0.87	0.97	0.96	0.95	1.01
Switzerland	0.97	0.97	0.99	1.02	0.97	1.05	0.94	0.96	0.98	0.99	0.98	1.00	**0.96**	0.99	0.97	**0.96**	0.99	0.97
Sweden	0.92	0.92	0.99	0.96	0.97	0.99	0.91	0.94	0.98	**0.90**	0.96	0.93	0.97	0.95	1.02	1.00	0.97	1.02
Greece	0.94	0.88	1.07	0.91	0.90	1.02	**0.84**	0.87	0.97	1.00	0.97	1.03	**0.90**	0.93	0.97	0.92	0.94	0.95
Ireland	**0.91**	0.87	1.04	**0.62**	0.72	0.85	0.94	0.90	1.04	**0.86**	0.88	0.98	**0.91**	0.93	0.98	0.96	0.91	1.06
Portugal	0.93	0.93	0.99	0.92	0.91	1.01	**0.86**	0.89	0.96	**0.81**	0.85	0.95	**0.81**	0.86	0.94	0.93	0.93	1.00
Spain	0.84	0.85	0.98	**0.77**	0.87	0.89	**0.76**	0.85	0.89	**0.79**	0.78	1.01	**0.70**	0.84	0.83	**0.78**	0.89	0.88
Turkey	0.96	0.94	1.02	0.87	0.90	0.97	0.89	0.88	1.01	**0.73**	0.82	0.90	**0.84**	0.85	0.99	**0.80**	0.85	0.94
Mean (unweighted)	0.92	0.92	0.99	0.92	0.93	0.99	0.89	0.91	0.98	0.92	0.93	1.00	0.90	0.93	0.97	0.92	0.94	0.98

Note: Bold types indicate β-values significantly different from unity at the 5% level. All β-values different from zero at the 1% level.

Table A3. Sector-wise stability and development of OECD export specialisation patterns for six sub-periods.

	1965–69		1969–73		1973–79		1979–84		1984–88		1988–92	
	β	β/R	β	β/R	β	β/R	β	β/R	β	β/R	β	β/R
Meat & meat preparations	0.97	1.01	0.97	0.99	1.00	1.01	0.98	1.01	0.96	0.99	0.93	0.96
Dairy products	0.96	0.99	1.00	1.05	0.97	0.98	0.86	0.94	0.84	0.93	1.03	1.04
Fish & fish preparations	0.96	0.97	0.94	0.95	0.94	0.96	0.93	0.93	0.96	0.99	1.00	1.01
Cereals & cereal preparations	0.87	1.00	0.79	0.97	0.87	1.08	0.94	0.99	0.89	1.03	0.94	0.97
Feeding-stuff for animals	0.93	0.97	0.93	0.98	0.69	0.93	0.70	0.94	0.69	0.85	1.02	1.09
Other food products	0.91	0.92	0.94	0.95	1.00	1.03	0.94	0.95	1.01	1.01	0.95	0.95
Beverages & tobacco	0.97	0.98	0.92	0.94	0.91	0.93	0.92	0.94	1.03	1.03	0.92	0.94
Animal & vegetable oil & fats	1.02	1.07	0.92	0.97	0.92	0.94	0.94	1.06	0.88	0.96	1.03	1.10
Cut flowers, bulbs, & oth. plants	0.99	1.00	0.85	0.89	0.96	1.01	0.93	0.99	0.98	1.01	0.94	0.96
Seeds & spores for planting	0.96	0.98	0.88	0.97	0.96	1.02	0.95	0.98	0.96	0.99	0.91	0.95
Skins & leather manufactures	0.96	0.98	0.86	0.91	0.95	1.05	0.97	1.03	0.93	0.99	0.96	1.02
Wood & wood manufactures	0.97	0.98	0.93	0.97	1.00	1.04	0.90	0.94	0.97	0.99	0.97	0.98
Pulp & paper	0.93	0.94	0.96	0.97	0.90	0.92	0.95	0.98	0.98	0.99	0.94	0.95
Textile fibres	0.98	1.00	0.97	1.00	0.83	0.88	0.95	1.01	0.88	0.90	0.87	0.98
Textile yearn, fabrics, etc.	0.85	0.89	0.89	0.99	1.02	1.07	1.06	1.08	0.92	0.93	0.91	0.92
Iron ore	1.02	1.03	0.89	0.92	0.98	1.00	0.94	0.94	1.01	1.09	0.87	0.93
Iron, steel & ferro-alloys	0.83	0.95	0.89	0.95	0.84	0.89	0.82	0.98	0.96	1.03	0.91	0.93
Aluminium	0.73	0.99	0.80	0.89	0.80	0.84	1.02	1.10	0.90	0.95	0.96	0.99
Non-ferrous ores & metals	0.84	1.00	0.96	1.02	0.73	0.77	0.97	1.04	0.87	0.98	0.87	0.97
Crude ferti., crude minerals & coal	0.94	0.98	0.88	0.93	1.00	1.08	0.90	0.94	0.93	0.99	0.85	0.88
Non-metallic minerals	0.94	0.97	0.75	0.84	0.84	1.06	0.99	1.02	0.90	0.92	0.97	1.00
Rest: rubber; electr. energy	0.79	0.91	0.93	1.06	0.87	0.94	0.73	0.87	0.83	0.89	0.96	1.07
Oil & gas	0.84	0.92	0.92	1.23	0.78	1.11	0.71	0.84	1.02	1.04	0.93	1.00
Organic chemicals	0.94	1.01	0.87	0.98	0.86	0.94	0.85	0.92	0.76	0.84	1.05	1.12
Inorganic chemicals	0.48	0.79	0.79	0.86	0.70	0.97	0.72	0.99	0.97	1.13	0.79	0.87
Dyestuffs, colouring materials	0.84	0.94	1.01	1.03	0.90	0.94	0.94	0.97	0.85	0.93	0.89	0.93
Pharmaceuticals	0.98	1.01	0.89	0.93	0.87	0.92	1.00	1.02	0.93	0.96	1.03	1.11
Fertilizers, manufactured	0.80	0.86	0.90	1.00	0.65	0.99	0.58	0.79	0.93	1.10	0.83	0.94
Plastic materials	0.90	0.95	0.89	0.94	0.90	0.96	0.81	0.89	0.67	0.77	0.87	0.97
Other chemicals	0.86	0.92	0.91	0.94	0.84	0.96	0.96	1.02	0.84	0.97	0.89	0.93

Agricul. & food proces. mach.	0.97	1.00	0.92	0.95	0.90	0.93	0.83	0.94	1.03	1.08	0.91	0.93
Textile & sewing machines	0.98	1.03	0.91	0.94	0.97	0.98	0.97	1.00	0.88	1.00	0.91	0.99
Paper & pulp machinery	0.95	0.98	0.81	0.93	0.95	1.02	0.98	1.02	0.95	0.99	0.98	0.99
Mach. for other spec. indu./proces.	0.98	1.00	0.92	0.93	1.00	1.04	1.00	1.02	0.98	0.99	0.99	1.01
Heating & cooling equipment	0.96	0.99	0.87	0.92	0.87	0.96	0.95	0.98	0.84	0.86	0.84	0.91
Metalworking machinery	1.00	1.01	0.96	0.97	0.96	0.99	0.94	0.96	0.94	0.96	0.97	0.99
Power generating machinery	1.03	1.07	0.96	0.98	0.93	0.95	0.70	0.87	0.90	0.98	0.97	1.01
Pumps & centrifuges	0.91	0.94	0.93	0.97	0.89	0.93	0.93	0.94	0.88	0.94	0.97	0.99
Typewriters & office mach.	0.91	0.96	0.79	0.92	0.82	1.11	0.70	1.00	0.78	0.95	0.92	1.12
Computers & peripherals	0.95	1.00	0.77	0.92	0.85	0.98	0.92	0.99	0.95	1.01	0.91	0.96
Semiconductors	0.71	1.00	0.84	0.94	0.93	1.02	0.95	0.99	0.87	0.92	0.91	0.97
Telecommunications equipment	0.75	0.81	0.83	0.91	0.93	1.02	0.87	1.01	0.99	1.07	0.90	0.94
Mach. for prod. & dist. of electricity	0.90	0.94	0.88	0.92	0.79	0.92	0.71	0.85	0.83	0.89	0.91	0.99
Consumer electronics	0.76	0.90	0.95	1.05	0.81	0.94	0.96	1.00	0.80	0.96	1.04	1.14
Domestic electrical equipment	0.90	1.01	0.88	0.95	0.87	0.93	0.90	0.97	0.82	0.86	0.92	1.01
Electromedical .equipment	0.94	0.98	0.92	0.95	0.93	0.98	0.97	1.06	0.90	0.95	0.94	0.95
Non-elec. medical equipment	0.96	0.98	0.79	1.09	0.86	0.93	0.95	1.00	0.92	0.95	0.94	0.95
Measuring & control. instrum.	0.95	0.97	0.98	0.99	0.92	0.96	0.94	1.00	0.95	0.98	0.82	0.85
Photogr. & optical goods, watches	0.97	0.98	0.83	0.93	0.93	0.95	0.99	1.00	0.94	0.96	0.96	0.98
Railway vehicles	0.90	1.03	0.78	0.97	0.78	0.98	0.62	0.79	0.42	1.21	0.51	0.94
Road motor vehicles	0.98	1.04	0.96	0.99	0.90	0.93	1.00	1.01	0.97	0.99	0.98	0.99
Aircraft	0.91	0.96	0.95	0.98	0.95	1.02	0.92	1.02	0.87	0.96	0.99	1.01
Ships and boats (& oilrigs)	1.00	1.03	0.85	0.90	0.92	1.03	0.94	1.00	0.85	0.97	0.67	0.92
Other non-electrical equipm.	0.88	0.90	0.97	0.99	0.88	0.92	0.97	0.99	0.91	0.93	1.04	1.06
Other electrical equipment	0.88	0.90	0.98	1.03	0.99	1.01	0.91	0.94	0.89	0.92	0.98	1.01
Manufactures of metal	0.86	0.92	0.84	0.86	0.94	1.01	0.80	0.87	0.83	0.93	0.99	1.02
Furniture	0.92	0.96	1.08	1.12	0.84	0.89	0.84	0.94	0.91	0.99	0.90	0.93
Clothing	0.74	0.88	0.67	1.00	1.07	1.14	1.10	1.13	1.01	1.03	0.98	1.01
Orthopaed. eq. & hearing aids	0.90	0.94	0.81	0.94	1.04	1.18	0.86	0.93	0.90	0.92	0.91	0.99
Industrial products, n.e.s.	0.92	0.95	0.92	0.96	0.93	0.99	0.93	0.96	0.79	0.88	1.02	1.06
Mean (unweighted)	0.91	0.97	0.89	0.96	0.90	0.98	0.90	0.97	0.90	0.97	0.93	0.98

Note: All β-values significantly different from zero at the 1% level.