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Abstract

This report investigates the impact of trade structure and trade specialization on long-run development patterns in a heterogeneous set of countries, including most OECD countries, developing and rapidly industrializing Asian and Latin American countries as well as ten Central and Eastern European countries over the period 1981 to 1998. The hypothesis that not trade *per se* matters for economic development, but that technology and skill intensity of trade flows is important, is empirically tested using data on various macroeconomic variables (GDP, investment, FDI inflows, schooling) together with industrial data on exports and imports from two sources: the UNIDO Industrial Demand-Supply Balance Database and the UN trade database. Industries are grouped according to their skill intensity, using a taxonomy of manufacturing industries by Peneder (1999).

The analysis of a revealed comparative advantages over time, using an index developed by Vollrath (1991), shows a trend towards de-specialization (i.e. specialization has become less pronounced) together with convergence for most countries, with the exception of South Asia. This has previously been observed for the OECD. This development is more pronounced in extremely low- and high-skill intensive industries, which are also the industries where initial specialization has been strongest.

Based on these descriptive results, the impact of certain specialization patterns on aggregate economic growth is tested in a panel, using a fixed effects model. The results point towards a role for trade structure in economic growth, although not as strong as expected. Especially trade in medium high-tech and in high-tech industries relates positively with GDP growth for East Asia, but also for the advanced OECD countries. Medium low-skill intensive exports (presumably to a large extent the transport industry) play a special role in catching-up economies, including East Asia. Finally, differences between the impact of export and import structure are observed. Thus, we conclude that the channels by which trade influences growth differ between exports and imports.

Keywords: trade specialization, structural change, dynamics of revealed competitive advantage, economic growth, spillovers

JEL classification: F14, L16, L60, O19, O33, O57

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Patterns of Trade Specialization and Economic Growth

An empirical analysis of trade and growth patterns in selected world regions as compared to OECD countries

Introduction

Any country's industrial structure and its path and prospects of development are likely to be related. The ability to allow for and cope with structural change, i.e. flexibility in adjusting to changes in the economic environment, changes in factor endowments and the like, is strongly determining a country's 'fitness' in a globalized world. On the other hand, most economically advanced countries display very little structural change in the short term. Their industrial structure and structural stability seem to be closely related to their prosperous development.

Thus, structural patterns and structural change are important issues, in particular for successfully catching-up countries. The investigation of industry patterns in backward economies as compared to those in the more advanced economies – in output as well as in trade – should allow to identify adequate industrial structures that are conducive to aggregate economic growth at certain stages of development. Such an analysis may also be helpful for the derivation of industrial policies aimed at promoting income convergence.

Two important questions arise in this context. First, the direction of causation between industrial structure and aggregate economic growth is not clear. The industrial structure can influence aggregate economic development via shifts in production towards industries with higher productivity growth. On the other hand, economic growth brings about structural change, implying that industry patterns depend to some extent on the stage of economic development. Increases in income levels, given differences in income elasticities across sectors, will cause demand for output of specific industries to rise more than for others. Thus, economic growth has an impact on industrial patterns and structural change, but it is also influenced by structural change.

Case 1: Increasing specialization in certain industries together with diverging trade patterns across countries. This occurs if countries increasingly exploit their comparative or absolute advantages and reinforce their specialization patterns accordingly.[1] This situation is likely to be relevant for less developed countries, but also for more advanced economies if specialization is induced by absolute advantages (e.g. oil in the case of OPEC or fish in Iceland).

[1] The concepts of absolute and comparative advantage will be explained in the section on theoretical determinants of trade below.

Case 2: Countries broaden their trade patterns while becoming more similar in their structures. De-specialization together with convergence in trade patterns usually goes hand in hand with a rising importance of intra-industry trade and is often observed for homogenous trading partners at an advanced stage of development (see, for instance, Laursen, 2000, for a study on OECD members covering the period 1970 to 1991).

These two common cases seem to be applicable to different countries depending on their stage of development. However, two more cases, although less common, are conceivable.

Case 3: Specialization together with convergence. Countries with initially distinct, but not very pronounced patterns of specialization increasingly specialize in the same industry. For example, a sharp rise in world demand for computer equipment may cause specialization in the production of these products by countries that initially showed a weak specialization in different industries, such as textiles, food, furniture or plastics.

Case 4: Conversely, countries may start from a rather similar structure and become increasingly different, although specialization is decreasing. Divergence and de-specialization may occur, for example, if one textile producing country immediately shifts part of its production to ICT-sectors while another textile producer moves towards motor vehicles. This case can be considered as a transitory stage in the direction to case 2 (de-specialization together with convergence) if the latter country eventually ends up exporting computers as well after having shifted production (and exports) from low to medium and then to high skill intensive industries.

The present study focuses on the second question stated above, namely, what kind of trade specialization patterns are beneficial to aggregate growth.[2] In other words: Is it desirable to have converging or diverging industrial structures and should countries focus their activities on few industries or broaden their specialization patterns?

The focus lies on a comparison of different trade specialization patterns in manufacturing industries across different groups of countries. Relating different trade patterns to macroeconomic development should lead to the identification of certain stylized facts about the trade structure which accompany economically successful countries. Most empirical studies so far have restricted their attention to either a single economic bloc, e.g. the OECD (Laursen, 2000) or the EU (Midelfart-Knarvik, 2000) or to a certain region, e.g. Asia (Timmer, 2000, Farah et al., 1997). Using a comprehensive database, the present study compares trade patterns of OECD countries to those of East Asia, South Asia, Latin America and CEECs and attempts to relate them to the growth performance of the respective regions.

[2] In the following, we shall analyse two aspects of trade patterns: the industrial structure of trade or trade composition, and industrial specialization with respect to trading partners. We are here only concerned with industrial patterns and not with geographical patterns of trade flows.

Because of limitations in data availability, long-term comparisons between CEECs and other regions cannot yet be made. However, it is possible to identify typical long-run patterns of structural change that have been observed in different geographical regions and compare them to the Eastern European experience so far. Given the rapid pace of Eastern European integration into the world's most important trading bloc – the EU – this group of countries can no longer be excluded from global analyses.

Section 1 gives an overview of the theoretical literature and tries to isolate relevant factors in the determination of trade patterns. The database and methods used for comparing different trade patterns are presented in section 2. The prevailing regional and sectoral patterns of trade specialization are described and empirical results concerning convergence and specialization of regional trade patterns are summarized in section 3. Special consideration is given to the Central and Eastern European countries. A brief description of the aggregate growth performance of all regions is provided in section 4. Section 5 tries to empirically establish a link between export composition, structural change in the trade sector, trade specialization and real income growth.

1 Theoretical determinants of trade patterns

This section briefly describes the most prominent approaches towards explaining international trade, with special emphasis on the predictions concerning sectoral or industrial trade patterns, leaving aside other important aspects such as welfare implications, tariffs etc.

1.1 Static trade theories

Most static trade models motivate the presence of international trade flows by the existence of differences in autarky prices for identical or at least similar products which are produced and consumed in different countries. Consequently, comparative advantages lie at the heart of the analysis in these models. A country holds a comparative advantage in the production of a certain good if it can produce the good relatively more cheaply in terms of a second good than its trading partner. Thus, even if the trading partner is able to produce both goods at absolutely cheaper prices, the existence of a comparative advantage will still make it profitable for the first country to specialize in the production of the first good and trade this good in return for the second one. Consequently, these comparative advantages determine the industrial pattern of trade specialization for a specific country. For example, a country that holds a comparative advantage in the production of textiles will show a strong specialization in exports of textiles.[3]

[3] Under perfect competition, prices will be influenced by underlying costs of production. Thus, international trade is explained by exploring the reasons for differences in production costs, which in turn can arise from differences in productivity, technology, endowments or from the impact of economies of scale due to a larger domestic market.

Absolute advantages exist if the production of a certain good is absolutely cheaper in one country than in the other. As the above discussion of the – historically younger – concept of comparative advantage suggests, absolute advantages alone are not sufficient to explain trade and trade specialization. Still, absolute advantages can also be induced by the presence of natural resources. For example, the presence of oil or other natural resources represent an absolute advantage that has an impact on trade and trade specialization.

The formulation of comparative advantages goes back to the work of David Ricardo and James Mill. Their hypothesis postulates that differences in labor productivity between countries give rise to trade, without further exploring the emergence of those productivity differentials. As labor productivity is influenced by many factors (capital intensity of production, technological progress), these other factors are often seen as being the ultimate source of international trade. The 2-good, 2-country, 1-factor Ricardian model predicts complete specialization for each country in the production of the good in which it has a comparative advantage. If countries differ greatly in size, or if differences in tastes among countries are sufficiently large, then one country's autarkic price ratio is dominating the world price ratio, which leads to incomplete specialization in one country (i.e. the larger one). Thus, there may be incomplete specialization simply because world demand for one good is larger than one country can supply. The model can be extended to many goods and many countries. In this case the clear and unambiguous predictions concerning the patterns of trade may be lost unless demand conditions are explicitly specified.

The Heckscher-Ohlin-Samuelson model or factor-proportions theory extends the 2-good, 2-country, 1-factor framework by introducing two factors of production: labor and capital. International price differentials in autarky are now determined by two proportions: the relative abundance of production factors and the intensity with which factors are used in the production of the two goods. In this 2x2x2-model, international trade emanates from differences in initial endowments under a specific set of assumptions (homothetic preferences, identical tastes and production functions, constant returns to scale, perfect competition, perfect factor mobility across sectors but no factor mobility across countries, no transport costs).[4]

The HO hypothesis postulates that the relatively labor abundant country holds a comparative advantage in the production of the relatively labor intensive good and will thus export more of this good and vice versa. Given assumptions about production technologies

[4] Despite its restrictive and simplifying assumptions, the HO model as formalized by Samuelson has been extremely influential. Various extensions exist, including internationally non-identical tastes, non-identical technologies, reversal of factor intensities, more than two goods, more factors and also more countries. In these cases, the general validity of the HO predictions becomes conditional. For example, the specific-factor (or Ricardo-Viner) model includes one sector-specific factor in a HO framework which is immobile between sectors, while the other factor, usually labor, is mobile. The HO proposition holds and specialization is determined by relative endowments of the sector-specific factor. Starting with the influential empirical study by Leontief (1954), the Heckscher-Ohlin-Samuelson model has also been subjected to various empirical tests, triggering off an extensive empirical and theoretical discussion.

and demand, the equilibrium in the presence of trade is always unique although different types of equilibria – including incomplete and complete specialization – can emerge. Which type of specialization prevails depends on the relation between the world price ratio of the two goods and the domestic price ratios under autarky.

Specialization in both countries is incomplete if the world price ratio for the two goods lies in between the two possible extreme price ratios which would prevail if each country specialized completely in the production of only one good in autarky.[5] If the world price ratio under trade lies outside the range specified above for only one country, the respective country specializes completely in the production of only one good, while the other country shows incomplete specialization. If the possible ranges of these two extreme price ratios for the two countries do not overlap, each country completely specializes in the production of the good, where it holds a comparative advantage.

The HO model has been the starting point for two related theorems that analyse the influence of trade specialization on income distribution, the Stolper-Samuelson theorem and the factor-price-equalization theorem. The Stolper-Samuelson theorem postulates that international trade will lower the reward of the scarce factor expressed in terms of any good (in both, nominal and real terms). Thus, factor rewards will converge internationally. As it describes the impact of trade on income distribution, it is also relevant in our context. When analysing the impact of trade specialization on growth, such considerations will clearly play a role. On the one hand, relative factor rewards drive comparative advantages and thus specialization. On the other hand, they influence aggregate income via the respective sector's share in total production.

The factor-price-equalization theorem is stronger and says that factor prices are internationally equalized as a consequence of free trade in commodities if commodity prices are internationally equalized at equilibrium. It holds only in the – more common – case of incomplete specialization. If at least one country shows complete specialization, factor prices are not equalized internationally. As factor price equalization is not very often found in empirical studies, the theorem and its numerous refinements may also be considered as giving reasons why factor prices are *not* equalized despite international trade.

The HO hypothesis essentially explains trade through supply-side factors and – by assuming homogenous demand in both countries together with homothetic preferences – more or less rules out demand factors. These factors are explicitly taken into account in the Linder hypothesis (Linder, 1961) which states that a critical amount of domestic demand is a necessary but not sufficient condition for a certain product to become an export good.

[5] Clearly, this is not feasible in autarky as, by assumption, there is always positive demand for both goods in each country. In the presence of trade, such a situation becomes feasible.

International trade is seen as an extension of the home market. Consequently, internal demand determines potential trade flows. Further, trade between two countries is more likely (and more intense), the more similar these countries are in their demand structures. As demand structures are themselves influenced to a large extent by per capita income, this will become a prime determinant of trade flows. The Linder hypothesis acknowledges the HO explanation for trade in agricultural goods, but claims that trade in manufactures is more adequately explained by demand structures.

1.2 New trade theories

Neither the Ricardian view nor the HO model seem to be validated by real trade patterns today. Most empirical studies reveal – at least for industrialized countries – increasingly similar industrial structures in production and in trade.

The so-called new trade theories (Helpman, 1981; Krugman, 1981; Ethier, 1982) are able to explain trade between similarly endowed countries and intra-industry trade (IIT) by introducing new features, including economies of scale, imperfect competition and to some extent also demand factors ('love for variety'). Almost all static trade theories largely neglect demand factors.

Krugman (1981) identifies three 'stylized facts' in international trade that cannot be explained by the traditional, static models: The bulk of international trade takes place between similarly endowed countries. This trade is often intra-industry trade and the growth of intra-industry trade has not led to serious problems in income distribution. Inspired by these facts and also by earlier empirical work (Balassa,1967, Grubel, 1970 and Kravis, 1971), Krugman develops a range of models (Krugman, 1980, 1981) based on the monopolistic competition model by Dixit and Stiglitz (1977), where imperfect competition, economies of scale, and the possibility of product differentiation lead to the emergence of trade even in the absence of differences in factor endowments. Internal economies of scale at the firm level together with demand for variety lead to IIT, the share of which in total trade is positively related to similarities in demand and production characteristics of the trading partners.

In these models, increasing returns to scale and product differentiation are sufficient to determine the volume of trade, however, the direction of trade and thus specialization patterns remain indeterminate unless transport costs are introduced. In the presence of significant (but not prohibitive) transport costs, the home-market effect matters and a country exports those goods for which domestic demand is higher. Thus, domestic demand determines the location of production and in consequence trade patterns. The home-market effect mentioned by Krugman is a formalization of the Linder hypothesis. In

addition to demand factors, also differences in factor endowments or technology – in other words, traditional HO-type factors – influence specialization.

Helpman (1981) provides an excellent integration of the Heckscher-Ohlin approach with the elements of new trade theory, i.e. product differentiation, economies of scale, and monopolistic competition. In his model, factor endowments à la Heckscher-Ohlin explain inter-sectoral trade, whereas intra-industry trade is explained by the factors mentioned above. With respect to inter-sectoral trade, the factor-price-equalization theorem applies. Further, the capital-rich country will be a net exporter of the capital intensive good and vice versa.[6] Concerning the composition of trade (inter- versus intra-industry) he shows that a redistribution of factor endowments which increases the difference in capital-labor ratios between countries reduces the share of IIT. Finally, he proposes two hypotheses regarding the relationship between the share of IIT and per capita incomes. The bilateral share of IIT is negatively correlated with absolute differences in per capita incomes and the share of IIT in world trade declines with increasing dispersion of per capita incomes.

Having been inspired by the same empirical studies and facts as Krugman, Ethier (1982) takes a different theoretical approach and concentrates on differentiated producer goods. He distinguishes between 'international' returns to scale, which arise from increased division of labor instead of larger firm scale, and traditional 'national' economies of scale. International economies of scale depend on the size of the world market and not on the national concentration of industry, and this leads to a theory of IIT in intermediates, which, from an empirical point of view, have a larger share in international trade than consumer goods. His conclusions are the following: International returns to scale depend on the interaction of scale economies due to division of labor and increased firm size, i.e. on the interaction between external and internal returns to scale at the firm level. Given such scale economies, the basic HO propositions are valid for trade in final goods. Further, IIT is relevant for intermediates and this kind of trade is also influenced by factor endowments and is complementary to international factor mobility. Although internal scale economies and product differentiation are necessary ingredients in his theory, the extent of such economies does not necessarily have a strong influence on the degree of IIT. The share of IIT rises if factor endowments become more similar, which is in line with Helpman's predictions.

[6] The pattern of intersectoral trade cannot in general be predicted from pre-trade price differentials or relative factor rewards. The latter may be used under certain conditions, but relative commodity prices also depend on the relative country size. The relative country size has also an influence on the volume of trade in this model, which is declining when size differentials increase.

1.3 Economic geography models

Economic geography models (see Fujita et al.,1999) are a related strand of literature with a slightly different focus. They stress the interaction of increasing returns to scale together with transport costs and the implications on the location of industry. Increasing market size and changes in transport (or better: transaction) costs allow to determine specialization patterns in production. Production factors are sector-specific and mobile in at least one sector, which is usually the manufacturing sector. In the basic model, agricultural goods are produced with constant returns to scale (CRS) and traded freely, thus agricultural wages are equalized across regions. Manufactured goods are traded at a cost and real wages between regions may differ in this sector. Workers are assumed to move towards regions with higher real wage rates and – due to increasing returns to scale (IRS) in this sector – this movement of workers itself influences the real wage differential. Consequently, the distribution of manufacturing workers across regions evolves over time, depending on the level of transaction costs and real wage differentials. Forward linkages (which imply a larger variety of goods produced and a lower price index in a region) and backward linkages (higher nominal wages due to access to a larger market) reinforce each other and can endogenously induce specialization in production structures between initially similar or even identical regions. These agglomeration economies, stemming from self-reinforcing location decisions of firms, consumers and workers, result in a core–periphery pattern, where centripetal and centrifugal forces work at the same time. The level of transport costs determines how many equilibria exist and their type. Above a certain level of transport costs, one symmetric equilibrium exists without specialization. At very low transport costs, the two linkage effects become strong enough to induce complete specialization, thus two stable equilibria with complete specialization and one unstable symmetric equilibrium exist. At intermediate levels, there are two stable equilibria with complete specialization, one symmetric locally stable equilibrium and two unstable ones in between. Introducing transport costs in the agricultural sector does not alter the results qualitatively; a reduction of these costs still has the same non-monotonic effect on concentration of production.

The basic model has been extended to include demand for intermediates, which further increases the strength of linkages and works towards concentration of production. This extension allows to put the model into the context of trade theories, as manufacturing now becomes at the same time a producer and consumer of intermediates, and international concentration can now emerge even in the absence of international labor mobility. A larger manufacturing sector offers a greater variety of intermediates, which lowers the costs for intermediates in the production of final goods (forward linkages), and it offers a large local market for intermediates (backward linkages). Both effects are beneficial to specialization of countries in only one sector. The relationship between the level of transport costs and the degree of concentration in production can be shown to be inversely U-shaped if relative factor prices between regions diverge. Imagine two economies which start from autarky

and where transport costs are prohibitive. Each economy produces two goods, manufactures and agricultural goods. When transport costs start to decline, trade emerges in the increasing returns sector first, which is usually modelled as being the manufacturing sector. Eventually, backward and forward linkages induce international differentiation such that manufactures are only produced in one region, which becomes the industrialized core. In the absence of international labor mobility this leads to divergence in real wage rates and uneven development with income divergence between the core and the periphery. A further reduction in transport costs makes the periphery attractive again because of its low wages. Thus, production starts shifting out from the centre, inducing income convergence together with decreased specialization (Krugman and Venables, 1995).

These latter models are often used to explain North-South trade, i.e. trade between industrialized countries and developing countries. They can also be extended to include more countries and more industries. The question then arises which industry will be the first one to spread out to other countries and to which countries. The reason for the spread of industry may alternatively be found in a rise in the demand for manufactures. Unfortunately, economic geography models tend to become algebraically too complicated to be solved analytically. Thus, the number and kinds of equilibria remain unknown. Simulation results suggest that the spread of industry is not uniform across countries and that small initial advantages can have large and long-lasting or even permanent effects. Industrialization proceeds in waves, where countries successively experience rapid industrialization once a critical mass of industries is established. Another interesting suggestion which results directly from these models and which is closely related to the empirical research here, concerns the characteristics of those industries which are the first ones to move out of the core: in general, the most labor intensive and most weakly linked industries leave first. They may also be industries with low transport costs or good logistics (for example cars, semiconductors). These industries then trigger off development towards a mature industrial structure in the peripheral country.

1.4 Summary

This brief review of trade theories offers several predictions concerning trade specialization patterns. Labor productivity differentials determine the pattern of specialization in the Ricardo model, relative factor endowments influence specialization in the HO model. Both these factors are also relevant in new trade theories, which additionally allow for a new type of trade, namely intra-industry trade. With this kind of trade also demand characteristics and market structure play a role: two aspects that have not always been included in classical trade models. Finally, new economic geography models additionally consider transport costs and their implications on specialization patterns.

Most theories focus either on supply or demand factors when explaining international trade and few have attempted to integrate both kinds of factors in a comprehensive model. Of course, supply and demand factors can be combined in a straightforward way, by postulating the dominance of one above the other (Linder, Helpman). It is also thinkable that their relevance differs, depending on whether one wants to explain exports or imports. Clearly, imports are demand-driven. Therefore demand factors, such as per capita income (i.e. stage of development) will strongly determine import patterns. Similarly developed economies will resemble each other in their import structures. Of course, in the case of imported producer goods and intermediates, supply-side considerations also play a role for import structure. But where will the import goods be purchased from? Most likely from the best supplier, i.e. the country which has a comparative advantage in producing the specific good, regardless of per capita income or stage of development. Thus, supply-side characteristics are likely to be more relevant when talking about export patterns. From an empirical point of view, endowment structures may differ a lot, whereas demand characteristics for countries at a similar stage of development may be relatively alike. This suggests that different explanations are relevant for explaining imports in contrast to exports.

Some models (i.e. the Linder hypothesis and new trade theories) have also clear implications for the relationship between per capita income and trade patterns. The different approaches outlined above and their structural implications for trade seem appropriate in different stages of development. Trade between relatively similarly endowed, high-income countries will mainly be of an intra-industry nature and driven by scale economies and product differentiation, resulting in increasingly similar trade patterns. Large differences in initial endowments, productivity, technology and per capita income will lead to inter-industry trade and increasing specialization according to comparative advantage. Thus the low-income country will specialize in low skill, low tech goods (often primary commodities or simple consumer goods), whereas the high-income country will specialize production and also exports in technology and skill intensive goods. Depending on convergence or divergence in productivity, skill endowments and/or technology, specialization will either decrease or intensify over time. Agglomeration economies and declining transport costs may initially reinforce existing specialization patterns, negative agglomeration externalities, changes in factor costs (rising wages in the centre) and further declining transport costs will start to work in the opposite direction, inducing a relocation of industries to the periphery and finally leading to convergence in output and trade structures.

In all these models, causation runs from the development level to an implied pattern of trade. Conversely, especially development economists often stress the developmental impact of exports. The argument is mostly based on the fact that the export sector has a higher productivity, a higher potential for economies of scale and positive externalities for

the non-export sector in the form of knowledge spillovers, process and product innovation, technological change, etc. (Feder, 1982). This argument can be transferred to a lower level of aggregation, which is the basis for the empirical research in the present study. Productivity, externalities and economies of scale are expected to differ between industries inside the export sector. Knowledge spillovers are presumably higher in the high-tech industries than in low tech, labor intensive ones. This implies a significant influence of trade *specialization* on development and also on economic growth. In a dynamic growth model, faster increases in productivity of one sector through exports have a permanent positive influence on economic growth.

The impact of exports on growth has been researched extensively and turned out to be highly positive in empirical studies. Although the same theoretical arguments apply to the sectoral composition of trade, this topic has been less researched and – to our knowledge – no comprehensive theory exists that links disaggregated trade flows to aggregate economic growth.

2 Data and methods

Working with disaggregate data – at the level of individual 3-digit industries, as is done here – implies a number of problems related to classification, missing values, limited data availability, etc. The UNIDO database offers comparable data for a large number of countries also outside the OECD. Unfortunately, it does not contain trade data for CEECs. Still, where available, trade and output data are reported for the same classification scheme based on industries. Time series for manufacturing exports and imports are thus taken from the UNIDO Industrial Demand and Supply Database at the 4-digit level of aggregation. Time series for output data at the industrial level are taken from the UNIDO Industrial Statistics Database (INDSTAT 4). Industries are classified according to ISIC, rev. 2, at the 3-digit level, and a few particular industries were taken from the 4-digit level database. Data for ten CEECs are taken from the UN database, which is classified according to NACE, rev. 1, 3-digits.[7] Aggregate data for GDP, GDP-deflator, exchange rates, domestic investment, and population are taken from the International Financial Statistics of the IMF. Purchasing power parities from the World Bank are used to make those data internationally comparable. Further, measures of schooling, which proxy for human capital, are taken from the Barro and Lee data set, which is available from the internet via the World Bank homepage.

The data set covers 54 countries and 34 industries over the period 1981 to 1997. Countries are grouped according to geographic region into six distinct classes:

[7] In general, trade data are broken down by goods, and output data are classified by industries. The data sources used here all reported trade data at the industrial level, however, using different industry classification schemes.

OECD-North, OECD-South, CEEC, East Asia, South Asia and Latin America (for a listing of countries in each individual group see Table A.1 in the appendix). OECD contains all member countries before 1994 (excluding Iceland), distinguishing between catching-up countries (OECD-South, comprising Greece, Portugal, Spain and Turkey) and advanced countries (OECD-North).

In order to combine disaggregated trade data for CEECs (classified according to NACE, rev. 1) with those of all remaining countries (ISIC, rev. 2), industries are grouped by skill intensity using the WIFO taxonomy of manufacturing industries (see Peneder, 1999).[8] Thus, export patterns are defined very broadly by looking at the shares of exports and imports in each of the four respective groups: low skill, medium skill - blue collar workers, medium skill - white collar workers and high skill intensive industries (see Table A.2 in the appendix for the grouping of ISIC, 3-digit industries).

A simple measure of distance is used to look at the two issues of structural change over time (specialization versus de-concentration) and similarity in trade structures across countries and regions (convergence/divergence). The measure is based on export and import shares (Landesmann and Szekely, 1995):

$$D_{ij} = \left(\sum_k (x_k^i - x_k^j)^2 \frac{x_k^i}{100} \right)^{1/2} \tag{3.1}$$

where x_k^i is the share of imports or exports of country *i* in industry group *k* and x_k^j is the import or export share of the same industry in country *j*.

This index ranges from 0-100, zero indicating completely identical structures and 100 being the extreme case of no similarity (largest distance). Comparing distance measures of one country over time allows to look at structural change and specialization tendencies, whereas a comparison across countries measures structural similarity and convergence (divergence) over time.

The measure of distance described above reveals specialization as such, but no indication of the particular kind of specialization (i.e. which industries are important) is given. For this purpose, a measure of revealed comparative advantage is used, which calculates the relative representation of a country's exports and imports in one industry compared to the average representation of that industry in total trade of the whole sample (Vollrath, 1991).

$$RCA_k^i = RXA_k^i - RMA_k^i \tag{3.2}$$

[8] This taxonomy has been established on the basis of OECD labor market data and refers to the NACE classification. At the level of disaggregation which was used here, we can reclassify industries according to ISIC unambiguously into the four skill categories.

where

$$RXA_k^i = \frac{X_k^i / X_n^i}{X_k^r / X_n^r}$$

and RMA_k^i is defined analogously. X_k^i are total exports (imports, respectively) of country *i* in industry *k*. Superscript *r* denotes all countries without country *i*, and subscript *n* refers to all industries except industry *k*.

The measure defined in equation (3.2) is a modification of a specialization index that has originally been constructed by Balassa (1965). His normalized relative export measure divides a country's share in exports of one good by the average export share in the total sample of countries. The above measure is refined in that it compares a country's trade share to the average share of the rest of the sample, excluding the country and commodity under consideration. Thus, double counting is avoided and the nature of trade, which is always a bilateral exchange of goods between two countries, is better reflected. The measure, which is also called 'relative trade advantage' or 'revealed competitive advantage', incorporates both, relative demand and supply dimensions. Thus, assuming no trade distortions, it comes very close to '... measuring true comparative advantage because ... [its] two-commodity and two-country architecture is consistent with neoclassical theory...'. (Vollrath, 1990, p. 276.) The revealed competitive advantage reflects a country's net world market position in the respective industry relative to its size and can also be considered as an index of competitiveness. It is recommended for analysing highly disaggregated trade flows, where some goods may not be exported (or imported) at all by some countries. At the highest level of disaggregation used in this study (ISIC 4-digit code), this problem has occurred.

A positive index reveals a competitive advantage, or an above-average relative net market share in the specific industry, whereas a negative index reveals a competitive weakness. The index is unbounded and symmetric around zero. The RCA may hide extreme sectoral specialization if it is equally strong in exports and imports, therefore always both components have to be considered. Each component will take a value between zero and infinity, with values greater than one indicating a specialization of exports or imports in the respective industry, and values below one indicating below-average trade flows.

The revealed competitive advantage can also be utilized to detect specialization and convergence in trade patterns, when it is compared over time or across regions. This is done in section 3.4. The following simple regression model

$$RCA_{k,T}^i = \alpha^i + \beta^i RCA_{k,0}^i + \varepsilon_k^i \qquad (3.3)$$

is estimated separately for each country group.[9] The coefficient β^i indicates whether existing specialization patterns have been reinforced over the observation period or not. If β^i is not significantly different from one, there is no change in specialization. $\beta^i > 1$ indicates increased specialization of the respective country, and if $0 < \beta^i < 1$ there has been de-specialization, i.e. a country (or a region) has gained competitive advantage in industries where it did not specialize and has lost competitiveness in those industries were it was heavily specialized initially. In the case of $\beta^i \leq 0$ no reliable conclusion can be drawn on purely statistical grounds, the specialization pattern is either random or it has been reversed.

Convergence across countries can be tested in the same fashion, using the following regression model

$$RCA^i_{k,T} = \alpha_k + \beta_k RCA^i_{k,0} + \varepsilon^i_k \tag{3.4}$$

which is now estimated separately for each industry (or industry segment). A β_k-coefficient of exactly one indicates again that individual country positions in this industry did not change over the observation period. If $\beta_k > 1$ we can speak of β-divergence in trade patterns, implying that countries which have been heavily specialized in specific sectors have become more specialized in these sectors, and vice versa. Structural convergence among countries is said to be present if $0 < \beta_k < 1$. Convergence is stronger the smaller β_k. If $\beta_k \leq 0$ no statistically sound conclusions can be drawn as to whether the initial pattern of competitiveness has been reversed completely or whether the present pattern is entirely due to chance.

3 Regional and sectoral trade patterns

The comparison of relative trade advantages (see equation 3.2) for all six regions and all four skill types in two different years (1981 and 1997) draws a clear picture of differentiation, which has changed quantitatively, but not qualitatively over time. There is a clear distinction between the trade patterns of advanced OECD countries and all other regions in the sample with respect to skill intensity of export industries. Two related trends dominate the picture: a trend towards convergence and a trend towards de-specialization. Similar to what has been observed for relatively homogenous groups of countries, also the larger and more heterogeneous set of countries shows the developments outlined as Case 2 in the introduction. Regions have become more similar and less specialized over the observation period in their manufacturing exports and imports. Specialization has decreased, but remained more or less the same over these two decades. Only very few switch-overs in revealed competitive advantage have been observed.

[9] See Laursen (2000) for a discussion of this formulation.

3.1 Sectoral specialization

The patterns of specialization in 1981 and 1997 are given in Table 1.[10] In the initial year, OECD-North emerges clearly as a leader in exports produced with a highly qualified labor force. In contrast, the revealed competitive advantages indicate a strong initial position in low skill intensive exports for all other regions. Their specialization in low skill exports is very pronounced, with export indices ranging from 2.34 (East Asia) to 6.62 (South Asia). Also the RCA indices are considerably greater than one in all country groups, a feature that cannot be found in any other skill category, except for high skill intensive exports from the advanced OECD countries. Here the export index is also significantly greater than one. This clear distinction between OECD-North and the remaining countries is only observed in the two extreme segments of high and low skill intensive industries. Further, the revealed competitive advantage of OECD-North in high skill intensive industries stems solely from the strong performance of the USA (with an RCA of 2.23 in 1981). All remaining advanced OECD countries and the EU as a whole either show a negative specialization index or a weakly positive one (for example Denmark, Germany, Italy and the UK).[11]

In 1981, a rather mixed picture is observed in medium skill intensive industries. The advanced OECD countries are the only region with above-average exports (especially so Japan), for all other regions (except South Asia) the share of medium skill intensive exports is close to the world average. Whereas advanced OECD and Latin American countries are characterized by a relatively high share of imports in medium skill, blue collar industries, OECD-South and Asian countries have relatively high imports in the white collar segment. Specialization in these industries is not very pronounced, the competitiveness measures are all well below one and smaller in absolute terms than in either the high skill or the low skill intensive sectors for all regions.

Table 1 shows the same measures of trade specialization in 1997 as well. Specialization in high and low skill intensive industries between regions has not changed. OECD-North still constitutes the only group in the sample with a revealed competitive advantage in high skill intensive industries. The competitive strength of the USA in this segment has declined due to an increased import share and decreasing exports relative to the world average. Japan has joined the group of relative net exporters in high skill intensive industries, with an RCA of 0.32. The EU could also gain relative market shares in these industries, the RCA switched from just below zero to a small positive value.

[10] Note that intra-regional trade is always included in the calculations.

[11] Individual country results are not displayed here, but can be obtained from the author upon request.

Table 1

Revealed competitive advantages of selected regions, 1981 and 1997.

	Exports		Imports		RCA	
	1981	**1997**	**1981**	**1997**	**1981**	**1997**
			low skill industries			
OECD-North	0.32	0.57	1.27	1.07	-0.95	-0.51
OECD-South	2.38	2.20	0.72	1.10	1.66	1.10
CEEC	.	2.17	.	1.21	.	0.96
East Asia	2.34	0.98	0.90	0.89	1.45	0.09
South Asia	6.62	8.16	1.19	0.95	5.43	7.22
Latin America	3.99	1.83	0.68	0.83	3.31	1.00
US	0.44	0.52	1.04	0.82	-0.60	-0.29
EU	1.23	1.30	1.22	1.25	0.01	0.05
JP	0.63	0.36	1.44	1.45	-0.81	-1.10
			medium skill - blue collar industries			
OECD-North	1.53	1.36	1.25	1.61	0.28	-0.25
OECD-South	0.82	1.44	0.80	1.20	0.01	0.25
CEEC	.	1.15	.	0.90	.	0.25
East Asia	0.91	0.47	0.73	0.45	0.19	0.02
South Asia	0.39	0.29	0.37	0.26	0.02	0.03
Latin America	0.24	0.98	1.11	0.96	-0.87	0.02
US	0.70	0.66	1.59	1.54	-0.88	-0.88
EU	0.85	1.15	0.73	1.05	0.12	0.10
JP	2.00	1.38	0.50	0.74	1.50	0.64
			medium skill - white collar industries			
OECD-North	1.24	0.87	0.83	0.68	0.41	0.20
OECD-South	0.70	0.55	1.25	0.81	-0.55	-0.26
CEEC	.	0.65	.	0.93	.	-0.28
East Asia	0.94	1.79	1.34	1.73	-0.40	0.06
South Asia	0.34	0.33	1.43	1.87	-1.10	-1.53
Latin America	0.95	1.02	0.90	1.27	0.06	-0.24
US	1.04	1.26	0.84	0.80	0.20	0.46
EU	1.04	0.74	1.08	0.84	-0.03	-0.09
JP	1.02	1.28	1.20	0.97	-0.18	0.31
			high skill industries			
OECD-North	4.69	1.80	0.76	1.03	3.93	0.77
OECD-South	0.45	0.40	1.36	0.98	-0.91	-0.58
CEEC	.	0.48	.	0.97	.	-0.49
East Asia	0.13	0.86	1.01	1.00	-0.89	-0.13
South Asia	0.22	0.29	0.93	1.00	-0.70	-0.71
Latin America	0.16	0.37	1.70	0.92	-1.54	-0.54
US	2.90	1.85	0.67	1.07	2.23	0.78
EU	0.87	0.97	0.93	0.93	-0.06	0.04
JP	0.70	1.17	0.76	0.85	-0.06	0.32

In all other regions, relative import shares exceed relative export shares. The market strength of East Asian countries in the high skill category has increased, although the RCA remains negative due to constantly high imports. The importance of low skill exports (including for example the food and textile industries) has declined, but remains high for catching-up regions (between 0.98 in East Asia and 2.20 in OECD-South). South Asia represents the only exception to this trend towards a reduced reliance on low skill intensive exports, with an increase in its export component from 6.62 to 8.16.

In the medium skill intensive industries, RCA measures are again considerably smaller in absolute terms, implying less evident regional specialization. The RCAs range from 0.02 to 0.28, apart from South Asia with a relatively bad performance in medium skill, white collar industries. OECD-North is still characterized by specialization patterns contrasting those of nearly all other regions, due to the good performance of the USA and due to the Japanese strength in medium skill, white collar activities. In the latter case, the competitiveness index has improved from -0.18 to 0.31. East Asia has experienced a switch from a revealed competitive disadvantage to an advantage caused by above-average medium high skill exports (the RCA improved from -0.4 to 0.06).

Specialization in Eastern Europe in 1997 is very similar to the pattern displayed by the catching-up countries inside the OECD. The similarity in sign and magnitude of RCAs is striking, also relative import and export components correspond closely. Resemblance to East Asia in 1981 and to Latin America in 1997 can also be deduced from the table. Broadly speaking, East Asia shows an initial trade structure in 1981 that is qualitatively similar to many catching-up regions (CEEC, OECD-South and Latin America) in 1997.

Global patterns of trade specialization with respect to skill intensity have not changed qualitatively, but specialization has generally become less pronounced. Over the observation period as a whole, structural developments have often led to an erosion of initial competitive advantages, implying convergence across regions. All regions – not including South Asia – are catching up with the advanced OECD countries in the skill intensity of their export industries. Inside this group, the USA clearly emerges as the leading country in terms of the skill intensity of its trade flows, although this position is being eroded to some extent because of the convergence process.

Furthermore, the importance of certain industry segments in global trade patterns has declined considerably. Especially in the low skill intensive industries, RCAs have strongly declined in absolute terms (except in South Asia, where specialization has increased). In the high skill intensive industries, there is also a strong tendency towards more uniformity among regions. Even in the medium skill intensive industries, a clear trend towards de-specialization can be observed, although initial specialization was considerably lower as compared to the high and low skill sectors, and less clear-cut across regions. In these

industries, regional patterns evolve more dynamically. Latin America and East Asia have experienced switches in the sign of revealed competitive advantage. The Latin American countries have improved their position in blue collar industries, but lost competitiveness in white collar activities. The Southern OECD countries have also gained relative net market shares in lower medium skill activities, while East Asian and Eastern European countries[12] have increased their relative market shares in white collar activities.

The differences between export and import specialization patterns suggest that the importance of IIT has risen in the medium skill intensive industries. Here import and export shares match to a great extent for nearly all regions, a feature that is not observed to the same extent in 1981. In contrast, in the high and low skill segment, one-way trade is still important. The advanced OECD countries export high skill products and are net importers in the low skill segment. The remaining countries are net exporters of low skill goods, while high skill industrial goods are imported.

3.2 Regional convergence

To assess convergence across different geographic regions, the measure of distance described in equation 3.1 was calculated, using export and import shares of different regions in each of the four industry groups. Figures 1 to 4 show the similarity of export and import structures to OECD-North and OECD-South. The choice of OECD-North as the prime benchmark results from its leading role in many aspects (productivity, per capita income and trade structure; for the latter see also the previous section). The Southern OECD countries are chosen as a second group for comparison, since they display a high degree of structural stability, while at the same time they are gradually catching up towards OECD-North. Their catching-up process can be described as 'climbing up the ladder', which means that catch-up is completed in low skill intensive industries first, before moving on to the next skill level (see Stehrer and Wörz, 2003, for a discussion of different catching-up processes). This kind of catching-up process can be seen as the standard way of convergence and is therefore used as another reference case here. The same measure of distance was used to describe the evolution of each region's trade pattern over time. Figures 5 and 6 display the time series created by calculating the year-to-year change in export and import structures for each region.

[12] For the latter group the reference years were 1994 and 1997.

Figure 1

Similarity in export patterns to OECD-North; 1981-1998

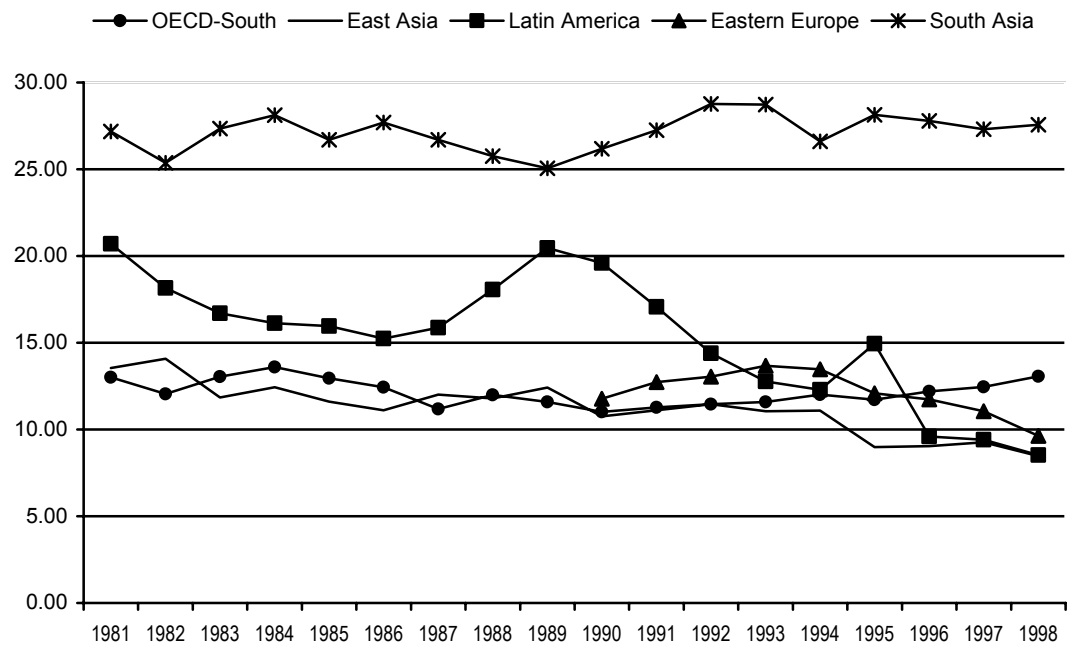


Figure 2

Similarity in import patterns to OECD-North; 1981-1998

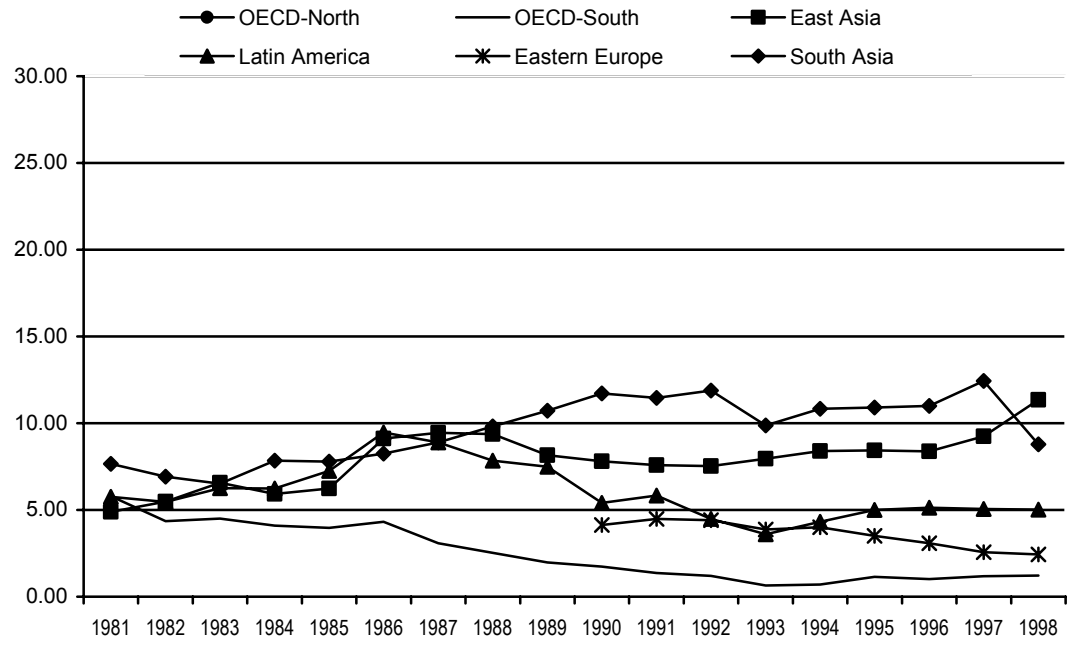


Figure 3

Similarity in export patterns to OECD-South; 1981-1998

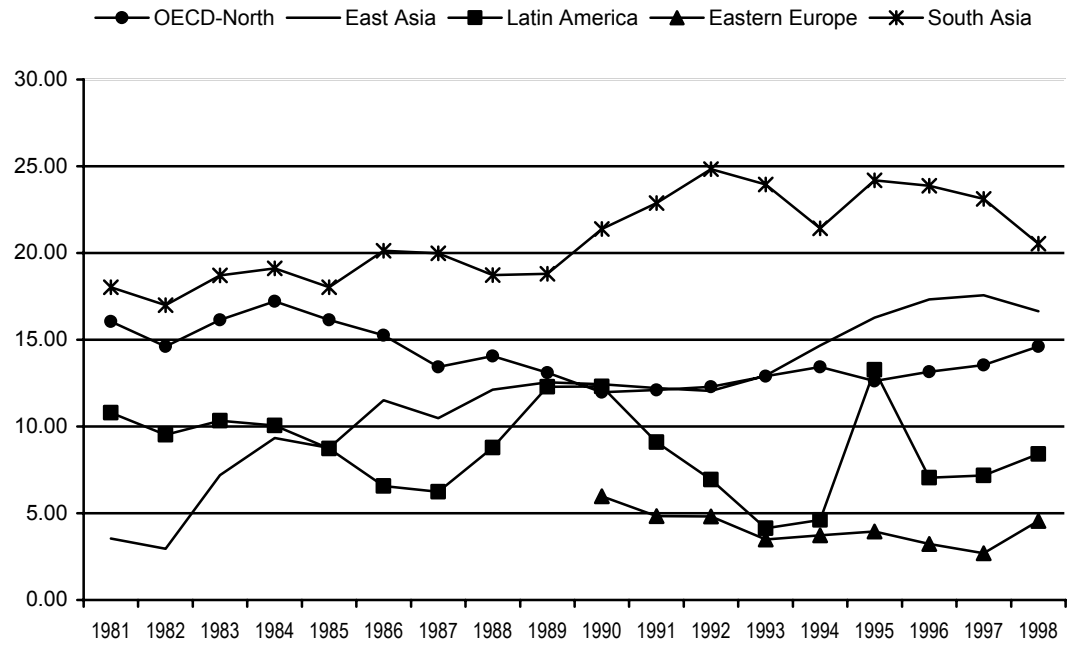


Figure 4

Similarity in import patterns to OECD-South; 1981-1998

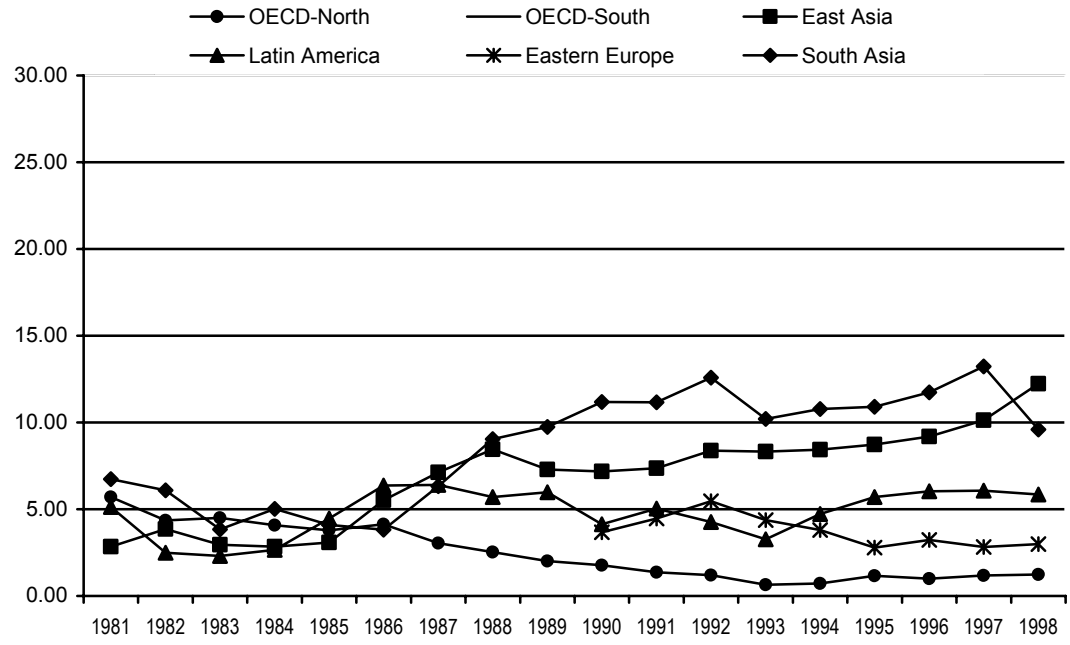


Figure 5

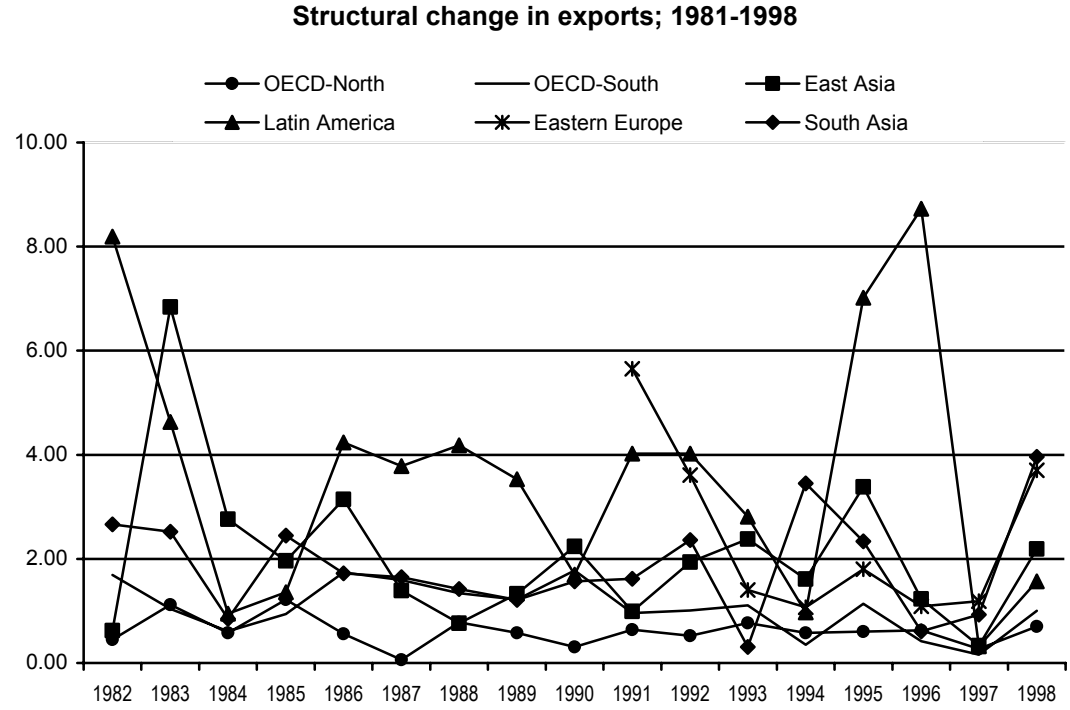
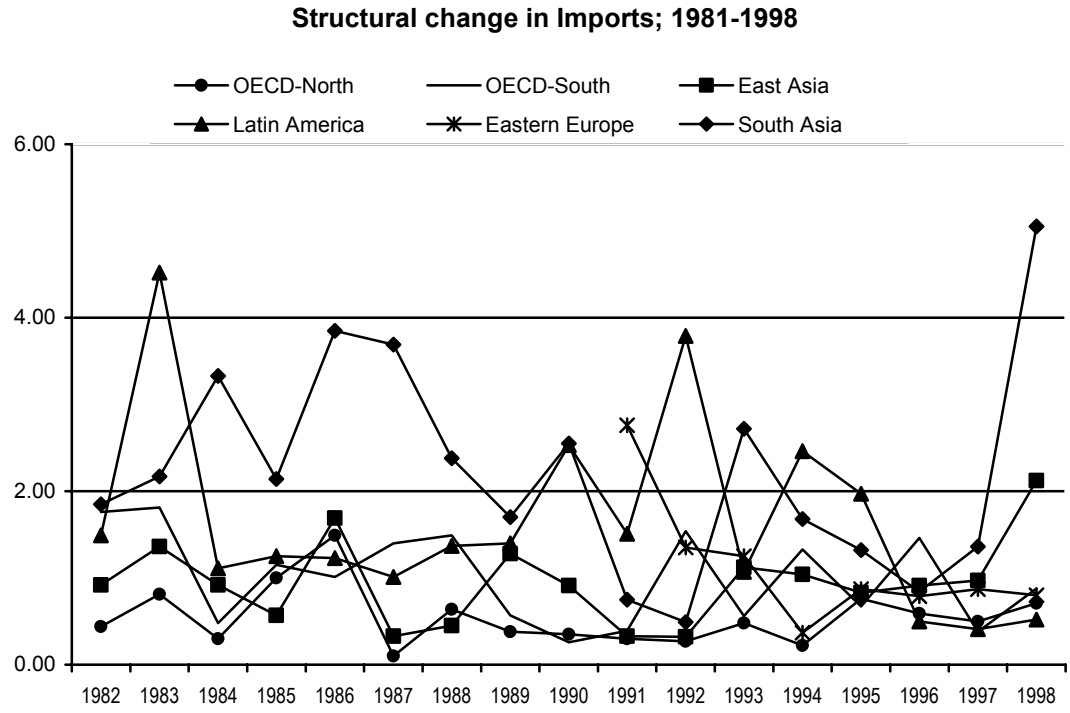


Figure 6



Some interesting features emerge directly from the inspection of these time series. First, import patterns are by far more similar across groups than export patterns. Countries are more specialized in their export flows, suggesting that factor costs and endowments do play a role in the determination of export structures. Thus both, HO factors as well as increasing returns to scale, may serve as explanations. In contrast, imports seem to be explained adequately only by new trade theories, putting emphasis on 'love of variety'. If imports were also determined by comparative advantages, then a clear distinction between a country's export and import goods should be seen. However, this is not the case: imports in all industries correspond roughly to the world average for all regions, implying that regions also import those goods on which they specialize in exports.

Second, regional trade patterns are relatively stable over time. Comparing the graphs for imports and exports reveals without any formal testing that structural stability is more pronounced in imports than in exports. Further, some regions, i.e. OECD, CEEC and South Asia, are clearly characterized by a higher degree of structural stability than others.[13] Latin America is the region with the highest volatility in trade structures, which becomes especially apparent in Figure 5. At the beginning of the observation period, East Asia as well shows a high degree of structural change, which has come down to moderate but not negligible levels.

Third, the general trend towards structural convergence in trade is far from being universally valid in all six regional blocs. The Southern OECD countries are slowly approaching the group of advanced OECD members in their trade structure throughout the 1980s. From the early 1990s onwards, imports have become more similar, while exports of the two regions have surprisingly diverged. OECD-South and East Asia departed from a strikingly similar pattern of trade specialization in the early 1980s, and have become increasingly differentiated over time. East Asia's export structure has gradually converged towards the average pattern of the advanced OECD countries. South Asia shows no convergence to any group of OECD countries: it is the only region in the sample with diverging import structures together with an export structure that is persistently different from the rest of the sample.[14] As mentioned above, Latin America has been subject to structural change throughout the observation period. Export restructuring is substantial, but varies in direction, so that periods of convergence are followed by phases of divergence.

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[13] CEECs display a relatively high degree of structural change in the first two years of the observation period 1990 to 1997. This may also be a statistical artefact and reflect high initial dissimilarity inside a small subgroup. Before 1993, industry data for imports and exports are only available for Hungary, Poland, Romania and Slovenia, only from 1993 (and 1994, respectively) data for more countries become available (Czech Republik, Slovakia, and the Baltic states). Structural similarity inside this group is discussed in more detail in section 3.3.

[14] In contrast to most other regions, which fall into Case 2, South Asia is typical for Case 1. This hints at fundamental differences in the relevant factors which explain trade patterns. In the case of South Asia, a Ricardian or HO explanation may be appropriate. In contrast, new trade theories, incorporating demand factors, economies of scale and imperfect competition, are more relevant in all other regions.

Figure 7

Structural change in exports, 4-year periods

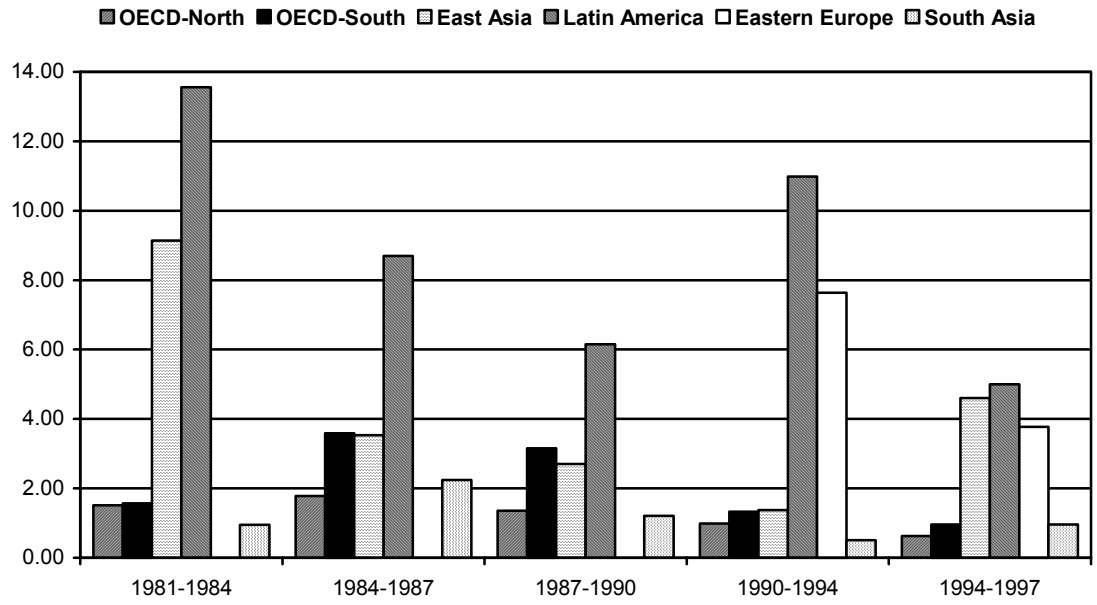
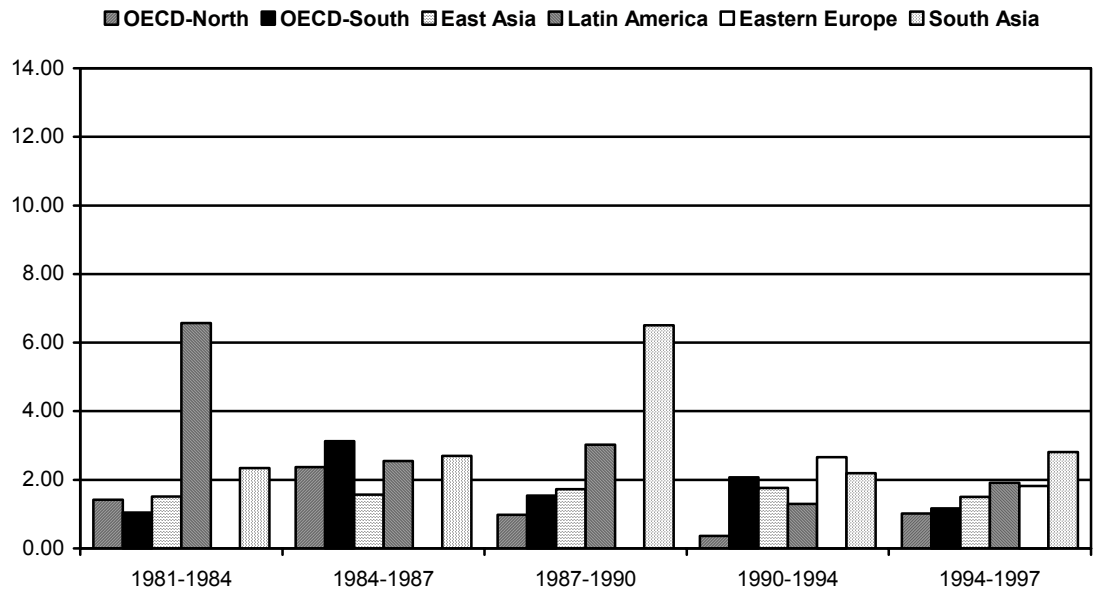


Figure 8

Structural change in imports, 4-year periods



In recent years, its pattern has been converging towards the advanced OECD countries. In summary, only East Asia and Central and Eastern Europe are substantially catching up with the advanced OECD countries in terms of their export specialization patterns.

Finally, the marked structural resemblance of CEECs' exports to those of the catching-up countries inside the OECD supports the view that per capita income or the stage of development is influential in determining trade patterns. The graphs further suggest that CEECs have started to orient their export patterns more towards those of the advanced OECD countries recently, whereas in the beginning, structural harmonization has been strongest with the group of Southern OECD members.

The plots in Figures 7 and 8 confirm the findings from above. Structural change is here measured by calculating the distance measure over four-year subperiods. Again, imports remain relatively stable whereas export structures display a higher degree of re-orientation, at least in East Asia and especially so in Latin America. South Asia seems to be an exception to the rule: structural adjustment in imports is more pronounced here than in exports. The Eastern European countries enter the picture in 1990 with a relatively stable import structure – reflecting that adjustment to the West has already taken place earlier (see also Landesmann and Szekely, 1995) – and again more volatility in export patterns.

3.3 Central and Eastern European countries

As mentioned above, due to the small number of countries and years for which data at the industrial level for the group of Central and Eastern European countries are available, a closer inspection of export and import restructuring is necessary here. Before 1994, data are only available for Hungary, Poland and Romania. Therefore, the years 1994 and 1997 were chosen as reference years, as in these years all ten candidate countries reported exports and imports at the industry level.[15] As specialization is defined with respect to the total sample, data for more recent years – although available – could not be considered here. This restricts our analysis to this rather short, but highly interesting time period.

The pattern of trade specialization in 1997 of the CEECs as a group bears great resemblance to the pattern of the Southern OECD countries in the same year, and also to the East Asian countries in 1981. The group itself is not too disparate, although broadly speaking, two subgroups can be identified: Hungary, Slovenia and also the Czech Republic are rapidly catching up and contrasting to the more structurally backward countries, Poland, Slovak Republic, Latvia, Lithuania and Romania.

[15] Yet, no data for Estonia and Bulgaria were available for 1994.

Table 2 shows specialization patterns for the group as a whole and for five selected countries. All CEE countries are above-average exporters in low and medium low skill intensive industries relative to the sample as a whole, and relative net importers in medium high and high skill intensive industries. Specialization in low skill exports is quite strong in 1994 and has declined, still the index of competitiveness remains positive in 1997, especially so in Poland and the Slovak Republic. The relative share of exports in high skill intensive industries remains stable, whereas the relative share of imports is declining, leading to a slight improvement in competitiveness for all countries in these industries. However, the RCAs are negative up to 1997. Not surprisingly, specialization patterns turn out to be very stable over the short period of observation, both for the group as a whole

Table 2

Revealed competitive advantages of selected CEECs, 1994 and 1997

	Exports		Imports		RCA	
	1994	**1997**	**1994**	**1997**	**1994**	**1997**
			low skill industries			
CEEC	2.57	2.17	1.18	1.21	1.39	0.96
CZ	2.07	1.54	0.94	1.08	1.13	0.46
HU	2.89	1.56	1.11	1.11	1.78	0.45
PL	2.80	2.53	1.27	1.12	1.53	1.41
SK	2.48	2.18	1.09	1.02	1.39	1.16
SI	1.58	1.42	1.13	1.26	0.45	0.16
			medium skill - blue collar industries			
CEEC	1.01	1.15	0.70	0.90	0.31	0.25
CZ	1.16	1.40	0.67	0.89	0.49	0.50
HU	0.56	0.97	0.86	0.92	-0.30	0.05
PL	1.24	1.27	0.60	0.96	0.64	0.31
SK	0.74	1.12	0.63	0.89	0.11	0.23
SI	1.28	1.35	1.10	1.19	0.18	0.16
			medium skill - white collar industries			
CEEC	0.60	0.65	0.96	0.93	-0.35	-0.28
CZ	0.59	0.64	0.98	0.98	-0.39	-0.35
HU	0.81	0.88	1.02	1.13	-0.21	-0.25
PL	0.47	0.57	0.98	0.85	-0.51	-0.28
SK	0.79	0.72	1.00	0.90	-0.21	-0.18
SI	0.79	0.82	0.98	0.93	-0.19	-0.11
			high skill industries			
CEEC	0.42	0.48	1.19	0.97	-0.77	-0.49
CZ	0.55	0.68	1.52	1.04	-0.97	-0.36
HU	0.42	0.69	0.99	0.78	-0.57	-0.10
PL	0.32	0.32	1.17	1.13	-0.85	-0.80
SK	0.45	0.39	1.31	1.25	-0.87	-0.86
SI	0.49	0.55	0.78	0.66	-0.28	-0.10

and for each country. The trend of structural development that becomes apparent from the data seems to lead towards less specialization and an upgrading of skills in net exports. This implies catching-up with the structural leader.

Compared to other regions, CEEC trade patterns are not extremely different from those of OECD countries. In 1994, all five CEECs show greatest resemblance in export structure to the Southern OECD countries. At the same time import structures are already equally close to those of the OECD-North. During the four years of observation, this picture has become more pronounced. Similarity in import structures to OECD-North and especially to the EU has in general increased. Some disparities between Hungary, Slovenia and also the Czech Republic on the one hand and Poland and Slovakia on the other are hidden by the aggregate. Although export patterns have also approached those of OECD-North, they still resemble more those of Southern OECD countries.

Again, import patterns are considerably more stable and more advanced initially than export patterns. This is especially true for Hungary and Slovenia, where the degree of export restructuring has been substantial. Poland and Slovakia show less re-orientation towards the EU in exports, and the Czech Republic is characterized by great structural changes in both exports and imports.

3.4 Structural developments

Without any formal testing, we have seen structural convergence by several regional blocs towards the advanced OECD countries and, because of its dominance inside this group, towards the USA. Further, an overall trend towards de-specialization becomes globally apparent. This has already been observed previously (for instance in Laursen, 2000), but only for OECD countries. Whether this trend is indeed restricted to industrial countries, or whether it can also be seen in other regions, can be tested by regressing the current index of specialization on its initial value. Departing from the descriptive results in the previous section, one expects to find that, besides the advanced OECD countries, also East Asia, Central and Eastern Europe and Latin America have reduced their reliance on traditionally important export sectors. The group of South Asian countries constitutes an exception to this trend according to the evidence presented so far.

The test results, using equation 3.3, confirm that trade patterns of all regions have become less specialized over the past two decades.[16] Over the whole period, de-specialization in trade patterns is observed for all regions (see Table 3). The coefficient on initial

[16] When using measures of RCA in regression analysis, the problem of non-normality in the error terms may occur (Vollrath, 1991; Laursen, 2000). This has not been a problem here, due to the large sample that arises from using RCAs for individual 3-digit industries.

Table 3

Structural change in trade specialization patterns by region, 1981-1997

	OECD-North	OECD-South	Latin America	East Asia	South Asia
			period 1981-1997		
coefficient	0.67	0.47	0.54	0.19	0.68
sig. of F (H0: b=0)	0.000	0.000	0.000	0.002	0.000
sig. of F (H0: b=1)	0.000	0.000	0.000	0.000	0.001
# of obs.	473	125	400	186	110
R^2	0.58	0.48	0.24	0.05	0.34
			subperiod 1994-1997		
coefficient	0.90	0.76	0.83	0.57	0.98
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.000	0.000	0.000	0.000	0.678
# of obs.	480	127	413	206	91
R^2	0.87	0.87	0.66	0.39	0.76
			subperiod 1990-1994		
coefficient	0.86	0.91	0.79	0.82	0.78
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.000	0.053	0.000	0.000	0.000
# of obs.	478	126	412	203	121
R^2	0.86	0.76	0.58	0.69	0.66
			subperiod 1987-1990		
coefficient	0.84	0.81	0.79	0.86	0.61
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.000	0.000	0.000	0.001	0.000
# of obs.	483	125	376	198	149
R^2	0.86	0.76	0.58	0.67	0.47
			subperiod 1984-1987		
coefficient	1.02	0.85	0.85	0.66	0.93
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.133	0.000	0.000	0.000	0.161
# of obs.	481	125	376	199	152
R^2	0.89	0.78	0.66	0.59	0.67
			subperiod 1981-1984		
coefficient	0.97	0.68	0.76	0.83	0.89
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.065	0.000	0.000	0.000	0.045
# of obs.	481	124	403	193	141
R^2	0.91	0.74	0.60	0.68	0.64

specialization is always significantly different from zero and from one. This trend towards less pronounced specialization patterns in trade has been strongest in East Asia (with the lowest coefficient of 0.19) and weakest in South Asia and the advanced OECD countries (the coefficients being 0.68 and 0.67 respectively). Latin America and the Southern OECD

countries also show a clear tendency towards less specialization in trade, but at a slower rate than East Asia.

The analysis of four-year subperiods reveals that for the advanced OECD countries, structural change has taken place mainly in the second half of the observation period. During the 1980s there was no change in specialization, trade patterns were rather sticky. De-specialization was strongest between 1987 and 1990. In contrast to this, the catching-up countries inside the OECD exhibited considerable structural change in the beginning and less so in the 1990s. Only recently, de-specialization has become more pronounced again. Restructuring in Latin America was equally strong over the complete period, leading permanently to more equalized trade patterns over the past two decades. There were no notable differences between individual subperiods. East Asia displayed by far the highest degree of structural change: de-specialization has progressed very rapidly in two subperiods, from 1984 to 1987 and from 1994 to 1997. Thus, East Asia is the region characterized by the highest degree of restructuring. It is also the region characterized by the most balanced pattern of trade specialization at the end of the sample period. South Asia, on the other hand, showed rather sticky patterns in trade again. Especially at the beginning and at the end of the observation period, the coefficient on initial specialization was not statistically different from zero. Still, de-specialization was present and rather strong between 1987 and 1994, implying a broadening of trade patterns over the whole period.

De-specialization in most of the countries would also imply cross-country convergence within each industry segment, given that most countries started from relatively pronounced specialization patterns. This can be tested using the simple regression model given in equation 3.4. The coefficient on initial specialization indicates whether or not countries have approached each other in their trade patterns. The results are given in Table 4, for the total sample and for two subsamples: the advanced OECD countries and all catching-up countries together.

Convergence is always found to be present in all four industry segments. Convergence is fastest in the high skill and medium high skill intensive industries. The relatively fast convergence in low and medium low skill intensive industries is mainly driven by including the East Asian countries. For the group of advanced OECD countries, convergence in these segments is much slower, but still significant. In the medium skill, blue collar activities, trade patterns remained actually stable over most of the period, convergence was only present in the late 1980s and early 1990s. In this subgroup, convergence in trade patterns is more pronounced in the medium high tech and high tech industries. However, convergence in high tech industries becomes less pronounced (but remains significant) when the USA is excluded from the subsample. US competitiveness in this category has decreased significantly and constantly over the observation period, the RCA has dropped

from 2.23 in 1981 to 0.78 in 1997. Competitiveness inside the OECD-North converges also substantially in the medium skill, white collar industries, and this result is robust to the exclusion of the USA. It is interesting to note that there has been no structural convergence in these industries among OECD-North countries in the first two subperiods (results not reported). The trend towards homogenous trade structures has become significant only from 1987 onwards for the medium high skill segment and from 1990 onwards for the high skill segment.

Table 4

Structural convergence in trade patterns by skill intensity, 1981-1997

	Skill intensity of industry			
	low skill	medium skill - blue collar	medium skill - white collar	high skill
		total sample		
coefficient	0.54	0.54	0.42	0.37
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.000	0.000	0.000	0.000
# of obs.	546	244	359	145
R^2	0.34	0.27	0.20	0.30
		OECD-North		
coefficient	0.77	0.87	0.41	0.43
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.000	0.069	0.000	0.000
# of obs.	205	87	128	53
R^2	0.75	0.64	0.29	0.57
		catching-up countries		
coefficient	0.46	0.40	0.39	0.29
sig. of F (H0: b=0)	0.000	0.000	0.000	0.000
sig. of F (H0: b=1)	0.000	0.000	0.000	0.000
# of obs.	341	157	231	92
R^2	0.24	0.15	0.15	0.16

The subsample of catching-up countries, including OECD-South, Asia and Latin America, displays stronger and faster convergence in all four skill categories.[17] Convergence is again especially pronounced in high skill intensive industries, and weakest in low skill activities. Over the whole period, trade structures were continually becoming more homogenous across catching-up countries. The coefficient indicating convergence was significantly different from zero and one, except for the period 1990-1994, where no convergence in the high skill segment was found.

[17] CEECs are not relevant in this analysis, as no data for 1981 are available.

3.5 Summary

The evidence presented so far reveals significant differences in trade specialization patterns across exogenously defined groups of countries. The main distinction is found between the group of advanced OECD countries and various groups of catching-up countries. In 1981, above-average specialization in high skill intensive industries by the former group in contrast to above-average specialization in low skill exports by the latter group is very pronounced. In general, these differences have diminished and trade patterns are much more homogenous across world regions in 1997, but no switches in revealed competitive advantages with respect to the broadly defined skill categories have been observed. The advanced OECD countries, whose trade pattern is largely dominated by the USA, is the only group in the sample with a revealed competitive advantage in exports from high skill intensive industries throughout the observation period.

The dynamics of revealed competitive advantages across groups and over time reveal a global tendency towards decreases in the intensity of specialization (de-specialization) together with regional convergence. The reduced reliance on traditional export goods is especially pronounced in East Asia, the advanced OECD countries and Latin America. The catching-up countries inside the OECD and South Asia display more stable structures. Increasing specialization is never observed. The results are fairly robust to the level of aggregation, convergence together with de-specialization are also predominantly present at the more disaggregated industry level as well as at the level of skill categories.

Such a result is not surprising for trade flows between industrialized countries. However, the present sample also includes trade flows between industrialized and less developed countries in Asia and Latin America, implying presumably large differences in factor endowments. Such trade flows have traditionally been regarded as being well explained by HO theory. It may therefore be concluded that relative factor endowments between these regions have become increasingly similar. In the case of East Asia, this is certainly true for skill levels in relation to the advanced OECD countries, but also for capital stocks, given large FDI inflows and high capital accumulation in these countries over the recent decades. As a result, the composition of trade must have shifted towards a higher share of IIT, which leaves less room for a pure HO explanation.

The empirical evidence presented here supports this view, when IIT is meaningfully defined as trade inside the same skill category. Hence, changes in the difference between the export and the import component of the relative trade advantage indicate increases or decreases of IIT. This implies that de-specialization, as defined by $0 < \beta^i < 1$ in equation 3.3, can alternatively be interpreted as a rising share of IIT in total trade. Accordingly, the determinants of trade have shifted from comparative advantage (due to relative endowments) towards other factors, such as demand characteristics, economies of scale and the like. Consequently, alternative approaches which are able to explain the

emergence of IIT have to be considered. This in turn suggests that the sample has become more homogenous in many respects, such as stage of development, per capita incomes and endowments.

Another result refers to a clear distinction between export and import patterns. Specialization in exports is clearly more pronounced with differing patterns between country groups than specialization in imports. This hints at an asymmetry in the relevant explanatory factors. Exports may be driven by comparative advantages to a larger extent than imports, and there is only little complementarity between the two. Especially in the high skill and low skill intensive industries, where export specialization is highest, imports correspond closely to the world average.

4 Growth performance

Let us now turn to a brief description of the aggregate growth performance of the various geographical regions involved in the study. There are large differences between regions on the one hand, and also disparities within regions on the other. The box plots in Figures 9 and 10 illustrate the median growth performance of each region and its distribution inside each region. The boxes represent the innerquartile range (25^{th} to 75^{th} percentile) and the crossing line inside each box the median of real GDP per capita levels (at purchasing power parities) and real GDP growth between 1981 and 1997. Lower and upper adjacent values are defined as the 25th (75th) percentile of the data minus (plus) 1.5 times the innerquartile range. These are indicated by the lines emerging from the boxes. More extreme values than these are plotted as individual circles. Real GDP per capita levels are made comparable across countries by using 1995 purchasing power parities from the World Bank. Long-run annual growth rates are calculated as a linear trend of the logarithmic real GDP over the whole period.

In 1981, the OECD-North countries had the highest level of per capita income (measured at purchasing power parities), followed by the OECD-South. East Asia and Latin America showed similar and rather low levels of per capita income (about one third of the average income in OECD-North), while South Asia was substantially poorer (mean income amounted to only about 7% of OECD-North). This situation has not changed dramatically over the subsequent two decades. The ordering of regions with respect to income has remained stable. East Asia is an exception, as this region has partly caught up in terms of GDP per capita and reached OECD-South levels (at purchasing power parities).

On average real per capita GDP has increased notably for the OECD countries and for East Asia. Latin America and South Asia showed smaller rises in real GDP levels between 1981 and 1997. In all five geographic blocs, income inequality between countries has

Figure 9

Real per capita GDP levels (at 1995 international dollars) in 1981 and 1997

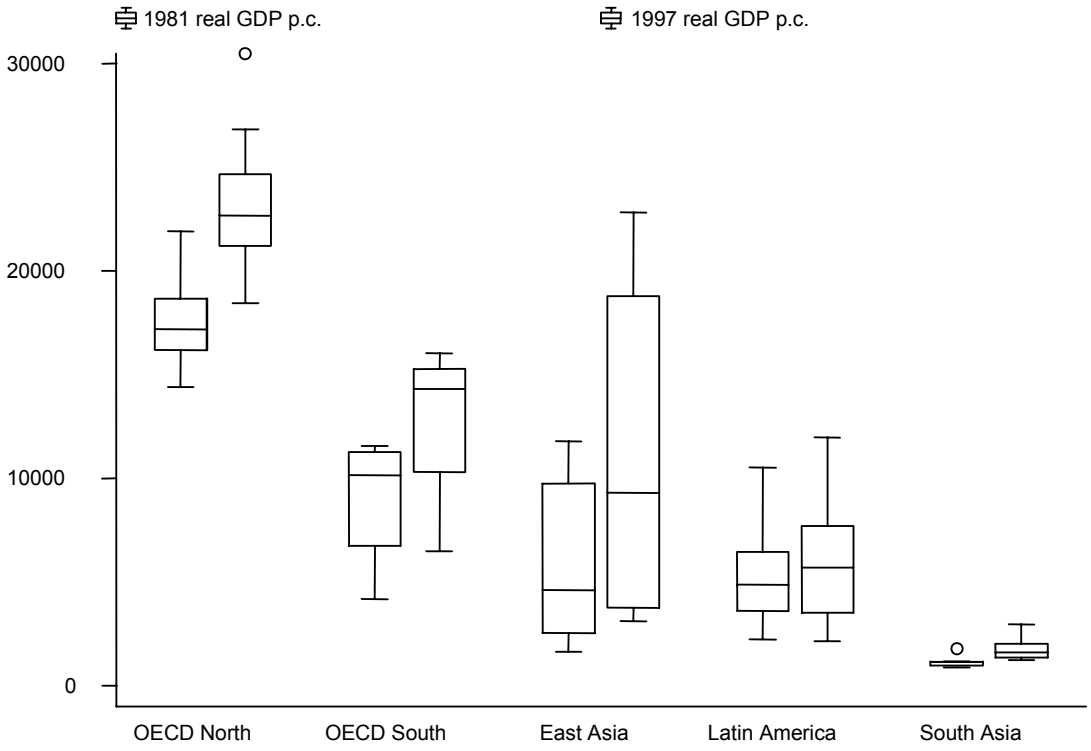
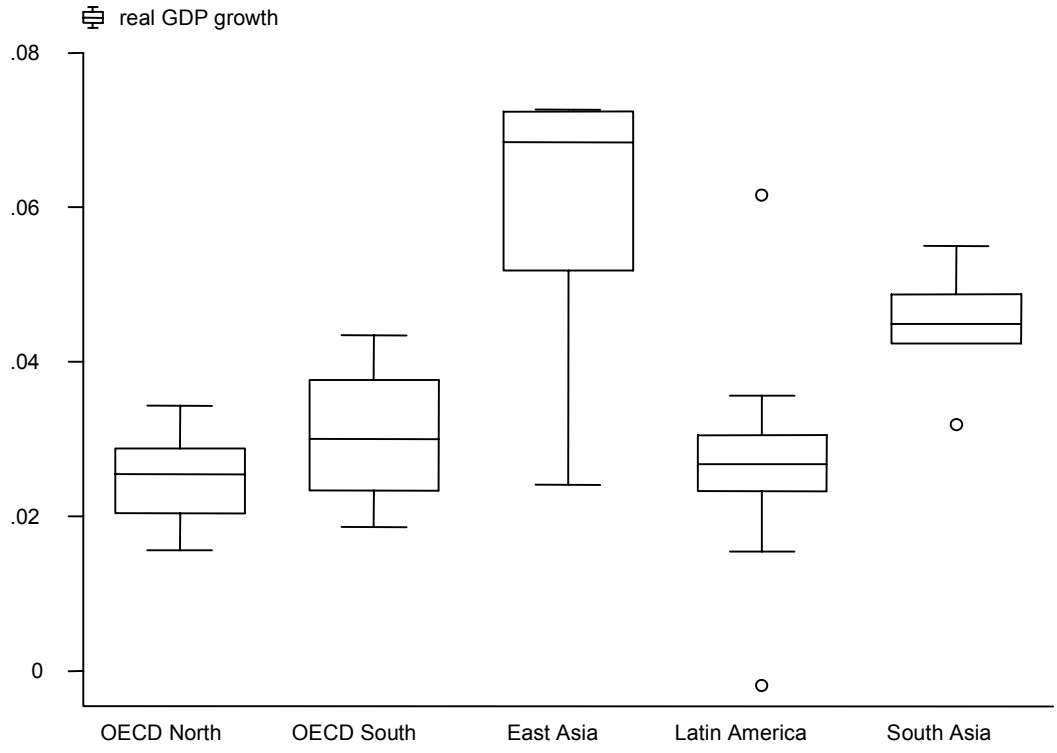


Figure 10

Real average annual GDP growth between 1981 and 1997



increased, especially so in East Asia. A few East Asian economies (Hong Kong and Singapore) have reached income levels which correspond to those of advanced OECD countries. But in this study, we are primarily concerned with differences in growth performance between country groups and how they relate to differences in trade specialization.

East Asia's growth performance is outstanding; however, there is a high dispersion in growth rates inside this group of countries. Average annual growth rates were ranging from 2.4% to 7.3%, the median annual growth rate was at 6.8% for this subsample. The OECD countries were not characterized by similarly high growth rates – still their per capita GDP levels remained far beyond those of other regions – and Latin America also showed a weaker growth performance on average. The few South Asian countries included in the sample experienced relatively high growth rates, which is partly due to the extremely low levels from which they departed. By the end of the observation period, Latin America and South Asia are thus lagging behind in terms of income levels, the latter group despite its relatively good growth performance.

Thus, growth performance between these broadly defined country groups is disparate. Regions which departed from lower income levels in 1981 show in general higher growth, which suggests some tendency towards income convergence in the long run. The advanced OECD countries grew on average at a rate of 2.5%. Average income growth in OECD-South and Latin America amounted to 3.1% and 2.7% respectively. The Asian economies exhibited high growth rates of 4.5% (South Asia) and 5.9% (East Asia). One prime suspect for explaining these differences in growth rates, especially in the context of East Asian countries, are differences in export performance. More specifically, this study is concerned with differences in trade structure and trade specialization and its consequences for aggregate development. In the following section this relationship will be explored in more detail.

5 Trade patterns and aggregate growth

It is a widely known and often confirmed fact that growth in exports correlates positively and significantly with GDP growth. The literature is extensive in this respect, and focuses more or less on various macroeconomic aspects of exports and growth, such as the impact of tariffs and trade policy as well as welfare implications of trade. Especially the link between aggregate exports and GDP growth has often been subject to empirical tests. Most authors use export growth as the explanatory variable, sometimes an export ratio or the growth rate times the export ratio is used. Levine and Renelt (1992) and Greenaway et al. (1999) provide good overviews of the most commonly used explanatory variables in growth regressions. The latter list a number of studies that deal with the effect of trade on growth. According to these surveys, trade has a positive influence on growth. More

precisely, most empirical studies (Edwards, 1998, Feder, 1982, Greenaway et al.,1999, Lee et al., 1998, Levine and Renelt, 1992, and Young, 1991, to cite just a few) find a positive effect of export growth on GDP growth.

The effect of the export structure on aggregate growth has been less researched in the literature. Recently, interest seems to emerge in linking structural developments to the aggregate level of income growth.[18] A few studies to mention are Amable (2000), Greenaway et al. (1999), Laursen (2000), and Peneder (2002), who all find positive effects from trade specialization on aggregate growth.[19] Amable (2000) reports that already specialization as such turns out to be positive for a country, but especially specialization in the electronic industry. Most authors concentrate on the effects of specialization in specific activities and report a significant positive influence of some industries. Greenaway et al. (1999) identify the fuel, metals, and textile industries as having a positive impact on developing countries' performance. Laursen (2000), using a sample of 18 OECD countries, finds evidence that specialization in the fastest growing sectors, in terms of export shares, correlates positively with GDP growth at the country level. He further observes that these sectors are in general identical to high-tech sectors. Peneder (2002) uses a sample of 28 OECD countries from 1990 to 1998 and finds that specialization in services represents a burden to future growth, because productivity gains are hard to achieve in this sector. For exports of technology driven and high skill intensive industries he finds positive effects on aggregate growth. He also reports a positive impact from increasing imports in the same industries.

A positive influence of growth in any export component on GDP seems to be obvious. Other things equal, a rise in exports will always augment national income due to simple growth accounting. By the same argument, specialization in exports of rapidly expanding sectors simply adds more to national income growth than specialization in other sectors by definition. However, this does not yet take spillovers into account. The fact that those sectors – at least for the developed countries – represent the most technologically advanced sectors[20] suggests that the positive influence will exceed the purely static income effect. Spillovers and other positive external effects are likely to be higher in those sectors than in others, which implies a differential effect of export growth between sectors.

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[18] The effects of export composition on productivity levels of respective sectors and industries is more straightforward to establish and has been researched somewhat more often, see for example Choudri and Hakura (2000), Fagerberg (2000), Keller (2000), Sharma (1996), Stehrer and Wörz (2003) and Timmer (2000).

[19] I am not aware of any recent studies that explicitly link trade structure and growth in a cross-section of countries. In this study, trade structure always refers to the composition of exports and imports in a given country, whereas trade specialization denotes a country's trade structure relative to the sample average. The former will be analysed more extensively here, trade specialization is then introduced as an explanatory variable in the regression model in section 5.3.

[20] See Laursen (2000).

Table 5 reports the correlation coefficients between export growth, the share of exports in GDP and the change in this share at two levels of aggregation. The influence of aggregate export growth on GDP turns out to be positive in the present sample as expected. The result is robust to the disaggregation of exports by industries. With the exception of medium skill blue collar exports, growth in all skill categories is significantly positively related to growth in GDP. Given that exports are a part of GDP, we are more interested in the correlation between export structure and growth. The correlations between openness in the different skill categories (measured by the ratio of exports to GDP) and real growth are less encouraging. Openness on the aggregated level translates into significantly higher rates of GDP growth. At the disaggregated level, however, this positive correlation is found only for one category – the medium skill white collar activities. Structural change, interpreted as a change in these shares, never shows a significant result.

Table 5

Pearson Correlation Coefficient of respective variable with real GDP growth

	Total	**Low skill**	**Medium Skill**		**High skill**
Exports			**Blue collar**	**White collar**	
Growth					
corr. coeff.	0.71	0.44	0.21	0.39	0.36
sig.	0.000	0.004	0.186	0.010	0.021
# of obs.	42	42	42	42	42
Share					
corr. coeff.	0.44	0.18	0.04	0.37	0.19
sig.	0.003	0.242	0.788	0.017	0.222
# of obs.	42	42	42	42	42
Change in Share					
corr. coeff.	0.18	0.08	-0.08	0.16	0.18
sig.	0.257	0.635	0.594	0.308	0.265
# of obs.	42	42	42	42	42
Imports					
Growth					
corr. coeff.	0.60	0.49	0.37	0.62	0.72
sig.	0.000	0.001	0.016	0.000	0.000
# of obs.	42	42	42	42	42
Share					
corr. coeff.	0.39	0.28	0.19	0.44	0.39
sig.	0.010	0.071	0.236	0.003	0.011
# of obs.	42	42	42	42	42
Change in Share					
corr. coeff.	0.03	-0.12	-0.17	0.10	0.26
sig.	0.869	0.451	0.273	0.512	0.101
# of obs.	42	42	42	42	42

Aggregate and sectoral import growth again both contribute significantly positively to GDP growth. The Pearson correlation coefficients are in size comparable to those of exports in the case of aggregate imports and low tech imports. However, they are especially high for the correlation between higher skill imports and economic growth. A possible reason for this might be that the growth enhancing effect of imports works primarily through embodied knowledge and technology transfer. This potential is higher for imports in medium high and high skill intensive industries.

The above view is confirmed when looking at the relation between import shares and growth. Aggregate growth is more often correlated with import than with export structure. All import shares, with the exception of medium skill - blue collar industries, show a significant correlation. Again, structural change does not correlate significantly with growth. Still, the correlation coefficients, which are relatively high for medium high skill and high skill imports, suggest that a higher share of those imports results in stronger positive external effects (such as learning and knowledge transfer, better quality of inputs, etc.) than other imports or exports in general.

Thus, at the aggregate and sectoral levels, increased openness on both sides has a positive impact on the economy. Furthermore, the trade structure can have a qualitative influence on aggregate economic development, in addition to the income accumulation effect alone. In the following, we shall look at partial correlations first, thus taking an isolated view of each sector's correlation with aggregate GDP growth. After having done that, externalities across industries together with the direct effects of trade flows will be analysed in an empirical growth model.

5.1 Exports, export structure and growth

The motivation for analysing trade patterns with respect to their influence on aggregate growth, as is done here, can be interpreted as a search for differences between industries with respect to the effect of trade in these different industries on aggregate income growth. In a regression model which includes trade flows in various industries at the same time, the associated coefficients will include both, direct and indirect effects. Therefore, we analyse the partial effects of trade in individual industries on growth first, before analysing the impact of the trade structure on growth in an econometric model. In the following, partial correlations between different types of exports/imports and aggregate GDP growth are presented. These individual effects tend to overestimate the influence of each industry, as will become clear below (see section 5.3), but they are able to reveal interesting insights that might otherwise be hidden.

Six industry clusters differing in their technology intensity are selected (Hatzichronoglou, 1997): Food and beverages (ISIC 31) and textiles and clothing (ISIC 32) are representing

the low tech segment. Manufacture of rubber and plastic products (ISIC 355+356) is selected as a typical medium low tech activity. Chemicals (ISIC 351+352, excluding drugs and medicine – 3522) as well as professional and scientific equipment together with machinery (ISIC 382+383+385, again excluding two 4-digit industries: radio, TV and communication equipment – 3832, and office computing and accounting machinery – 3825) represent the medium high tech sector. Finally, the manufacture of ICT equipment (ISIC 3825+3832) represents the high tech industries.

Regressing the rate of aggregate economic growth on the rate of growth of exports in each industry separately (see Table 6) very nicely confirms the differential impact of high tech versus low tech exports on growth. Although a positive relationship between increases in exports and growth in all industries is expected, the coefficient on export growth turns out to be significant only in the medium high-tech and high-tech industries, except for a positive coefficient in the textile industry. However, the results are not robust to the exclusion of individual regions in this quite heterogeneous sample. They are strongly driven by including the rapidly industrializing East Asian countries as well as the advanced OECD countries in the sample. Especially if the former group is excluded, no significant correlation is found for any industry, although aggregate exports still contribute significantly positively to GDP growth. In all other variations of the sample, exports of medium high tech industries always contribute significantly positively to aggregate growth, whereas the medium low and low skill intensive industries – with the exception of textiles – never do so. The results suggest that the technology intensity of exports plays a relevant role only for rather advanced economies. Further, trade in technology intensive goods is important in the context of East Asia, but not so for other developing countries. If either of those country groups is excluded, the coefficient on higher tech exports becomes insignificant.

Apart from this geographical distinction, also differences between industries emerge. Certain industries can be identified as having a key impact on growth. Two of them are medium high technology intensive: chemicals, and machinery and scientific equipment. This point will be discussed further below. Besides, the textile industry also seems to play a special role, confirming the result by Greenaway et al. (1999).

Given significant differences across industries, the question arises to what extent the initial structure matters. The correlation between initial shares and long run GDP growth will indicate whether initial structure has a lock-in effect – either in a positive sense, that certain trade patterns are especially beneficial to subsequent growth, or in a negative sense, that it impedes high growth.

The interpretation of the coefficient on the initial export share is not straightforward. A significantly negative coefficient clearly indicates a negative correlation between the export

Table 6

Partial correlations between exports (growth, share) and real GDP growth, 1981-1997

	total sample		wo East Asia		wo South Asia		wo Latin America		wo OECD-South		wo OECD-North	
	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.
growth												
food and beverages	0.049		-0.045		0.127	*	0.075		0.056		0.048	
textiles and clothing	0.073	**	0.027		0.100	***	0.125	***	0.073	**	0.050	
rubber and plastic	0.037		0.014		0.073	**	0.040		0.038		0.019	
chemicals	0.144	***	0.023		0.246	***	0.145	***	0.142	***	0.124	**
machinery and scienific equipment	0.107	***	0.044		0.124	***	0.115	***	0.108	***	0.097	**
ICT equipment	0.057	**	0.022		0.072	**	0.066	*	0.059	*	0.051	
initial share												
food and beverages	0.005		0.007		0.006		0.015		0.004		-0.013	
textiles and clothing	0.013		0.020	*	-0.003		0.016		0.018		-0.002	
rubber and plastic	0.178	**	-0.152		0.231	**	0.151		0.183	**	0.208	**
chemicals	-0.055	**	-0.027	*	-0.051	**	-0.112	***	-0.055	**	-0.049	
machinery and scienific equipment	-0.022		-0.028	**	-0.017		-0.038	*	-0.023		0.043	
ICT equipment	0.054		-0.038		0.072	**	0.045		0.054		0.102	**
change in share												
food and beverages	-0.081	*	-0.062	*	-0.121	*	-0.078		-0.077		-0.058	
textiles and clothing	0.035		0.062	*	0.039		0.064		0.033		-0.020	
rubber and plastic	-0.008		0.011		-0.005		-0.009		-0.009		-0.024	
chemicals	0.052		-0.001		0.133		0.074		0.050		0.036	
machinery and scienific equipment	0.073		0.043		0.108	*	0.038		0.074		0.069	
ICT equipment	0.023		0.018		0.039		0.013		0.021		0.024	
share relative to average world share												
food and beverages	0.000		0.416		0.853		0.608		0.628		0.387	*
textiles and clothing	0.000		0.276	***	0.006		0.949		0.386		0.280	
rubber and plastic	0.004		0.241		0.910	*	0.090		0.434		0.260	
chemicals	-0.005	*	0.095		0.454		0.169	***	0.004	*	0.093	
machinery and scienific equipment	-0.011	*	0.054	**	0.017		0.132	***	0.009	*	0.052	
ICT equipment	0.005	***	0.002		0.210	***	0.001	***	0.007	***	0.004	***

Notes: wo…without. - *indicates significance at the 10% level. - **indicates significance at the 5% level. - ***indicates significance at the 1% level. -

share in this industry and growth. This might be due to a high export share in growth hampering industries or equivalently it may be due to a lack of exports in growth promoting industries. Consequently, the coefficient has to be interpreted differently in the case of a country which shows an initially high share in this industry as compared to a country where the initial share is relatively low. Likewise, a positive coefficient always hints towards

reinforcing trade and growth patterns, i.e. either high initial exports in growth promoting industries or equivalently low initial exports in growth hampering industries are both beneficial for long-run growth.

The intention of this exercise is the identification of certain trade structures that are particularly conducive to aggregate economic development. In order to pin down these industries, the distinction of these four alternative cases is important. Therefore the results will be analysed subject to the results that are obtained from using changes in these shares as an explanatory variable. This allows to classify industries into two groups: those where exports have a growth promoting effect in contrast to those with a growth impeding effect. Structural change has a positive effect only if it helps a country to move out of growth impeding industries or into growth promoting ones. In the case of a desirable initial structure, structural change is not required to improve growth.

		Export growth		
	coeff.	**-**	**+**	
initial share.	**-**	high share. in 'bad' ind.	low share in 'good' ind.	⇒ structural change beneficial
	+	low share in 'bad' ind.	high share in 'good' ind.	⇒ initial structure optimal

A negative coefficient on the initial share together with a significantly positive coefficient of subsequent export growth in the same industry will indicate that exports in the respective industry actually promote growth; however, the initial export share has been low in the sample. Consequently, a re-allocation of resources to boost exports in this industry would prove successful for income growth. If both coefficients are significantly negative, the initial specialization pattern is not beneficial for growth, i.e. high initial exports in a growth hampering industry are revealed. Again, a re-allocation of resources to reduce exports in this industry would prove beneficial for aggregate growth. A positive coefficient on the initial share in combination with a negative coefficient on export growth reveals that exports have been low in an industry, which is detrimental to growth. Finally, a positive coefficient on both variables indicates that countries have initially shown high export shares in the most promising industries. In the two latter cases, no gains from structural change are expected.

The results in the two upper panels of Table 6 show differences between industries. Exports of food and beverages never show a significant correlation, neither their growth nor their initial share has a significant impact on aggregate income growth. This result is robust to the exclusion of different groups of countries.

Although textiles and clothing constitutes a low tech, low skill activity, it still has a significantly positive effect on growth, which is stronger for countries that have initially been exporting these goods. This illustrates a typical Ricardian case, where a country specializes in the

production and consequently exportation of those goods in which it holds a comparative advantage, and this specialization also maximizes output. The coefficient on export growth in the textile industry is rather large and highly significant. The result is influenced by the Asian countries in the sample, who traditionally have a large share of textiles in their exports, and the Northern OECD countries. This observation can easily be reconciled with static trade theories, emphasizing the effectiveness of optimal world wide allocation.

Initial exports of rubber and plastics prove to correlate positively with GDP growth. However, export growth in this industry does not show any significant correlation with aggregate growth, except when South Asia is excluded. When Singapore, South Korea and Hong Kong are excluded from the sample, the initial export share of the rubber industry becomes insignificant (and negative), whereas the positive effect of export growth remains. Thus, country-specific features (abundance of raw material in Singapore) partly drive the result in this case. This confirms our previous observation that the role of exports and export structure has played a very special role for the path of economic development in these countries.

The chemical industry also plays a special role for development. For this industry, the results are somewhat less sensitive to the choice of the sample. The coefficient on the initial share is always negative and significant. Growth of these exports correlates significantly positive with GDP growth, indicating that structural change towards a greater importance of this industry in total exports would add positively to GDP growth.

Relative exports of machinery and scientific equipment reveal the same feature, although the coefficient on the initial export share becomes significant only when either the East Asian or the Latin American countries are excluded. Exports in these two medium high technology intensive industries (chemicals and machinery) seem to provide a good potential for a satisfying growth performance. With respect to the East Asian countries, they have already directed exports to a larger extent into high tech industries in the early 1980s as compared to most other countries in the sample and consequently needed less restructuring in the sense of industrial upgrading of exports than the sample as a whole.

The only high tech activity included in the analysis here, the manufacture of computing and communication equipment, also shows an advantage of initial specialization, given that an expansion of those exports and a high initial share both contribute positively to GDP growth. Excluding the East Asian countries from the sample renders the coefficients insignificant: neither the initial export share nor export growth in this industry then matter for growth. Thus, country effects are again strong in the case of high tech exports, which is not very surprising. More specifically, this sector plays a special role in the growth performance of East Asian (but also advanced industrialized) countries.

Most of the above results do not depend on the inclusion of the industrialized countries (OECD-North). This indicates that the relationship between export patterns and economic growth is not so much driven by the advanced OECD countries. On the contrary, it is rather driven by including East Asia in the sample. If this group is left out, most results change. Rubber and plastic exports no longer have a reinforcing positive influence on growth. Further, the influence of medium high tech exports (i.e. chemicals and machinery and scientific equipment) is altered. The only exception is given by the high tech industry considered here, namely ICT exports. Their positive developmental impact vanishes completely if either the East Asian or the Northern OECD countries are excluded.

The two bottom panels of Table 6 look at the effect of structural change (i.e. changes in export shares of each industry) and of export specialization (i.e. a country's export structure with respect to the average pattern in the sample) on aggregate GDP growth. Relative changes do not show a significant correlation with aggregate growth in most industries. Only structural change towards a smaller export share of food and beverages has a significantly positive effect on growth. However, the result is not robust to variations in the sample. The last panel shows the impact of specialization. It is interesting to note that for the sample as a whole, above-average specialization in the medium high tech activities (chemicals and machinery) shows a negative correlation with growth. However, when excluding the Latin American and the OECD-South countries (as well as the East Asian countries in the case of the machinery equipment industry), this relationship becomes positive and the significance improves. Finally, specialization in ICT industries correlates positively and highly significantly so with GDP growth. The result depends again crucially on including the East Asian countries. Thus, their special role with respect to export-oriented development is again confirmed.

Although the results are rather exemplified, they can be taken as indicative of a more general relationship. There seems to be a high potential for economic growth when a country is boosting exports (and showing trade specialization) in medium high tech and high tech industries, which are in this case represented by the chemical industry and the manufacture of machinery and scientific equipment and the manufacture of ICT equipment. This potential is lacking in low tech and medium low tech industries.[21] Especially medium high tech industries may offer a large potential for development due to the following characteristics: They are characterized by production processes that are technologically sophisticated enough to have positive technology spillovers and a large scope for productivity gains, but at the same time they are not so technology and skill intensive that this would pose an insurmountable obstacle to entry by firms from developing countries. Thus, shifting export-bound production to those industries yields the high rewards in terms of growth and thus development.

[21] A similar result is found in Stehrer and Wörz (2002).

In contrast, both extremely low and extremely high tech industries lack one of those two preconditions that render the medium high tech industries so attractive. Although high tech industries offer technology and knowledge spillovers, which are important agents in the development process, thus having a positive impact on growth, they may be technologically too advanced in the rich countries and consequently backward countries are precluded from entering these sectors directly. Low tech industries do not offer the potential for long-term productivity gains, technological progress and external effects. Thus, specialization in these industries may yield temporary, static gains from trade, but not dynamic gains. The textile industry is a good example of an industry which offers static gains from trade. The empirical evidence so far has shown that it plays a special role for growth, however, less in the sense of playing a key role in technological progress, but rather for the fact that it has a large potential for exploiting cost advantages (i.e. comparative advantages).

As final comment, the analysis cannot make inference on causality, it is merely showing correlations or stylized facts. Especially in the context of export patterns, the question of causality is hard to answer. It is easier to find arguments for the causal influence of imports and import structure on growth.

5.2 Import and output structure and growth

Despite the positive correlation between import growth and GDP growth at the aggregate level, not all industries contribute significantly to growth (see Table 7). The positive influence of textiles and clothing that was observed with respect to exports, has disappeared. However, imports of medium high and high tech activities (chemicals, machinery and scientific equipment, ICT equipment) correlate positively with growth. This further underlines the above argument that the positive impact of imports on growth stems from embodied knowledge and technology or other intangibles. The effect was strongest in the chemical industry. The coefficients are in general larger when GDP growth is regressed on imports rather than on exports. It may be concluded that this knowledge transferring effect is stronger than the positive income accumulation and learning effect that is generated by exports.

The results are fairly robust to the exclusion of individual country groups, with the exception of East Asia. If this region is excluded from the sample, only the positive impact of the chemical industry remains (but becomes weaker), while all other coefficients become insignificant. Thus, East Asia plays a special role in these results. The importance of medium high tech and high tech imports for development mainly stems from the inclusion of these countries, who are at the same time characterized by an outstanding growth performance. One may take the argument one step further and say that the growth

Table 7

Partial correlations between imports (growth, share) and real GDP growth, 1981-1997

	total sample		wo East Asia		wo South Asia		wo Latin America		wo OECD-South		wo OECD-North	
	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.
growth												
food and beverages	0.059		-0.025		0.143		0.100		0.078		-0.002	
textiles and clothing	0.048		0.003		0.088		0.089		0.063		-0.014	
rubber and plastic	0.084		-0.006		0.125	**	0.129	*	0.113	*	0.026	
chemicals	0.442	***	0.173	*	0.463	***	0.556	***	0.483	***	0.392	***
machinery and scienific equipment	0.261	***	0.048		0.336	***	0.299	***	0.271	***	0.229	***
ICT equipment	0.140	**	0.019		0.187	***	0.159	**	0.142	**	0.115	
initial share												
food and beverages	-0.011		0.035		-0.063		-0.028		0.003		-0.019	
textiles and clothing	-0.031		-0.014		-0.025		-0.093		-0.031		0.042	
rubber and plastic	-0.580	***	-0.190		-0.587	***	-0.889	***	-0.660	***	-0.472	*
chemicals	0.031		0.068	*	0.013		0.041		0.029		-0.009	
machinery and scienific equipment	-0.024		-0.029		-0.013		0.006		-0.029		-0.055	
ICT equipment	0.066		-0.064		0.106	**	0.073		0.070		0.089	*
change in share												
food and beverages	-0.303	***	-0.115		-0.333	***	-0.296	**	-0.346	***	-0.345	***
textiles and clothing	-0.077		-0.012		-0.098		-0.049		-0.086		-0.148	**
rubber and plastic	-0.089		-0.048		-0.079		-0.027		-0.105		-0.190	*
chemicals	-0.075		0.165		-0.285		-0.126		-0.060		0.045	
machinery and scienific equipment	0.261		0.027		0.453	*	0.314		0.251		0.286	
ICT equipment	-0.038		-0.042		-0.026		-0.008		-0.052		-0.052	
share relative to average world share												
food and beverages	-0.011	**	-0.003		-0.005		-0.004		-0.002		-0.009	
textiles and clothing	-0.003		0.001		-0.005		-0.013		-0.011		-0.040	
rubber and plastic	-0.015	*	0.000		0.010		0.015		0.029	**	0.073	*
chemicals	0.001		0.006		0.004		0.012		0.009		0.041	
machinery and scientific equipment	0.009		0.004		0.007		0.007		0.004		0.017	
ICT equipment	0.011	**	-0.009		-0.003		-0.003		-0.003		0.069	

Notes: wo…without. - *indicates significance at the 10% level. - **indicates significance at the 5% level. - ***indicates significance at the 1% level. –

promoting effect of imports through embodied technology or knowledge transfer can only become active when the importing country also has the potential to reap these intangible

assets. Most of the East Asian countries possess a highly skilled labor force, which allows them to make best use of those embodied assets.[22]

In contrast to the previous results, the initial import structure does not show strong and lasting effects. Only in the rubber and plastic industry does an initially high share correlate significantly negatively with long-run GDP growth. The third panel of Table 7 reveals that structural change towards an increasing import share of the food industry is accompanied by slower GDP growth over the period. More interesting to note is the fact that increasing imports of machinery and scientific equipment always correlate positively with growth and even significantly so when the subsample of South Asian countries is excluded. The same relationship is observed for relative changes in exports. Thus, the special role of this medium high tech activity for aggregate economic development is once again highlighted.

With respect to specialization on the import side (see the last panel of Table 7), very few significant result were obtained. There is a negative growth effect stemming from import specialization in the food industry, which is not robust to the exclusion of individual country groups. Similarly, the positive impact from specialization in ICT imports is also not robust to variations in the sample. These imports have presumably the highest potential for positive, growth enhancing knowledge and technology spillovers, thus inducing a learning effect in the importing country. This growth promoting effect is higher in catching-up countries than in advanced industrialized economies, which is reflected by the fact that the coefficient (although insignificant) becomes positive when the OECD-North countries are excluded from the sample. As soon as one of the other country groups (i.e. the catching-up countries) is excluded, the coefficient becomes negative. Although most of the results are not statistically significant at a reasonable level, there is a distinction between specialization in low tech imports (negative influence on growth) and high tech imports (positive effect) for the sample as a whole. However, the results are highly sensitive to variations in the sample.

Similar results are obtained with respect to industrial production (Table 8), with one notable difference: The exclusion of East Asia does not alter the results in the same way as before. Without including the subsample of East Asian countries, a significant relationship between trade at the industry level and aggregate GDP growth could rarely be established. The correlation between industrial output and aggregate output is not dependent on this subset of countries, however. That implies that the East Asian growth performance is intimately linked to trade (exports and imports!) and further that East Asia is very special in showing a strong correlation between trade flows in individual industries and aggregate income

[22] At least, the results are suggestive in this respect and supported by the information that we have on schooling. Average years of schooling are highest in the subsample of advanced OECD countries (the number has increased from 8.7 to 9.8 over the period), followed by East Asia. In this subsample the average number of years has increased from 6 to 7.5 years. The respective figures for OECD-South and Latin America were 5.1 and 5.2 years in 1981, and 6.6 and 6.3 years in 1997 respectively. South Asian people attended school on average for 2.8 years in 1981 and 3.3 years in 1997.

growth. Thus, the present analysis confirms the view that the East Asian miracle can be ascribed to high openness and rapid trade growth. However, the recipe does not seem to be applicable to all 'patients', as export and import growth in various industries is no longer significant once the East Asian countries are excluded.

Table 8

Industrial production and real GDP growth, 1981-1997

	total sample		wo East Asia		wo South Asia		wo Latin America		wo OECD-South		wo OECD-North	
	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.	coeff.	sig.
growth												
food and beverages	0.136		0.070		0.209	*	0.053		0.179		0.119	
textiles and clothing	0.241	***	0.168	***	0.281	***	0.224	***	0.273	***	0.204	**
rubber and plastic	0.109		0.088		0.138		0.032		0.116		0.141	
chemicals	0.136	***	0.080	**	0.154	***	0.211	***	0.129	***	0.121	**
machinery and scienific equipment	0.052	**	0.037	**	0.067	**	0.052	*	0.049	*	0.047	*
ICT equipment	0.169	***	0.036		0.185	***	0.200	***	0.172	***	0.168	***
initial share												
food and beverages	-0.023	*	0.001		-0.022		-0.051	***	-0.023	*	-0.024	
textiles and clothing	0.033		0.044	***	0.033		0.021		0.038		0.017	
rubber and plastic	0.102		0.007		0.163	*	0.066		0.104		0.151	
chemicals	-0.072		-0.020		-0.084	*	-0.129	**	-0.073		-0.018	
machinery and scienific equipment	-0.006		-0.016		-0.002		-0.027		-0.005		0.081	
ICT equipment	0.018		-0.001		0.022		0.013		0.017		0.128	***
change in share												
food and beverages	-0.326	***	-0.286	**	-0.327	***	-0.315	**	-0.311	**	-0.310	**
textiles and clothing	0.137		0.184	*	0.086		0.142		0.141		0.096	
rubber and plastic	-0.211	*	-0.078		-0.212	*	-0.318	**	-0.199	*	-0.112	
chemicals	0.105		0.080	*	0.102		0.185		0.097		0.099	
machinery and scientific equipment	0.046	*	0.038	**	0.059	*	0.050		0.042		0.039	
ICT equipment	0.203	***	0.010		0.211	***	0.316	***	0.199	**	0.236	***

Notes: wo…without. - *indicates significance at the 10% level. - **indicates significance at the 5% level. - ***indicates significance at the 1% level. -

Thus, whereas the impact of trade on national income differs across regions, the impact of output structure is relatively robust. Increases in the production of textiles, chemicals and machinery and scientific equipment always contribute significantly to growth, whereas food and beverages and the production of rubber and plastics never show a significant correlation. Even more than that, when using the difference in growth rates between industrial production and aggregate output, these two industries contribute negatively to growth. This result is entirely robust to the sample used. The contribution of ICT equipment

to growth turns out to be significant only when East Asia is included in the sample, which underlines the special development path that is characteristic for this region. As is shown by Stehrer and Wörz (2002), only the East Asian countries are converging in productivity in the high tech industries (ICT) towards the leading country, the USA. This increase in productivity results in higher output of the industry with a positive impact on the aggregate rate of income growth.

With respect to the effect of initial specialization, the results differ according to the specific sample used and are in general not often significant (see the middle panel of Table 8). An initially high share of food in manufacturing production is often correlated with lower growth rates.[23] Structural change has a stronger impact on GDP growth (last panel of Table 8). Whereas increasing specialization in food and beverages is robustly and negatively correlated with growth, specialization in medium high and high tech industries (machinery, scientific equipment and ICT equipment) often accompanies high GDP growth.

The analysis revealed that industrial structure and structural developments can matter for growth, however, there are large differences between world regions. An upgraded output structure – in the sense that technology intensive industries play a greater role – correlates positively with an above-average long-term growth performance. Similarly, increasing output in more sophisticated activities shows the same positive correlation. With respect to trade flows, the results are quite sensitive to the underlying sample. The impact of trade structure, trade restructuring and trade specialization on the path of development is very distinct in different world regions. A sophisticated, technology intensive trade structure has played a great role in the East Asian growth miracle. In contrast, South Asia has pursued a strategy of exploiting initial comparative advantages, leading to increased specialization on textiles. This has certainly offered some potential for growth as well, however, the long-term prospects might be limited in this case. Some more general facts could also be observed: A growing share of food and beverages (in output and in trade) is nearly always associated with lower GDP growth rates over the sample period.

The above results do not account for joint effects or cross effects of different industries. So far, the analysis is only a partial one, looking at the individual influence of each industry on GDP in isolation. In the next section, an empirical model is constructed which enriches the analysis by estimating the effect of trade composition and trade specialization on growth.

[23] Productivity catching-up is not analysed here. The reader is referred to two related papers, Stehrer and Wörz (2002) and Stehrer and Wörz (2003). The results match with the findings in Table 8.

5.3 An empirical growth model

This section analyses the joint effect of various export components on growth. The empirical framework uses elements from 'classic' and 'new' growth models, adopting a supply side point of view. The dependent variable is the average long-run annual rate of real GDP growth. Population growth and the investment ratio are included as the two primary sources of growth. Investment is one of the rare variables that can always robustly be associated with GDP growth (Leamer, 1983; Levine and Renelt, 1992; Sala-i-Martin, 1997). The level of initial GDP per capita is included to control for the initial stage of development. This will indicate whether countries have been able to utilize an initial advantage of backwardness leading to rapid catching-up with the more advanced OECD countries in the sample. Further, a variable of schooling in the initial year is introduced to account for differences in human capital. Especially the inclusion of the rapidly industrializing East Asian economies on the one hand and the slowly progressing South Asian countries on the other hand seems to call for including such variables. Before investigating the effects of the export structure on growth, the model is used for testing the impact of exports in general. Thus, the benchmark specification is given below:

$$DGDP^c = \alpha + \beta_1 INV^c + \beta_2 DPOP^c + \beta_3 GDP_0^c + \beta_4 PRIMSCH_0^c + \gamma EXP^c + \varepsilon_c \qquad (5.1)$$

where

$DGDP^c$ = long-run annual growth rate of real GDP

INV^c = long-run average investment ratio

$DPOP^c$ = population growth

GDP_0^c = log of per capita GDP (in PPPs) in 1981

$PRIMSCH_0$ = fraction of the population aged 15+ which has completed primary schooling as highest education

EXP^c = one of the export variables given below.

The effect of exports on growth is measured in different ways to shed light on various channels via which growth can be affected. First of all, a higher rate of export growth (DX^c) should always be associated with a higher rate of GDP growth. Below, we will look at differences in this effect between industries. Secondly, openness is usually also seen as a positive influence on growth. This is captured by the period average share of exports over GDP (XSH^c). In the third specification, we include both terms, growth and the share simultaneously. The rationale for including openness in addition to export growth is to control for the differential effect of increased exposure to the world market versus the income augmenting effect of growth in exports.

The fourth specification includes a cross term, which multiplies export growth with the share of exports. The coefficient on the cross term can be interpreted in analogy to the analytical model derived by Feder (1982) as measuring the beneficial effects of exports on other sectors, or equivalently the productivity differential between export and non-export sectors together with the presence of externalities between the two sectors. If these indirect effects are not present, i.e. exports matter for GDP only directly as a component of aggregate income, then the coefficient should be zero. With this specification, the model can be interpreted in a way that does not rely on the neo-classical assumptions of perfect competition, which would leave no room for the impact of structural differences, externalities and so on. In the benchmark model, total output is produced by a non-export sector on the one hand and an export sector on the other hand. These two sectors are allowed to have different effects on growth. More specifically, the export sector can have positive externalities for the non-export sector, which is captured by the coefficient of the cross term. Below, the export sector will be further disaggregated into different segments according to the skill intensity of industries. The impact of the export structure on growth is established via differences in productivity and spillover potential across industries. Most theoretical arguments for a positive influence of trade on growth rely on improved resource allocation through increased openness and exposure to the world market. In the fourth specification, the export coefficient actually captures two growth enhancing effects: Marginal factor productivity is likely to be higher in the export sector, due to the more competitive environment, higher innovation potential, better access to resources and flexibility in adapting to new circumstances, etc. Secondly, the coefficient also includes spillovers from the export to the non-export sector (or from the high tech to the medium and low tech sectors below). Finally, increased openness, expressed as changes in openness ($DXSH^c$), may also spur growth. This is tested for by the last specification.

The results for this benchmark specification are given in Table 9.[24] The sample period is split into four subperiods and observations are pooled. OLS regression is performed on the pooled sample, including time dummies. Average growth rates are calculated as a linear trend of the variable (after taking logarithms) for each period. Shares are calculated as average share of the respective variable over GDP for each period. All variables are highly significant and show the expected sign. The share of investment in GDP relates positively to growth, as well as increases in the labor force (proxied by population growth). Initial GDP is negatively related, implying convergence in the sample as was suggested by the box plots above. This is worth noticing given the heterogeneous sample, including industrialized countries on the one hand and developing and less developed Asian

[24] The sample now consists only of the OECD and all Asian countries, yielding a total of 30 observations over four subperiods. Because of the limited data availability, CEECs had to be excluded. Further, the inclusion of most of the Latin American countries rendered the results often insignificant. As has already become clear from the discussion of trade patterns, developments in Latin America are often highly volatile, with periods of opposing developments. In the aggregate, these effects cancel out. Therefore, this group has been excluded from the analysis. It has to be kept in mind, however, that the results from this section only refer to the smaller sample of OECD and Asian countries.

countries on the other hand. The negative coefficient on primary schooling indicates that human capital has the expected, positive impact on growth. A high fraction of people who have completed primary schooling as their highest education implies that the fraction of people with higher schooling is low.[25] Thus, we expect a negative coefficient.

Table 9

Regression results for aggregate exports

	1	2 growth	3 shares	4 both	5 cross-term	6 change in shares
INV	0.1665	0.1554	0.1199	0.1234	0.1243	0.1673
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
DPOP	0.4450	0.4447	0.3415	0.3708	0.3159	0.4500
	0.003	*0.001*	*0.021*	*0.009*	*0.023*	*0.003*
GDP_0	-0.0058	-0.0033	-0.0078	-0.0051	-0.0065	-0.0056
	0.001	*0.059*	*0.000*	*0.010*	*0.000*	*0.003*
$PRIMSCH_0$	-0.0004	-0.0004	-0.0003	-0.0003	-0.0004	-0.0004
	0.034	*0.052*	*0.126*	*0.130*	*0.062*	*0.035*
DX		0.1091		0.0963		
		0.000		*0.001*		
XSH			0.0203	0.0145		0.0125
			0.008	*0.051*		*0.693*
DX*XSH					0.2483	
					0.000	
adj. R2	0.844	0.861	0.852	0.865	0.865	0.842
obs.	123	123	123	123	123	123

Further, the positive influence of exports or – more generally – of trade on growth is confirmed, the γ-coefficient is always significant and positive. The growth enhancing effect of exports is partly due to increased investments, as the coefficient on investment simultaneously drops when the export share is included. When controlling for exposure to the world market, the positive influence of export growth still remains highly significant. The fourth specification indicates that positive externalities from the export sector are especially important. Thus, exports add more to national income than their direct effects: they also improve productivity in the non-exporting sector. The cross term is highly significant and the coefficient is considerably higher than the effects of export share and export growth together. Finally, changes in the export share do not influence GDP, the export coefficient is insignificant in the last specification (associated with a drop in the adjusted R^2).

[25] This does not follow automatically, however, for the present sample the relationship holds. This was checked by correlating the variables for primary schooling to those of secondary schooling, which gave a significantly negative correlation.

The purpose of this study is, however, not to confirm the strong relationship between trade and growth, but to look at the impact of trade structure, structural change and trade specialization on growth. Trade structure is measured by the industrial composition of trade. Structural change is defined as the change in this composition over time, and trade specialization is measured by the relative trade advantage defined in section 2 and its export and import components. The empirical model is now adjusted to include export variables in the four skill categories separately. Again, different specifications are tested to account for various channels of influence:

$$DGDP^c = \alpha + \beta_1 INV^c + \beta_2 DPOP^c + \beta_3 GDP_0^c + \beta_4 PRIMSCH_0^c + \sum_i \gamma_i EXP_i^c + \varepsilon_c \quad (5.2)$$

The results are shown in Table 10. The export variable is again defined in different ways. In the first specification, it refers to growth rates of industrial exports (DX_i^c). Although we expect a positive coefficient in all four categories, the coefficients should differ according to skill intensities. We expect a statistically stronger relationship between high skill exports and growth for two reasons. First, productivity may be higher in more sophisticated industries, which are in general also characterized by a higher degree of capitalization. Second, knowledge and technology spillovers from high skill to lower skill intensive industries are expected to be stronger. Even more than that, only few such spillovers are expected to arise from the lower skill activities.

The impact of the trade structure will be captured by looking at the export composition (XSH_i^c). This specification does not include export growth and thus neglects the direct growth accounting effect of exports. It concentrates solely on the influence of the trade structure on growth. Here, we clearly expect a negative influence stemming from a relatively large share of low skill exports as opposed to a positive influence from a large share of high skill exports on GDP. The export share can equivalently be interpreted as openness in the respective industry. The argument remains unchanged: higher exposure to the world market induces the use of more modern techniques and creates more competitive pressure, feeding back positively on productivity and thus output growth. These effects are expected to be of greater importance in the more skill demanding industries, where the impact of technological progress is higher than in routinized production processes.

The third specification reports again both effects jointly and allows to discriminate between the direct effect of export growth and the effect of export structure on GDP growth. The fourth specification, using the cross term between the export share and export growth in each industry, will indicate whether externalities and differences in productivity exist between industries. If the coefficient on this variable is different from zero, it will indicate the presence of such externalities and productivity differentials.

Table 10

Regression results for export structure

	1 growth	2 shares	3 both	4 cross-term	5 relative growth	6 change in shares
INV	0.1463	0.1362	0.1220	0.1254	0.1680	0.1588
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
DPOP	0.4506	0.3883	0.4067	0.4061	0.4438	0.4792
	0.003	*0.010*	*0.008*	*0.005*	*0.003*	*0.002*
GDP0	-0.0049	-0.0065	-0.0052	-0.0062	-0.0060	-0.0059
	0.007	*0.003*	*0.023*	*0.001*	*0.001*	*0.001*
PRIMSCH0	-0.0004	-0.0005	-0.0004	-0.0004	-0.0005	-0.0004
	0.083	*0.024*	*0.055*	*0.070*	*0.022*	*0.079*
DX 1	-0.0011		-0.0016		0.0000	
	0.951		*0.928*		*0.992*	
DX 2	0.0170		0.0155		-0.0001	
	0.086		*0.116*		*0.520*	
DX 3	0.0112		0.0102		0.0000	
	0.311		*0.357*		*0.917*	
DX 4	0.0117		0.0115		0.0001	
	0.121		*0.123*		*0.404*	
XSH 1		0.0223	0.0103			-0.0214
		0.684	*0.852*			*0.224*
XSH 2		0.0431	0.0232			0.0114
		0.655	*0.809*			*0.260*
XSH 3		0.0949	0.0916			0.0059
		0.013	*0.016*			*0.603*
XSH 4		-0.1663	-0.1728			0.0041
		0.044	*0.036*			*0.597*
DX*XSH 1				0.1000		
				0.736		
DX*XSH 2				1.4448		
				0.001		
DX*XSH 3				0.2537		
				0.081		
DX*XSH 4				-0.2050		
				0.185		
adj. R2	0.848	0.849	0.852	0.859	0.841	0.842
obs.	123	123	123	123	123	123

The effect of the export structure on output growth can be made more explicit by looking at the growth differential between various industries' exports and aggregate export growth. This will eliminate the direct accounting effect and is given in specification five. Export growth is now measured as the growth of exports in the specific industry relative to

aggregate export growth. It can also be argued that structural change should have an impact on growth, which is given in the last specification. Here, changes in export shares are used as explanatory variables.

The results are first of all remarkable in so far as they reveal very clearly the importance of manufacturing exports. Despite the fact that the estimations in Table 10 exclude all non-manufacturing exports – in contrast to the results given in Table 9, where total exports (manufacturing and non-manufacturing) have been considered – the adjusted R^2 of the regressions drops only slightly. This confirms the widely held view that manufacturing exports are important for development. Apart from this, the results are not too supportive of the initial hypothesis. Export growth only relates positively to growth in the medium skill - blue collar industry. This comprises mainly transport equipment and wood products, including furniture. Presumably, the automobile industry is driving the result in this case. This industry is very important for the export sector, especially in East Asia.

The export structure explains GDP growth slightly more often than sectoral growth rates. In line with the previous observation on the effect of the chemical industry on growth, it is again the medium skill - white collar activities which are exerting a significantly positive influence on growth. The negative coefficient for the share of high skill exports is surprising and does not fit into the argumentation above. It further underlines the special role of medium high skill intensive industries. They seem to offer the highest potential for positive spillovers and productivity gains. The high skill intensive industries – computing and communication equipment, as well as aircraft and drugs and medicine – are not characterized by an equally high growth promoting potential. Maybe they are too advanced, bind too many resources and involve too high sunk costs in order to generate net positive effects for the economy as a whole. The results are robust to including both, growth and share, at the same time. When the effect of openness is controlled for, export growth no longer adds positively to GDP growth. It is rather openness in the respective industry that matters, more precisely openness in the medium high skill intensive industries. Together with the observation that openness in the four top high skill intensive industries correlates negatively with growth, this suggests the presence of product cycles in development. According to this reasoning, for our sample the products manufactured in the high skill intensive industries are not yet mature enough to be exposed to the world market. Output of lower skill intensive industries on the other hand would be too outdated or too little demanded in order to have a large effect on development.

Column 4 makes clear that positive externalities only arise from medium skill intensive industries. Both subgroups, blue and white collar activities, have a significant and positive impact on growth, which is especially strong for blue collar industries. The latter effect stems from the positive influence of growing medium low skill exports and might reflect productivity gains arising from strong scale effects in these industries. The negative

coefficient on the cross term in high skill exports is (at least) not significant. However, it is quite clear that exports in this sector do not produce positive externalities in contrast to the medium skill sectors.

The last two specifications did not yield any significant results. Relative growth rates are never significantly associated with the dependent variable. Apparently, the differences in export growth rates among the four skill segments are not large enough to be able to explain aggregate output growth. Similarly, structural change does not have a significant influence on GDP growth. We know from section 3 that structural change has been modest and furthermore has led to increasingly similar trade patterns. This may explain its inability to account for differences in aggregate development.

In contrast to the effect of aggregate trade flows, which might be rather similar regardless whether exports or imports are used as explanatory variables, the impact of the trade structure on growth is expected to be different on the export as opposed to the import side.[26] Thus, in equation 5.3, various import measures are used to explain GDP growth:

$$DGDP^c = \alpha + \beta_1 INV^c + \beta_2 DPOP^c + \beta_3 GDP_0^c + \beta_4 PRIMSCH_0^c + \sum_i \gamma_i IMP_i^c + \varepsilon_c \quad (5.3)$$

The results are presented in Table 11. They are often different to what we have obtained previously. As a first general remark, the fit of the equation is slightly improved when using imports instead of exports. The import side is more relevant for development than exports and export structure. Secondly, whereas the composition of exports had a greater influence on GDP than growth in exports, it is now import growth which matters more often. Especially growth in medium skill, blue collar industries and growth in high skill intensive industries promotes growth in GDP. The effect of high skill imports might be stronger, however, the difference between the two is not significant at the 5% level.

High import shares often correlate negatively with GDP growth, except for the medium skill, white collar industries. Here, openness on the import side has a significantly positive influence on growth at the 10% level. Again, this industry segment turns out to play a special role, reflecting its potential for knowledge spillovers and learning effects through increased integration into world markets.

[26] In the seminal paper by Levine and Renelt (1992), the results of the growth equation remain essentially unchanged if measures of imports or total trade are used as explanatory variables instead of exports. Thus they conclude that, when testing the effect of exports on growth, one might interpret the results as measuring the effect of trade on growth more generally. This might be true at the aggregate level, however, according to the arguments put forward in the theoretical section, I would expect to find different effects from exports and imports when broken down by industries or industry groups. Therefore both variables are used in the estimation.

Table 11

Regression results for import structure

	1 growth	2 shares	3 both	4 cross-term	5 relative growth	6 change in shares
INV	0.1682	0.1334	0.1473	0.1488	0.1642	0.1800
	0.000	*0.000*	*0.000*	*0.000*	*0.000*	*0.000*
DPOP	0.3706	0.3172	0.3046	0.3398	0.4627	0.4418
	0.006	*0.043*	*0.036*	*0.017*	*0.002*	*0.002*
GDP0	-0.0050	-0.0064	-0.0056	-0.0066	-0.0057	-0.0057
	0.002	*0.002*	*0.003*	*0.000*	*0.001*	*0.001*
PRIMSCH0	-0.0006	-0.0004	-0.0005	-0.0005	-0.0005	-0.0005
	0.005	*0.079*	*0.012*	*0.010*	*0.029*	*0.012*
DM 1	-0.0202		-0.0171		-0.0005	
	0.548		*0.617*		*0.326*	
DM 2	0.0340		0.0356		-0.0003	
	0.061		*0.051*		*0.178*	
DM 3	0.0081		0.0007		-0.0002	
	0.819		*0.984*		*0.313*	
DM 4	0.0664		0.0598		0.0004	
	0.043		*0.072*		*0.290*	
MSH 1		-0.0169	-0.0054			-0.0495
		0.771	*0.920*			*0.165*
MSH 2		-0.0447	-0.0167			0.0332
		0.739	*0.892*			*0.085*
MSH 3		0.1274	0.0763			-0.0407
		0.080	*0.258*			*0.277*
MSH 4		-0.1696	-0.1075			0.0859
		0.198	*0.377*			*0.013*
DM*MSH 1				0.3087		0.858
				0.250		123
DM*MSH 2				1.1272		
				0.010		
DM*MSH 3				-0.4002		
				0.064		
DM*MSH 4				1.1511		
				0.009		
adj. R2	0.874	0.849	0.874	0.877	0.842	0.858
obs.	123	123	123	123	123	123

When openness is controlled for, the positive influence of increases in both, lower medium skill and high skill imports remains significant. The negative coefficients on the average import shares together with the strong positive effect of import growth suggests that countries with a below-average share of high skill imports and high import growth in these

industries grew on average faster. This points towards the importance of imports for development by transferring knowledge and technology. In analogy, the same interpretation has to apply to the medium low skill intensive industries.

Using cross terms, i.e. import growth multiplied with the import ratio, further supports the view that imports in high skill intensive industries have substantial positive spillovers for other sectors. The coefficient is rather large and significant at the 1% level. The same result is again obtained for the medium low skill sector. The influence of medium high skill imports is now clearly negative (significantly so at the 10% level). These results are not only in favour of a link between trade structure and growth, they also point towards qualitatively different mechanisms of how exports versus imports and their structure matter for growth.

In contrast to substantial positive spillovers from exports in the medium high skill intensive industries, such imports induce negative externalities on the remaining industries. Thus, whereas learning effects are increasing in exports, there might be decreasing returns to learning when imports serve as substitutes for domestically produced inputs. With respect to high skill intensive industries, exports did not produce positive spillovers, whereas imports showed a large and highly significant potential for positive externalities. A plausible explanation for this empirical fact can be found in large knowledge and technology spillovers from high skill imports, while at the same time export goods from these industries are not mature enough to be competitive on the world market. They might produce very high sunk costs and bind many resources in their production, resulting in negative externalities for the rest of the economy.

Finally, the effect of trade specialization is estimated in equation 5.4:

$$DGDP^c = \alpha + \beta_1 INV^c + \beta_2 DPOP^c + \beta_3 GDP_0^c + \beta_4 PRIMSCH_0^c + \sum_i \gamma_i RCA_i^c + \varepsilon_c \quad (5.4)$$

Trade specialization is measured by the relative trade advantage, the measure of revealed competitive advantage, which has been introduced in section 2. It calculates a country's market share in a specific industry relative to that industry's average share in the total sample for exports and imports. In equation 5.4, I use again three different specifications. RCA_i^c refers first to the net market share (exports minus imports), in the second and the third specification it refers to the logarithm of the export and import component respectively. Results are displayed in Table 12.

Table 12

Impact of trade specialization on growth

	Net	Exports	Imports
INV	0.1587	0.1411	0.1470
	0.000	*0.000*	*0.000*
DPOP	0.4108	0.4221	0.3449
	0.005	*0.005*	*0.021*
GDP0	-0.0102	-0.0101	-0.0058
	0.000	*0.000*	*0.010*
PRIMSCH0	-0.0005	-0.0006	-0.0004
	0.027	*0.009*	*0.101*
RCA 1	-0.0002	0.0035	-0.0188
	0.154	*0.448*	*0.302*
RCA 2	-0.0011	0.0005	-0.0055
	0.750	*0.887*	*0.689*
RCA 3	0.0041	0.0089	0.0012
	0.129	*0.046*	*0.957*
RCA 4	0.0029	0.0024	-0.0205
	0.368	*0.189*	*0.139*
adj. R2	0.848	0.852	0.8489
obs.	123	123	123

Differences in trade specialization do not relate significantly to differences in GDP growth. The coefficients all show the expected sign, a negative correlation is observed between specialization in low and medium low skill intensive industries as opposed to a positive correlation between medium high and high skill intensive industries and growth. However, the effects are never statistically significant. Export specialization is always positively related to GDP growth. Specialization in medium high skill exports contributes significantly positively to GDP at the 5% level. Again, there is evidence for a special role of the medium high skill intensive industries. Although the coefficients for import specialization are never significant, they also support the importance of medium skill, blue collar industries. In general, import specialization is negatively associated with economic growth (although never significantly so). However, the coefficient for medium high skill intensive industries is positive, which would imply that above world average imports in this industry have a positive growth effect.

The results obtained from using trade specialization as an explanatory variable are not too encouraging. But they fit into the general picture. The medium high skill intensive industries play an important role for development, and export specialization in those industries is often associated with higher income growth rates. Similar results are obtained for high skill intensive industries, but never significantly so.

5.4 Summary

The analysis reveals that the trade structure has an impact on growth. The effects of industry-specific trade flows on aggregate economic development vary between imports and exports. Imports at the industrial level show more often a significant correlation with GDP growth than exports.

In a first step, a few typical industries were selected and their exports and imports were related to aggregate income growth. This partial analysis shows that growth in trade volume always matters positively for GDP growth. The initial trade structure as well as structural change has qualitatively different effects. The results are highly sensitive to the choice of the sample. The positive impact of trade in very skill intensive industries on GDP growth depends strongly on including the group of East Asian countries. On the other hand, structural change in output has a significant influence on aggregate growth and robustly so for all country groups. This underlines the special role that trade has played in the development of many of the East Asian economies. Whereas the effects of industrial output restructuring are relatively robust to the choice of the sample, the special influence of trade structure on growth relies strongly on the inclusion of the East Asian countries.

The present research was intended to illuminate the relationship between trade structure, trade specialization and growth. The research was guided by the hypothesis that different types of exports (or imports) have differential effects on growth. The empirical evidence has more or less been supportive of this hypothesis, even if the results were not as strong as one would expect from the East Asian miracle. We know from section 3 that – with the exception of the East Asian and, to a lesser extent, also the Latin American countries – the amount of structural change in trade patterns has been moderate. Apart from the general tendency towards increasingly similar trade structures, there have not been great changes in specialization patterns excluding those two country groups. In line with this evidence, the significant relationship between export structure and aggregate growth vanishes when the group of East Asian countries is excluded from the sample. Thus, structural change as such seems to play a role for development, but apparently the variation in trade patterns has not always been sufficient in order to exert this influence in the present sample.

The comprehensive empirical model revealed differences in the relevance of export and import structure for growth. Whereas the structure of exports is more often related to GDP than export growth, growth in industrial imports matters more than average import shares. More precisely, high skill imports spur growth in GDP, as well as increasing imports in the medium low skill segment. In contrast, a large share of medium high skill exports induce higher growth, whereas a high share of high skill intensive exports reduce income growth on average. This leads to the conclusion that imports affect growth positively by transferring knowledge and technology across national boundaries. Knowledge can spill over from more skill intensive industries to less skill intensive industries. Exports, on the

other hand, have a positive impact by offering a high learning potential, generating economies of scale due to larger quantities produced, and creating increased competitive pressure. However, a mature production structure is a necessary requirement in order to be able to reap these benefits. Thus, it might not be possible for backward economies to benefit from leading-edge production processes.

Both, trade structure and trade specialization point towards a prominent role played by medium high skill intensive industries: In these industries, export growth, export specialization and import specialization exerted a positive influence on development. A negative effect arose from a high import share in these industries, but it was not significant. The effect of trade in high skill intensive industries on growth, which was *a priori* assumed to be of great importance, turned out to be sometimes negative (export share) or insignificant on the export side and positive with respect to imports. This supports the view that intangibles (embodied technology, etc.) are responsible for the growth promoting effect of imports. This rests on the – plausible – assumption that such intangibles are higher in the case of high skill intensive industries. It would further give an argument for infant-industry protection. Exports influence aggregate income growth to a large extent by simply augmenting the level of GDP through growth in trade volume. However, there is more to this than what is captured by this direct growth accounting effect. A positive influence of export growth on aggregate income growth could only be established for the medium skill categories and not for other skill categories. Thus, trade structure is important.

Conclusions

This study has investigated the relationship between trade structure/trade specialization and economic growth for a heterogeneous set of countries. These issues have not often been researched, partly due to the fact that comprehensive theories which establish a relationship between trade structure and growth are lacking. Growth theories remain in general on the aggregate, economy-wide level. Trade theories are more concerned with explaining the determinants of trade and trade structure or specialization and do not provide general predictions concerning the impact of trade structure and specialization on growth. Some empirical studies exist which focus explicitly on this link. However, they deal exclusively either with industrialized or with developing countries. The present sample includes highly and less developed countries as well as rapidly developing countries and transition countries and thus allows to take a more general look on the link between trade structure and growth.

The first part described trade patterns for different groups of countries – OECD-North, OECD-South, East Asia, South Asia, Latin America and CEECs – and their evolution over the past two decades. A few general features could be observed. First, there is a pronounced distinction between OECD-North – the most advanced group – and all other

groups. Whereas the former show an above-average trade specialization in high skill intensive industries, the latter group is characterized by an above-average specialization in low skill intensive exports. This clear distinction in specialization patterns becomes less pronounced over the observation period, however, it does not change in qualitative terms.

Second, specialization is especially strong in extreme segments (high skill and low skill) and weak in medium skill intensive industries. This points towards a stronger role for intra-industry trade in the medium skill segments as opposed to the top high and low segments, where comparative advantages still play a greater role.

Third, there has been a clear trend towards more similarity in trade patterns in the sample. Patterns of trade specialization by skill intensity of individual industries give an unambiguous picture of global convergence coupled with de-specialization. This trend has already been observed in previous studies for more homogeneous samples in terms of stage of development. Therefore, the result is all the more remarkable given the heterogeneous set of countries here. Differences in relative market strength have diminished between all countries and the results are fairly robust to the exclusion of individual countries or country groups. De-specialization in the strong sense, i.e. accompanied by reduced variation in trade specialization patterns, is observed only for the OECD and East Asian countries. Latin America and South Asia also show de-specialization in the weak sense, however, the degree of specialization has not decreased in these two regions. Strict convergence in the sense of decreasing variance occurred in all industries but the medium skill, blue collar segment. Further, convergence in high skill intensive industries was significantly faster than in low skill intensive industries at the 5% level.

CEECs showed a high degree of restructuring in the early 1990s, which is not surprising given their transformation process. However, perhaps surprising is their immediate convergence towards the advanced OECD countries, implying that their specialization patterns are increasingly different from those of other catching-up countries inside the OECD (especially the cohesion countries in the EU15). In the early 1990s, CEECs showed the greatest resemblance in export structure to the Southern OECD countries. Import structures at the same time were already close to those of OECD-North. This similarity in import structures to OECD-North and especially to the EU has further increased. Although export patterns have also approached those of OECD-North, they still resemble more those of Southern OECD countries. Some disparities between Hungary, Slovenia and also the Czech Republic on the one hand and Poland and Slovakia on the other are hidden by the aggregate. In the former group, export restructuring towards high skill intensive industries has been substantial. In the Czech Republic also import patterns exhibited a great deal of structural change. Poland, Slovakia, Romania and the Baltic States show less re-orientation towards the EU in their trade patterns.

This general trend towards homogeneous trade patterns (de-specialization and convergence) certainly opens up new questions. The theorist will mainly be concerned with the following issues: Why do global trade structures converge? According to the theoretical approach which is used to explain trade patterns, different explanations will be offered. Second, what does such a global structural convergence imply from a theoretical point of view? Does it prove or falsify certain approaches? Which approach should be pursued, or should different approaches be integrated (for instance in the way that Helpman, 1981, combined elements of different approaches)? Many additional variables are needed to investigate these issues. For example, endowments, demand structures, types and paths of technological progress and its diffusion, FDI, etc. and their relationship to production and trade patterns have to be taken into account.

The empirical researcher and the policy adviser will be more interested in the following questions: What is the impact of structural convergence on economic development? Will it lead to income convergence or is it the result of converging per capita incomes?[27] From the viewpoint of classic trade theories, specialization according to comparative advantage should be optimal and yield gains in efficiency. In the small country case, where world prices are not influenced by these efficiency gains, this will also result in positive income growth. From a new trade theory point of view, income convergence has to be accompanied by structural convergence, as convergence in per capita income levels leads to more similarity in demand structures. Thus, the question of causation has to be analysed further. Also new growth theories, allowing for increasing returns and externalities, can offer an explanation for qualitative differences between various types of exports (and imports) by allowing for technology and knowledge spillovers from trade.

The econometric analysis conducted in the second part of this report has tried to fill up this gap by relating trade flows and trade shares in qualitatively different industries to the long-run aggregate growth performance of a country. Disaggregating trade flows into four broad categories – low skill, medium low skill, medium high skill, and high skill intensive industries – has yielded interesting insights that are supportive of the hypothesis that not only exports *per se* matter for growth, but the *type* of exports is crucial.

Simple correlations showed that increases in the trade volume always contribute positively to GDP growth, with the exception of increased exports in medium low skill intensive industries. The positive relationship is not equally strong in all industries. Exports of medium high skill intensive industries play a special role for growth, as do imports in high skill intensive industries. There is a clear tendency in the relationship between the composition of trade and growth. A higher share of trade in medium skill (and for imports also high skill) intensive industries correlated positively with aggregate income growth.

[27] In the present sample, which includes a wide range of per capita income levels, income convergence is present but not very strong; see section 4.

Finally, structural change towards a higher importance of lower skill intensive industries is negatively correlated with GDP growth.

The analysis also supported the – often held – view that trade plays a special role in the development of East Asia, more so than for other world regions. The exemplified results, obtained from the analysis of selected industries, revealed that the impact of trade structure on GDP growth depended crucially on the inclusion of the group of East Asian countries in the sample. The impact of the output structure was not sensitive to the inclusion of this group of countries.

A comprehensive empirical growth model confirmed the above results. First of all, the variation in GDP growth was explained equally well when disaggregated trade flows, instead of total trade, were used as explaining variables. By doing so, a certain fraction of trade flows – namely all non-manufacturing trade – was automatically excluded from the analysis. Non-manufacturing trade does not seem to add a lot to explaining differences in economic growth between countries. It has to be mentioned that the analysis only refers to the manufacturing sector. Thus, further research is necessary to extend the focus to trade in agriculture, utilities and producer services.

One of the main results pointed towards a special importance of medium high skill industries in export patterns, indicating a large potential for positive externalities from specialization in those industries. On the other hand, imports in high skill intensive industries added to higher GDP growth. This suggests that the growth promoting effect of imports consists primarily in their ability to transfer knowledge and embodied technology, whereas exports promote growth through learning and scale effects. Thus, a relationship between trade structure and growth could be established empirically.

Trade specialization was not found to be significantly linked to growth performance, with one exception. In general, specialization in lower skill activities is negatively related to growth, however, not significantly so. Further, whereas export specialization is positively associated with growth, import specialization shows a negative correlation. Again, the importance of medium high skill exports was reconfirmed, emphasizing the special role of these industries for development.

In general, the results in the analytical part were not too supportive of a strong role of trade structure and specialization at this level of aggregation, given that the coefficients were often insignificant. Future research should probably look more carefully at individual industries and their implications for growth at the economy-wide level. Perhaps the results are weakened here by aggregating industries into four broad categories, using a classification that has been developed on the basis of OECD data for one specific year.

Further, structural convergence at the industrial level may hide qualitative differences between countries or groups of countries. A closer look at quality segments within industries is needed and would probably yield new, interesting insights. For example, although Korea and Germany are converging in their export patterns, it may be the case that Korea is exporting the low-quality products in a certain industry, whereas Germany is specializing in the high-quality goods of the same industry.

The global tendency towards universally average patterns might seem desirable at first sight. Whether this is the case and why convergence occurs are still open questions, besides the possibility that a more detailed analysis might reveal clear specialization tendencies within certain industries. This latter scenario would imply the possibility of 'development traps' for some countries; it would also give new grounds to traditional Ricardian or HO explanations of international trade.

The observed convergence of trade patterns is not accompanied by equal convergence in growth performance. Thus, either structural change is not yet complete, or structural convergence as such is not sufficient to induce income convergence. The results point towards both explanations. Trade restructuring towards increased similarity to the advanced OECD countries has coincided with income convergence in the case of East Asia. On the other hand, rigid trade patterns go hand in hand with persistently low income levels in South Asia. Although the econometric analysis did not include CEECs (for statistical reasons) the observation that their trade patterns were adjusting rapidly to resemble those of OECD-North in the early and mid-1990s together with their relatively higher subsequent growth rates (as compared to OECD-North) lends some support to the hypothesis that trade structure/trade specialization has an impact on growth.

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Appendix

Table A.1

List of countries

OECD-North	
AUS	Australia
AUT	Austria
CAN	Canada
DNK	Denmark
FIN	Finland
FRA	France
DEW	Germany
ITA	Italy
JPN	Japan
NLD	Netherlands
NZL	New Zealand
NOR	Norway
SWE	Sweden
GBR	UK
USA	USA
OECD-South	
GRC	Greece
PRT	Portugal
ESP	Spain
TUR	Turkey
CEEC	
BU	Bulgaria
CZ	Czech Republic
EE	Estonia
HU	Hungary
LV	Latvia
LT	Lithuania
PL	Poland
RO	Romania
SK	Slovak Republic
SI	Slovenia
East Asia	
HKG	Hongkong
IDN	Indonesia
KOR	Republic of Korea
MYS	Malaysia
PHL	Philippines
SGP	Singapore
THA	Thailand
South Asia	
BGD	Bangladesh
SRL	Sri Lanka
IND	India
PAK	Pakistan
Latin America	
ARG	Argentina
BOL	Bolivia
CHL	Chile
COL	Columbia
ECU	Ecuador
SLV	El Salvador
GTM	Guatemala
MEX	Mexico
NIC	Nicaragua
PAN	Panama
PRY	Paraguay
PER	Peru
URY	Uruguay
VEN	Venezuela

Table A.2

List of industries and skill intensity

		ISIC Code	Definition
LOW SKILL		311	Food products
		313	Beverages
		314	Tobacco
		321	Textiles
		322	Wearing apparel, except footwear
		323	Leather products
		324	Footwear, except rubber or plastic
		355	Rubber products
		356	Plastic products
		361	Pottery, china, earthenware
		362	Glass and products
		369	Other non-metallic mineral products
		371	Iron and steel
		372	Non-ferrous metals
MEDIUM SKILL	blue-collar	331	Wood products, except furniture
		332	Furniture, except metal
		381	Fabricated metal products
		3841	Ship building and repairing
		384d	Transport equipment
		390	Other manufactured products
MEDIUM SKILL	white-collar	341	Paper and products
		342	Printing and publishing
		351	Industrial chemicals
		352d	Other chemicals
		353	Petroleum refineries
		354	Misc. petroleum and coal products
		3832	Man. of Radio, TV, and Communication equipment and apparatus
		383d	Machinery, electric
		385	Professional and scientific equipment
HIGH SKILL		3522	Man. of Drugs and Medicine
		3825	Man. Of Office, Computing and Accounting Machinery
		382d	Machinery, except electrical
		3845	Man. Of Aircraft

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