



EUROPEAN CENTRAL BANK

EUROSYSTEM

OCCASIONAL PAPER SERIES

NO 55 / MARCH 2007

**GLOBALISATION AND  
EURO AREA TRADE  
INTERACTIONS AND  
CHALLENGES**

by Ursel Baumann  
and Filippo di Mauro



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## ABSTRACT

As a major player in world trade, the euro area is strongly influenced by globalisation, but is far from being a passive spectator. The paper analyses how the euro area's trade specialization has changed in response to stronger international competition and the emergence of new global players, evaluating results and possible challenges ahead. The message remains mixed. On the positive side, the export specialisation of the euro area is increasing in some medium-high or high-tech sectors where productivity growth is strong and demand robust, such as pharmaceuticals, also by a more intensive recourse to importing intermediate goods from low-cost countries. On the other hand, in comparison to other industrialised economies, the euro area has been somewhat slower in moving towards research-intensive goods and away from labour-intensive sectors. While this could reflect data classification issues, it may also be a sign of structural rigidities in the euro area, which hinder adjustment processes.

**INTRODUCTION AND SUMMARY OF THE MAIN CONCLUSIONS<sup>1</sup>**

Globalisation is not a new phenomenon, but there is growing consensus that its impact is fundamentally changing world patterns of production and trade. For the euro area,<sup>2</sup> a very open economic area with a strong manufacturing orientation, such developments obviously have a critical relevance. What aspects of globalisation are the most important for the euro area as a major player in world trade? What are the main channels through which the globalisation process is exerting its effects? How is the euro area adjusting to this, overall? These are the main issues we aim to address in this paper. Recent changes in euro area trade are analysed against the background of comparative advantages as well as in comparison with other large economies. The ultimate objective is to assess how the euro area's trade patterns have changed in response to stronger competition and to other recent changes in the economic environment, drawing conclusions on the possible direction that further adjustments may take (and paying due attention to classification issues related to the indicators used).

Section I discusses predictions based on trade theories as to the trade effects of globalisation and provides the conceptual framework. It also lays out the set of complementary trade indicators that we consider to analyse recent changes in euro area trade. Section II looks at the euro area's export performance at the aggregate and sectoral level. It aims to determine where the euro area's specialisation lies and how this has changed in recent years. The analysis assesses factor and technology intensity of exports, looks at how dynamic destination markets are and establishes a connection between trade and sectoral productivity. Section III looks at euro area import penetration; a special emphasis is given to intermediate imports, used as a proxy for the increasing fragmentation of production across countries. The intermediate imports data are then used to create alternative measures of sectoral specialisation net of imports. Changes in

intermediate imports are also related to sectoral value added shares in order to tentatively assess whether the location abroad of some production stages is consistent with an increase in value added across sectors as available resources are used more effectively. Finally, Section IV summarises the main findings of the paper and discusses the outlook for euro area trade in the light of an increasingly integrated and globally competitive external environment.

The main result of the paper is that substantial adjustments have been taking place in euro area trade, which could reflect globalisation among other things. In particular, on the positive side, (i) the export specialisation of the euro area is increasing in some medium-high or high-tech sectors where productivity growth is strong and demand robust, such as pharmaceuticals, while declining in lower-tech sectors, such as textiles and (ii) the euro area appears to increasingly import intermediate goods from low-cost countries, in order to lower production costs and perhaps to focus on the higher value-added stages of the production chain.

Nevertheless, there are also signs that further adjustments may still be needed. The first is that the euro area still has a higher specialisation in relative terms than other major industrialised countries – including the United States, the United Kingdom and Japan – in predominantly labour-intensive categories of goods. Moreover, despite the closer integration of emerging markets' labour pools into the world economy, the euro area has not become less specialised in exporting labour-intensive goods, even when accounting for intermediate imports. While this could reflect the predominant use of relatively highly-skilled labour or an effective

1 We are grateful for the contributions from D. Taglioni (Sections I and III), C. Hornok (Boxes 4 and 5) and K. Benkovskis (Section II.1). Excellent research assistance was provided by N. Queiros de Faria and R. Pereira. Moreover, the paper draws on some previous internal work by S. Cabral and M. Bussière and has greatly benefited from comments by R. Anderton, H. J. Klöckers, D. Taglioni and by an anonymous internal referee.

2 Throughout the entire paper we refer to the euro area excluding Slovenia due to the period covered by the analysis, which ends before the adoption of the euro by this country.

use by multinational companies of labour supplied abroad, it may also be a sign of relatively protected product and labour markets, which could have sheltered the manufacturing sectors from competitive pressures, thus delaying adjustment processes. In comparison with the euro area, the United States appears to be moving more decisively towards research-intensive products, while retreating from labour-intensive and raw materials-intensive products. Second, there is evidence that the euro area is losing ground in one of its traditionally strong sectors – machinery and equipment – since higher intermediate imports are associated with stagnant exports, which could be a sign of deindustrialisation in this field. This is corroborated by the strong rise in imports of capital goods (particularly machinery and transport equipment) from the new EU Member States,<sup>3</sup> which appears to be in part displacing intra-euro area imports.

3 Throughout the entire paper we refer to the new EU Member States excluding Bulgaria and Romania as the analysis was undertaken while these countries were not yet members of the EU.

## I GLOBALISATION AND TRADE: THE CONCEPTUAL FRAMEWORK

### I.1 RECENT TRENDS

Globalisation is a catchword for the growing interdependence of economies via an increase in cross-border transactions in goods and services, natural resources, capital and labour. In the past decade the process of globalisation has accelerated as the use of ever more sophisticated information and communication technology has grown exponentially, while a breakthrough in connectivity, partly via the internet, has reduced the costs of transporting goods and information across the globe.<sup>4</sup>

This technological empowerment across the world has been accompanied by a strong rise in foreign direct investment (FDI) (see Chart 1). This has led to new ways of doing business: production processes have become increasingly internationalised as companies have established affiliates abroad to gain access to foreign markets and reduce input costs, while supply-chains have been set up on a global scale as a way of gaining a competitive edge.

Globalisation has also allowed emerging countries to enter and compete in world markets.

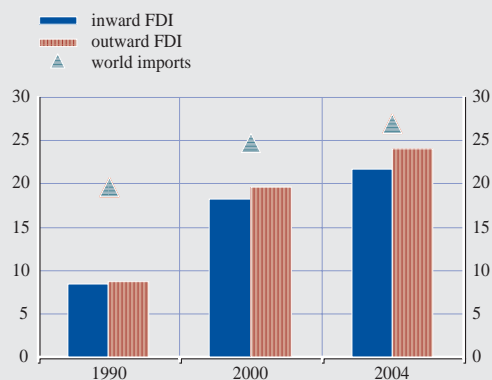
The growing integration into world trade of emerging Asia, as well as that of central and eastern European countries (CEECs) following the collapse of the Soviet Union (see Chart 2), has led to a sharpening in the competitive environment and to large changes in the structure of global trade.

Over time, globalisation means that national boundaries for goods, services and production factors are becoming less important in economic terms. This, in turn, implies that overall welfare gains are being realised as the world's scarce resources are reallocated into the most productive activities across the world. For the euro area – a large and relatively open economy – the benefits are likely to be significant, since closer trade integration worldwide, by leading to higher world trade, will increase demand for euro area goods. Moreover – all else being equal – stronger international competition should bring about lower costs for firms and lower prices of traded goods for consumers in the euro area, increase the availability of new product varieties, induce technology and knowledge transfers, as well as increase

<sup>4</sup> For a more detailed description of how the current era of globalisation is different from previous such eras, see for instance Bourguignon et al (2002) or Bernanke (2006).

**Chart 1 World imports and the global stock of inward and outward FDI as a proportion of world GDP**

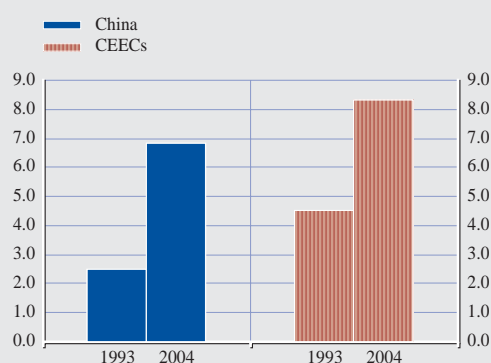
(percentages of GDP)



Source: United Nations Conference on Trade and Development, World Investment Reports 2005 and 2006.

**Chart 2 Integration of China and the CEECs into world trade**

(Exports+imports by country/region divided by world exports+imports, in percentages)



Sources: CHELEM and ECB calculations.  
Note: Trade flows are in values and include only goods.



productivity and economic growth. These benefits notwithstanding, market forces will trigger large changes in the structure of trade and the economy in line with comparative advantages, thus altering the relative returns on capital and labour.<sup>5</sup>

## 1.2 CONCEPTUAL FRAMEWORK

What can trade theory tell us about the likely direction of adjustments in trade patterns following the structural shift induced by globalisation? The world of today consists of very complex trade relationships between a growing number of countries and it is characterised by an increasing number of goods, services and production tasks, which altogether, simple models of trade cannot fully capture. Nevertheless, such models are still informative and provide important yet – given the different assumptions on which they are based – different predictions as to how globalisation will affect world trade structures. A brief summary is provided below.

To start with, traditional trade theories that assume perfectly competitive markets and are aimed at explaining inter-industry trade – see

**Table 1 R&D intensity**

(percentages of GDP, 2003)

	R&D intensity <sup>1)</sup>
EU25	1.9
euro area	1.9
France	2.2
Germany	2.6
Italy (2002)	1.2
United Kingdom	1.9
United States	2.6
Japan	3.2
Czech Republic	1.3
Hungary	1.0
Poland	0.6
Slovakia	0.6
China	1.3

Sources: OECD Science, Technology and Industry Scoreboard 2005, except EU25 and euro area (Eurostat, structural indicators database).

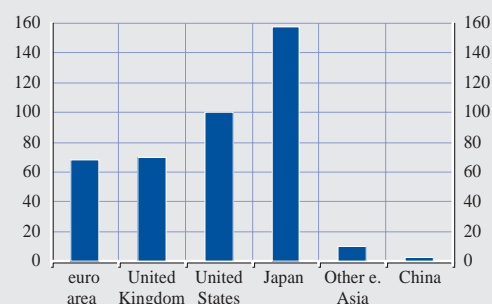
1) Gross domestic expenditure on R&D as a percentage of GDP.

Ohlin (1933) and Ricardo (1963) or Krugman and Obstfeld (2003) for a summary – suggest that countries engage in trade according to their comparative advantages. These are determined by the relative availability of factors of production as well as differences in productivity.

<sup>5</sup> See for instance Bernanke (2006).

**Chart 3 Physical capital/labour ratios across countries**

(Index, US = 100, 1999)

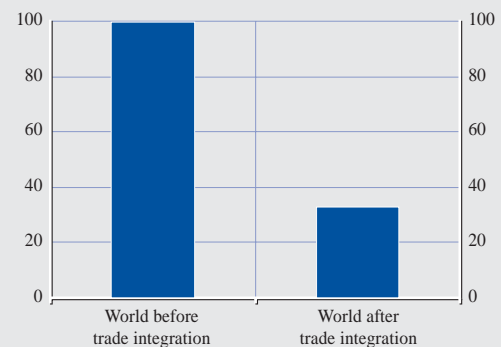


Sources: World Bank (Sandeep Mahajan (PRMEP) 2002) and ECB calculations.

Note: "Other e. Asia" stands for "other emerging Asia". For the definition of country groups see Table A1 in Annex A. Prices and exchange rates are for 1987.

**Chart 4 Physical capital/labour ratios for the world<sup>1</sup> before and after trade integration**

(Index: world before trade integration = 100; 1999)



Sources: World Bank (Sandeep Mahajan (PRMEP) 2002) and ECB calculations.

Note: Prices and exchange rates for 1987.

1) World before trade integration is proxied by the United States, the United Kingdom, the euro area and Japan. The world after trade integration additionally includes China, other emerging Asia and Hungary.

A country would thus optimally specialise in the production of those products that use the abundant productive resources more intensively. Despite notorious difficulties in actually measuring factor endowments, available evidence confirms that capital/labour ratios are much lower in emerging, low-wage economies than in developed, high-income countries, particularly Japan and the United States (see Chart 3). Differences in the intensity of research and development (R&D) are also large across countries, with intensity relatively high in Japan and the United States, somewhat lower in the euro area and significantly lower in China and some of the CEECs (see Table 1). This would support the idea that, a priori, developed economies have a comparative advantage in the production and export of capital-intensive and research-intensive goods, whereas the comparative advantage of emerging economies is more likely to lie in the production and export of labour-intensive goods.

These traditional trade theories and the trade patterns that follow from them suggest that the integration of new players – such as China, the CEECs and India – into world trade leads to a further sharpening of these comparative advantages across countries. Chart 4 illustrates the reason for this. An initial situation without the fast-growing emerging countries is assumed and the world capital/labour ratio is indexed to 100.<sup>6</sup> When these new players are integrated, the capital/labour ratio of the world drops to around a third of its starting level, since these countries are heavily labour-abundant. This would mean strong market pressure for developed economies to shift their production and export structures towards more capital-intensive goods.

Other trade theories, however, lead to different conclusions about the impact of globalisation on trade. The new trade theories (developed mainly to explain the existence of extensive intra-industry trade among developed economies) replace the assumption of perfect competition on product markets with the one of monopolistic competition, and introduce

product differentiation, scale economies and utility functions including preference for variety.<sup>7</sup> These theories describe well the existence of intra-industry trade flows between trade partners with similar factor intensities and comparative advantages. Hence they are consistent with the view that more open global markets would ultimately lead to a fall in cross-country industrial specialisation. This clearly holds provided that openness leads to a convergence of international factor intensities and incomes – as assumed by standard trade and growth theories.<sup>8</sup>

The literature on the new economic geography, by contrast, suggests that industrial activities concentrate in certain countries or regions, determined by the availability of skilled labour pools, specialised suppliers and knowledge externalities.<sup>9</sup> In these theories, specialisation across countries is thus motivated not only by factor proportions but also by externalities and spillovers that lead to self-reinforcing equilibria in agglomerated industry clusters.<sup>10</sup> Predictions of trade flows arising from the theory of economic geography are, however, ambiguous, since they mostly depend on historical “accidents”. Furthermore, agglomeration also creates congestion costs, offsetting some of the positive effects.

Recent evidence (Schott, 2004; Fontagné et al., 2006) suggests that capital and skill-intensive countries use their endowment advantage over low-wage countries to produce “vertically superior” varieties of a good. These are varieties

6 Capital-labour ratios are estimated for two sets of country groups: the first (defined as “world prior to trade integration”) includes the United States, the United Kingdom, the euro area and Japan, and the second (defined as “world after trade integration”) additionally includes China, the “other emerging Asia” countries and Hungary. The ratios are calculated using World Bank data from Sandeep Mahajan (PRMEP, 2002).

7 An example is the Spence-Dixit-Stiglitz utility function, see Dixit and Stiglitz (1977) and Spence (1976).

8 See for instance Helpman and Krugman (1985) and Kierzkowski (1984).

9 See for instance Krugman (1991), Fujita et al (1999) and Porter (1990).

10 The theories of trade and economic geography seem to be relevant in explaining some of the specialisations in industries across euro area countries, see Box 3.

that are relatively capital or skill-intensive and possess added features or higher quality, thereby leading to high value added return by commanding high prices. This evidence would suggest that conventional tests of trade theory using industry-level data are problematic because much of the endowment-driven specialisation might still take place, but at a level that was – until recently – hidden to the researcher. It would partly explain why developed economies – and most notably the euro area – continue to produce and export in industries, such as apparel and textiles, which are commonly associated with developing countries, and why they do so even in those instances where protection and market segmentation do not fully motivate the choice of foreign consumers to pay a premium for the higher priced labour-intensive goods produced there.

In an attempt to solve some of the puzzles of recent trends in international trade, Grossman and Rossi-Hansberg (2006) focus their analysis on a growing feature of globalisation – the increasing fragmentation of production across countries. Their models have two main implications. First, while specialisation may still be in line with factor endowments, it will apply not only to final goods but also to individual production tasks. For example, regardless of the nature of the final product, labour-intensive tasks or stages of the production process will tend to be relocated to labour-abundant countries. Developed economies will be more likely instead to focus on the upper stages of the value chain (e.g. research, development, planning and design, the production of skill and technology-intensive parts and the marketing of products). The second implication is that, because of the critical role of multinational companies in the global economy, the concepts of national boundaries and geographical specialisation across countries is becoming less meaningful. As multinational companies take advantage of differences in endowments, factor costs, skills and technology across countries, emerging economies can through them gain easy access

to otherwise unavailable technologies. As a result, emerging economies could experience large increases in productivity as they quickly move up the technological ladder, possibly leading to a specialisation in high-tech (final or intermediate) goods. Similarly, industrialised economies, by making use of the abundant labour in developing countries via production or task off-shoring, may ultimately increase their specialisation in labour-intensive products while reducing the domestic labour devoted to it.

The main conclusion of the above discussion is that even theoretically, there is no single benchmark against which to assess the way global trade patterns will move in the light of globalisation pressures. This is because a number of forces tend to pull in different directions than a simple comparative advantage model would have predicted. As the overall results of these forces are indeterminate, and theory on the issue is still nascent, the question of the direction in which trade patterns are changing, which is the focus of the rest of this paper, is essentially an empirical one. A corollary to this discussion is that changes in market shares and in countries' trade specialisations might not be a clear and fully satisfactory signal of the underlying national competitiveness.

### **1.3 HOW DO WE MEASURE ADJUSTMENTS IN EURO AREA TRADE IN A GLOBALISED WORLD?**

In line with the above discussion, traditional indicators of trade performance used by the applied trade literature need to be cautiously interpreted in the light of trade globalisation. The overriding reason for this is that globalisation triggers substantial structural changes in production and trade specialisation, which may either not be captured by standard indicators or make their interpretation difficult. A loss in export market share, for instance, might well be expected if new trade players are entering the field. And, more generally, there may even be circumstances in which such a loss

can actually be seen as a positive development, as it could in fact allow developed economies to reorient their production and exports towards goods with higher value added content.

Trade theory would suggest that, ultimately, any change in the structure of euro area trade should be evaluated against the long-term welfare gains that it provides, thus whether it leads to an increase in current and future per capita income, wealth and productivity. Since, however, a satisfactory measure of welfare is difficult to attain in practice, the strategy we adopt here is to rely on a set of indicators – rather than on a single measure – to assess the extent and nature of aggregate structural changes that are taking place now and are likely in the future. We are interested in gauging the direction in which the euro area is adjusting to the competitive challenges posed by the changes in world demand and relative prices caused by the emergence of new global players and to other changes in the economy. Moreover, we analyse how quickly these adjustments are taking place, as a quick adjustment would minimise the losses that occur in the transition period as a result of resources being locked into inefficient uses.

We will use five main indicators. The first indicator is the realised specialisation of exports by factor intensity, which we employ with the aim of verifying whether changes in trade specialisation are in line with notional comparative advantages. While indicators of specialisation are largely ex post measures of trade performance, reflecting past decisions by firms regarding the sectoral/geographical markets on which to focus, changes over time in these measures can give some indication as to how the euro area export sector has readjusted in recent years in comparison with other economies.

Second, we look at how the trade specialisation across countries compares with the composition and dynamics of world import demand. Is the euro area specialising in sectors which are the world's most dynamic and/or least volatile? Is

there evidence that emerging markets are becoming stronger competitors in the most dynamic sectors of world demand, leading to potentially lower profit margins in those sectors?

The third indicator we use is sectoral productivity. In the long run, exports are likely to increase in the sectors where productivity is highest, as the most efficient producers tend to participate in highly competitive export markets. Against this background, we also look at whether strong and rising trade specialisations are paralleled by high sectoral productivity growth across sectors and relative to other developed economies.

The fourth set of indicators addresses the issue of international production sharing and focuses on export indicators, net of imports. While our approach is similar to the standard Lafay index<sup>11</sup> (an indicator of revealed comparative advantage that nets out imports from exports at the sectoral level), we focus on intermediate imports, which are likely to better capture – although this is not free from caveats – international production sharing for a particular good. The comparison of trade specialisation based solely on exports with that based on exports net of intermediate imports sheds light on some aspects of international production sharing, including its impact on trade structures across countries.

Finally, we look at whether, across sectors, increased sourcing of intermediate inputs from low-wage countries is associated with increasing value added. While a more rigorous econometric analysis would be required to obtain solid conclusions, we provide some tentative evidence on whether changes in the sourcing of inputs is allowing euro area firms to concentrate on stages of the production chain where value added is higher.

<sup>11</sup> See Lafay (1992). The standard Lafay index is often used in the applied trade literature, see European Commission (2005), and Feletigh et al. (2006).

## 2 DEVELOPMENTS IN EURO AREA EXPORTS

### 2.1 STRUCTURAL VERSUS CYCLICAL CHANGES IN GLOBAL TRADE PATTERNS

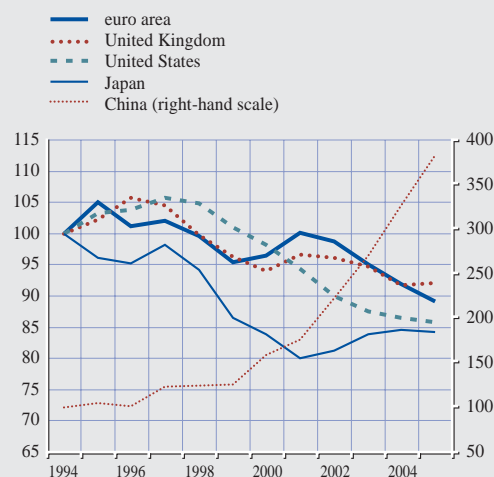
The extent to which export developments are affected by structural factors such as globalisation is evident from basic broad indicators of trade performance, i.e. export market shares and export price competitiveness (Charts 5 and 6). Two features stand out. First, as expected, against the background of new low-income global trade players entering the field, export market shares of the incumbent countries have fallen in recent years, while that of China, for instance, has dramatically increased (Chart 5).

For the euro area – and the United Kingdom – this loss has been relatively contained and mostly concentrated in the last few years in conjunction with the appreciation of the euro. In contrast, the United States and Japan experienced a sharp loss in market share between 1998 and 2002-03. More recently, Japan's market share has recovered and that of the United States stabilised, which could suggest that the structural adjustment to global trade integration is taking place across countries and regions at different points in time and over different horizons.

A second feature, strongly related to the previous point, is that diverging trends in export market shares are hardly in line with movements in relative export prices,<sup>12</sup> except for the euro area (for a discussion of export market shares and export price competitiveness across individual euro area countries, see Box 1). Chart 6 shows developed economies' export market shares in relation to export price competitiveness, defined as the export prices of a country's competitors over the prices of the country's own exports (an increase in the index therefore signals an improvement in competitiveness). The most striking developments occurred in Japan, which suffered considerable export market share losses in spite of strong gains in price competitiveness. This

Chart 5 Export market shares

(in volumes; index: 1994 = 100; annual data)



Sources: IMF, Eurostat and ECB calculations.  
Note: Last observation refers to December 2005.

reflects a shift of part of Japan's production facilities abroad, which has meant the use of neighbouring countries as export platforms.<sup>13</sup> In the United States, the improvement in price competitiveness since 2002 has led only to some stabilisation in the export market share, while in the United Kingdom, relative export prices have improved since 2000, but the export market share continued to decrease until early 2005.

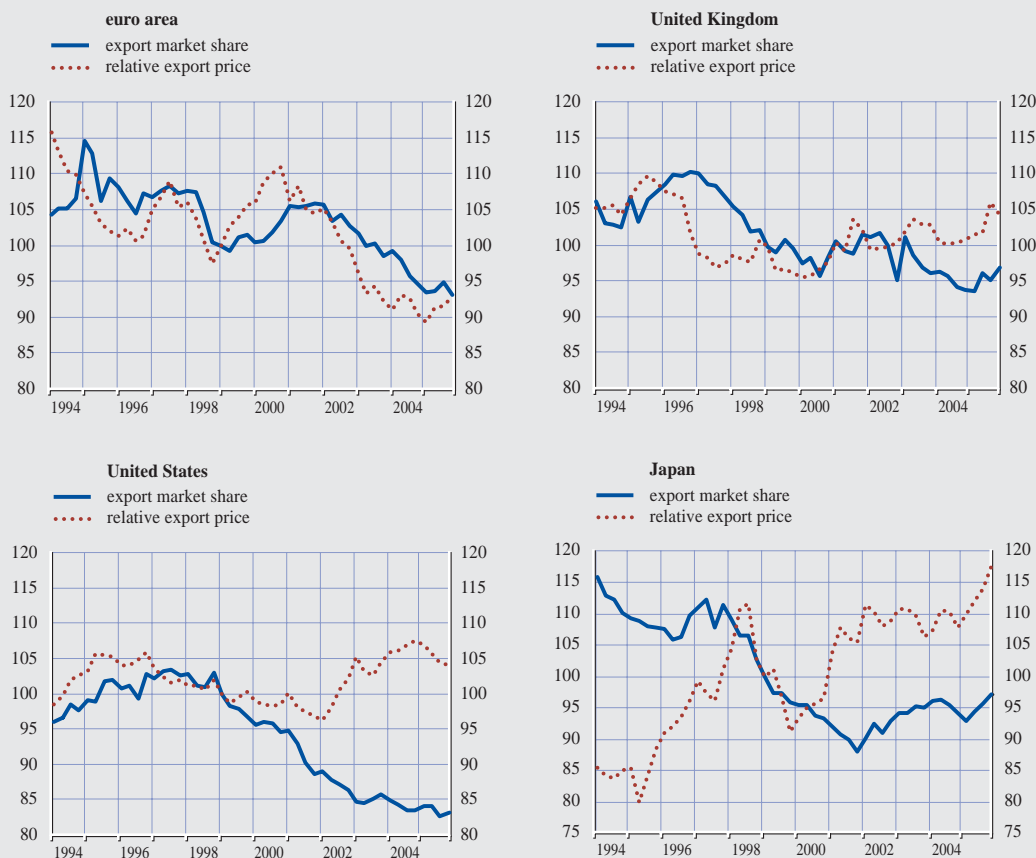
12 In this paper, we focus on relative export prices as a measure of price competitiveness, although there are many others, each having their own merits. More discussion on the relationship between changes in the nominal euro effective exchange rate and relative export prices as well as other measures of price competitiveness can be found in a previous Occasional Paper (see MPC Task force of ESCB (2005)).

13 See Abe (2003) for more detail on Japan's trade response to the increasing competition from China. Moreover, OECD (2002) finds a large increase in Japanese intra-firm trade with the rest of Asia and other countries over the 1990s.



Chart 6 Export price competitiveness and export market shares

(Index 1999 Q1 = 100)



Sources: Eurostat external trade statistics and national accounts, and ECB.

Note: Relative export prices equal a weighted average of competitor export prices divided by domestic export prices (an increase reflects a gain in price competitiveness). The real export market share is derived as the volume of exports divided by a weighted average of import volumes for major trading partners. Foreign demand and competitors' export prices are computed by the ECB.

Box 1

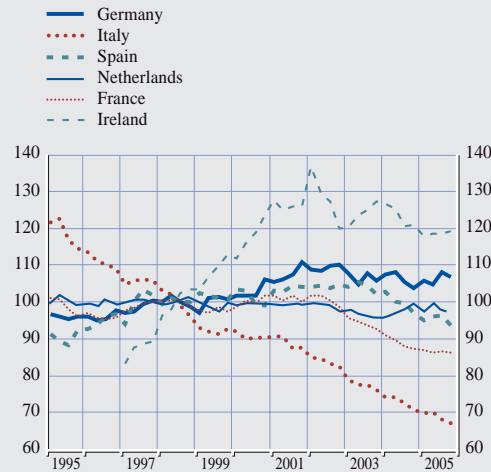
EXPORT MARKET SHARES AND EXPORT PRICE COMPETITIVENESS OF EURO AREA COUNTRIES

This box looks at export market shares in relation to their main determinant, price competitiveness, for the individual euro area countries.<sup>1</sup> For the euro area in aggregate, we had found that the export market share was relatively stable between 1994 and 2002, while some market share losses occurred thereafter. This is the result of a relatively diverse performance across euro area countries (Chart A). While Italy has experienced significant losses since 1995, as – to a lesser extent – has France, most other countries have held broadly stable export market shares or even increased them (particularly Ireland and Germany).

1 This Box draws on ECB (2006), in which the competitiveness and export performance of the euro area and of individual euro area countries is discussed in more detail.

**Chart A Export market shares, selected euro area countries**

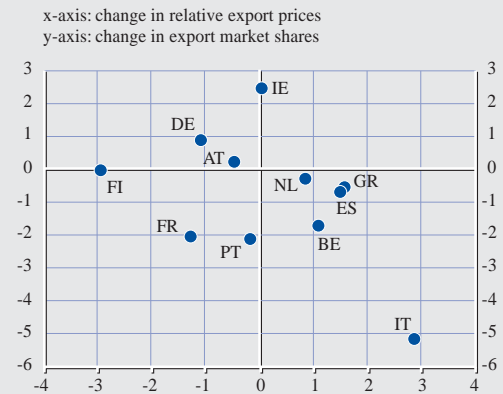
(index: 1998 = 100; quarterly data; seasonally adjusted)



Sources: Eurostat national accounts and ECB calculations  
Note: Last observation refers to the fourth quarter of 2005.

**Chart B Price competitiveness and export market shares across euro area countries**

(annual percentage changes)



Note: The data show average annual rates of change for the period 1998-2005. Price competitiveness is proxied by relative export prices corresponding to country export prices divided by competitors export prices. An increase in relative export prices implies a fall in competitiveness.

Chart B shows the relationship between export market shares and price competitiveness (measured here as relative export prices) across euro area countries. Differing movements in price competitiveness across euro area countries need to materialise through changes in actual costs and prices, as adjustments in nominal exchange rates are no longer possible within the euro area.<sup>2</sup> Focusing on the period since 1998, there appears to be a positive correlation between relative export prices and export market shares at the euro area country level. It appears that the export performance of Ireland has been relatively favourable given developments in relative export prices, whereas export market shares in France, Finland and Portugal have been lower than perhaps suggested by price developments, as price competitiveness has improved, but market shares have fallen nevertheless. Italy's large loss in export market share seems to be closely related to the substantial fall in its export price competitiveness. Overall, the correlation between changes in export market share and relative export prices is not particularly strong, however, suggesting that other determinants, such as non-price competitiveness, the different sectoral specialisation across countries and the different ways of adjusting to globalisation also influence export market shares at the country level.

<sup>2</sup> See ECB (2005) for a comprehensive discussion of inflation differentials within the euro area.

Against this background, one tentative way of assessing how much of the loss in euro area export market share may have been a consequence of China having recently become a new major player in world trade is to simply subtract world imports from China from the euro area foreign demand indicator.<sup>14</sup> Chart 7 shows that this does not change the dynamics of the euro area export market share before 1999,

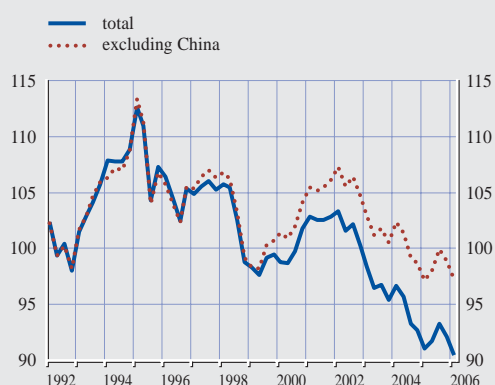
as China's trade growth was similar to growth in world trade in this period.

However, between 1999 and 2006, which corresponds to the period of rapid expansion of China's share in world trade, the euro area's market share loss is significantly smaller

<sup>14</sup> All calculations are made in constant prices from 2000.

**Chart 7 Euro area world export market shares, total and excluding China**

(volume index: 1992 = 100)



Source: ECB calculations.

if China is excluded. This indicates that the trade integration of China associated with globalisation may have been a prominent reason for the fall in the euro area export market share beyond export price competitiveness effects.

## 2.2 RECENT DEVELOPMENTS IN EXPORT SPECIALISATION

### 2.2.1 THE DATASET

The previous section has shown that structural factors, which could be associated with globalisation, seem to have exerted an influence on global trade. To further evaluate recent changes in the structure of euro area exports, we need to look at trends in sectoral specialisation. The aim is to compare these findings with respect to the trends expected on the basis of the standard comparative advantage framework outlined in Section 1, as well as with trends for major competitors. To do so, we use the CHELEM database of the Centre d'Etudes Prospectives et d'Informations Internationales (CEPII), which reports information on bilateral trade flows across countries for goods in value terms (in US dollars), broken down into 71 sectors.

For our purposes we use two distinct, but fairly complementary ways of aggregating and analysing the data:

- 1) a four-product group classification in accordance with the factor intensity of production; and
- 2) a 17-product group classification in accordance with technological intensity.

The first classification is intended to broadly test whether specialisations are in line with comparative advantages based on factor endowments. By contrast with the standard theoretical framework (which examines two production factors) we consider four factors of production, i.e. (i) raw materials (including energy-related goods), (ii) labour, (iii) physical capital and (iv) research. The export flow data based on the initial 71 sectors are thus aggregated into four product groups, depending on which of these factors of production the sectors mostly use. As an example, fertilizers fall in the predominantly raw materials-intensive category, while clothing is categorised as predominantly labour-intensive, cars are predominantly capital-intensive and aeronautics predominantly research-intensive. The classification methodology follows (with some modification) that undertaken by Yilmaz (2003), which builds on Hufbauer and Chilas (1974), and is described in Table A3 of Annex A.<sup>15</sup> A caveat that applies to this classification is that it is largely subjective and that some goods can be quite difficult to classify as their production may use several factors to a similar extent. Moreover, the results may be misleading if, for instance, a country focuses on the labour-intensive production stages of a predominantly research-intensive good.

The second classification aggregates the raw data into 17 sectors according to their technological content, using the breakdown in the OECD Science, Technology and Industry Scoreboard 2005. The classification establishes the technological content by ranking the 17 sectors by their R&D intensity, defined as R&D spending divided by production or value

<sup>15</sup> This classification is also applied in some recent trade policy papers, see for instance European Commission (2005).

added in 12 OECD countries. It is thus somewhat better founded than the first classification as it is more objective. Nevertheless, this classification also has caveats in that it is still quite broad, so that more finely disaggregated products or product stages within industries classified as high-technology may not actually require much R&D investment, while others in low-technology industries may be highly research-intensive. In this second breakdown, we exclude trade flows of energy-related products<sup>16</sup> in order to avoid distortions resulting from the highly volatile prices of oil and other energy-related products.

### 2.2.2 COMPARATIVE ADVANTAGE AND FACTOR INTENSITY

In order to assess whether the euro area<sup>17</sup> and its main competitors have an export specialisation broadly in accordance with their relative factor abundance, we use the first data classification mentioned above – four product groups – to construct an index of revealed comparative advantage (RCA). Following Balassa (1965), we compute the relative export specialisation of individual countries across the four product groups with respect to the world average as follows:

$$(1) \quad RCA_{k,i} = \frac{X_{k,i} / \sum_i X_{k,i}}{X_{w,i} / \sum_i X_{w,i}}$$

The numerator represents the percentage share of sector *i* in country *k*'s total exports, and the denominator corresponds to the percentage

share of sector *i* in total world exports. If  $RCA_{k,i} > 1$ , then country *k* is specialised in sector *i* relative to the world average. The normalisation by the world average share of exports by sector controls for cyclical changes in the world export structure; the RCA index can therefore be interpreted as a structural index of specialisation.

The results show that over the period 1993-2004, euro area exporters appear to have been specialising in predominantly capital and research-intensive, but also labour-intensive, categories of exports (see Table 2). The specialisation in the latter category does not seem to be fully in line with the capital/labour ratio of the euro area, which is much higher than in emerging economies. Partly, this reflects the export specialisation of some euro area countries in lower-tech sectors such as textiles and paper (for more information on the specialisation of individual euro area countries, see Box 3).<sup>18</sup>

By contrast, the three developed competitor economies considered – i.e. the United States, United Kingdom and Japan – have no revealed comparative advantage in labour-intensive

16 More precisely, we exclude trade flows related to the mining of coal, extraction of crude petroleum and natural gas, electricity, coke, refined petroleum products and nuclear fuel.

17 Unless otherwise indicated, we focus on extra-euro area trade flows in this paper.

18 Part of the explanation could also clearly relate to the relative arbitrariness of the classification by factor content, including the inability of this approach to take into account differences in skill levels (which could be relatively high in the euro area).

**Table 2 Revealed comparative advantage by factor intensity**

(Index<sup>1)</sup>; average 1993-2004)

Exports are predominantly	euro area	United States	United Kingdom	Japan	China	Other emerging Asia	CEECs
Raw materials-intensive	0.5	0.7	0.6	0.1	0.6	0.7	1.6
Labour-intensive	1.1	0.7	0.9	0.5	2.2	1.2	1.2
Capital-intensive	1.2	0.9	1.0	1.5	0.4	0.5	1.2
Research-intensive	1.1	1.4	1.2	1.4	0.9	1.3	0.5

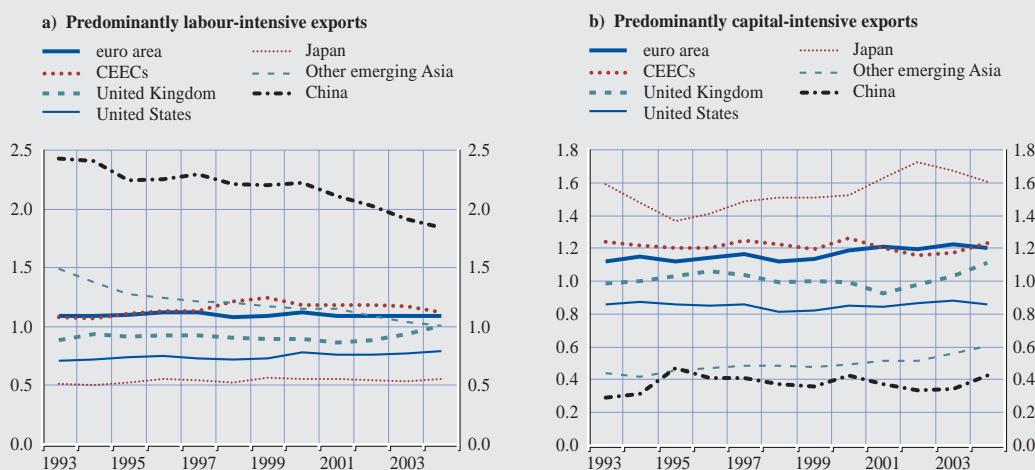
Sources: CHELEM and ECB calculations.

Note: Country and product groups are defined in more detail in Tables A1 and A3 in Annex A. Sectors are aggregated according to the extent to which they require each of the four factors of production.

1) Balassa index of revealed comparative advantage

Chart 8 Developments in revealed comparative advantages

(index; annual data)



Sources: CHELEM and ECB calculations.  
Note: Balassa index of revealed comparative advantage.

exports; they specialise in research-intensive products, in line with their relatively high R&D spending in relation to GDP. In addition to this, Japan is specialised in predominantly capital-intensive goods, reflecting its high capital/labour ratio as seen in Section 1.2. Unsurprisingly, China, but also other emerging Asia and the CEECs, have an export concentration in labour-intensive goods. The other emerging Asia countries are also specialised in research-intensive products. This is not the case for the CEECs, whose lack of revealed comparative advantage in research-intensive goods clearly reflects their low R&D investment shares. The CEECs have an export specialisation in predominantly capital and raw materials-intensive goods.

Overall, the sectoral export specialisation by factor intensity broadly reflects the countries' relative factor endowments. Most notably, on average, developing countries tend to specialise in exporting labour-intensive products, while capital and research-intensive exports are the main focus of developed economies.

The trade integration of the emerging countries should a priori have led to large changes through

time in comparative advantages and thus specialisation across countries in recent years. Chart 8 shows changes in revealed comparative advantages over time.

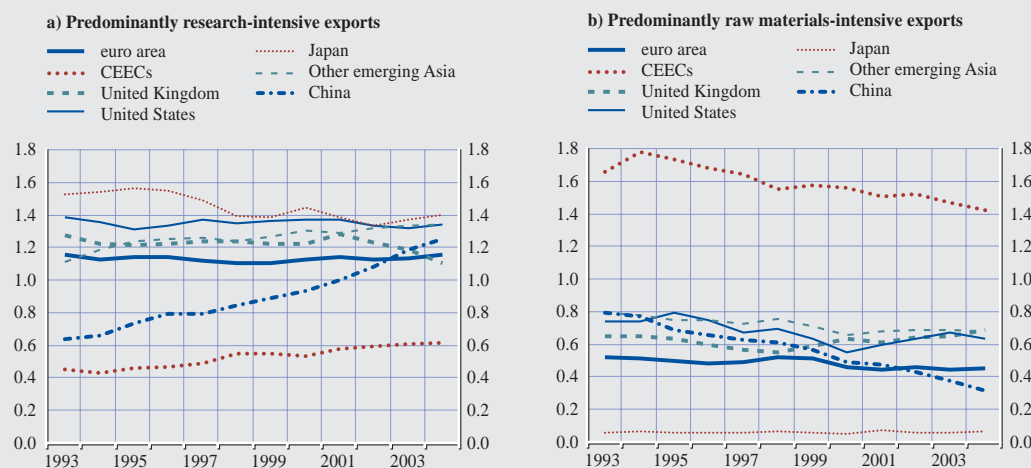
Overall, there have not been major changes in the specialisation in capital or labour-intensive goods, except for some decline in China's and other emerging Asia's specialisation in the latter category. It is striking, however, that the euro area's specialisation in labour-intensive goods exports has hardly moved since 1993, remaining relatively high despite the closer trade integration of the CEECs and emerging Asia. Other emerging Asia has in fact become, in relative terms, less specialised in labour-intensive exports than the euro area. Box 2 argues that this could reflect product and labour markets in the euro area being relatively protected compared with other developed economies, which may have sheltered the manufacturing sectors from competitive pressures, thus delaying potential adjustment processes in industry structures.

As for predominantly research-intensive products, the emerging countries seem to have extended their export specialisation, with a



## Chart 9 Developments in revealed comparative advantages

(index; annual data)



Sources: CHELEM and ECB calculations.  
Note: Balassa index of revealed comparative advantage

particularly sharp increase in China (Chart 9). This can be explained by the rising FDI flows that bring the technologies of developed countries to emerging market locations. Moreover, emerging economies, which are far behind in terms of technology than more developed countries, can often imitate technologies that have proven successful elsewhere. This enables them to avoid the risks and costs involved in innovation of their own and thus to enter research-intensive product markets more rapidly. Japan and the United States have broadly retained their already strong positions in this type of exports. By contrast, the euro area has only a relatively weak specialisation in research-intensive products and has not extended this over time, while the

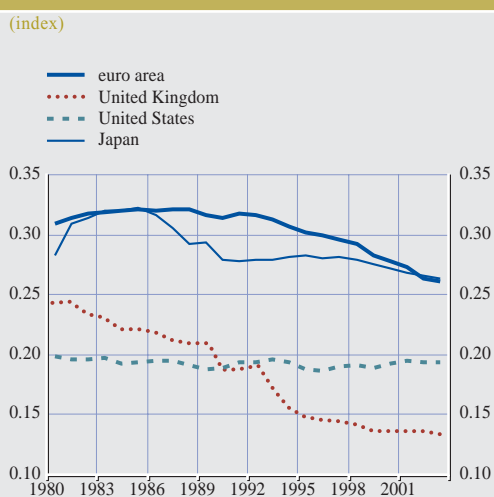
UK's specialisation in this product group has declined since 2001. Over the years, China and other emerging Asia have become more specialised in this product category than the euro area or the United Kingdom, possibly suggesting more competitive pressure for the developed economies in the future. Nevertheless the reader should bear in mind that the growing specialisation of China and other emerging Asia in research-intensive industries may be partly exaggerated. The classification used, which categorises broad industries such as "computer equipment" or "optics" as, overall, research-intensive sectors, is unfortunately unable to distinguish the presence of labour-intensive activities as a result of multinationals operating in these low-wage locations.

### Box 2

#### PRODUCT AND LABOUR MARKET REGULATION ACROSS DEVELOPED ECONOMIES

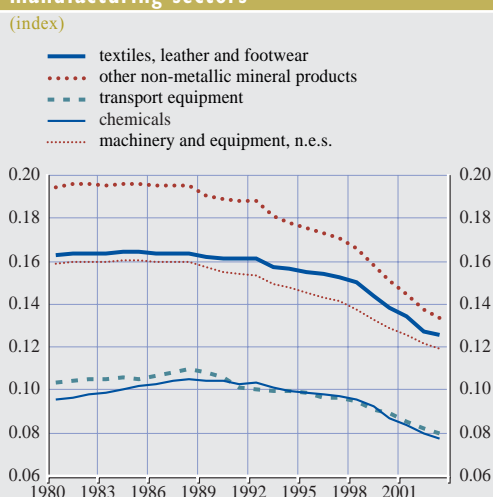
Excessive product and labour market regulation may slow down the process of adjustment to the forces of globalisation, by constraining firms' ability to react to a rapidly changing economic environment. In the face of competition-hampering product market regulation, firms may have fewer incentives to reorientate their production to new areas and may be discouraged from innovating. Moreover, the process of market entry and exit of firms may be slowed down,

**Chart A Regulation of goods and services markets across countries**



Sources: OECD and ECB calculations.

**Chart B Euro area product market regulation indices across selected manufacturing sectors**



Sources: OECD and ECB calculations.  
Note: n.e.s. stands for "not elsewhere specified".

leading to higher adjustment costs. Employment protection legislation may hinder the creation of new firms and their rapid expansion, while an excessive level of protection may decrease the ability of markets to adjust.

Chart A compares the extent of product market regulation in the manufacturing and services sectors in the euro area with that in the United States, the United Kingdom and Japan, based on an index of product market regulation compiled by the OECD. While it is not possible to gauge the amount of "excessive" regulation, these data suggest that product markets are substantially more regulated in the euro area than in the United States or the United Kingdom, probably making them more insulated from competitive forces. However, since 1992 there has been an increase in the tendency towards deregulation, in part likely to be related to the single European market.

Of the manufacturing sectors, transport equipment and chemicals (including pharmaceuticals) are the most deregulated, see Chart B. The most protected sector is that of other non-metallic mineral products.

**Table Summary index of the strictness of employment protection legislation**

	Late 1980s	Late 1990s	2003
euro area	2.9	2.5	2.3
Germany	3.2	2.5	2.2
France	2.7	3.0	3.0
Italy	3.6	2.7	1.9
United Kingdom	0.6	0.6	0.7
United States	0.2	0.2	0.2

Source: OECD Employment Outlook (2004)

Employment protection legislation is also stricter in the euro area than in the United Kingdom or the United States (see Table). Protection has fallen somewhat in Germany and Italy since the late 1980s, but remains broadly unchanged in France. Overall, while this evidence is very tentative, the lower degree of flexibility of product and labour markets in the euro area could suggest that further adjustments in industry and export structures are to be expected, in particular in

the most regulated sectors.<sup>1</sup> As the nature and the duration of adjustment costs are determined by the flexibility of the economy to respond to shocks, this calls for further deregulation of euro area product and labour markets in order to keep transitional losses to a minimum.

<sup>1</sup> As regards the industrial structure of the EU, this conclusion is corroborated by van Ark (2005), who confirms that the adjustment process towards a new industrial structure has developed more slowly in the EU than in the United States.

### 2.2.3 SPECIALISATION BY SECTOR ACCORDING TO TECHNOLOGY CONTENT

This section focuses on the more detailed second classification outlined above, which adds useful additional information on technology intensity across export sectors by examining their research content. This breakdown helps to further highlight the strengths and shortcomings of the euro area's export specialisation, by allowing us to assess how changes in export specialisation are related to the dynamism of world imports and to productivity growth differentials in different sectors across economies.

We first turn to a sectoral assessment of the dynamism and volatility of world import demand, which we will then relate to the export specialisation

across countries. Table 3 shows that there are large differences in the growth rates of world imports and their volatility across sectors. On average over the period 1993-2004, the most dynamic sector of world demand was the pharmaceutical sector (though starting from a relatively small base at around 3% of world imports), followed by electronics and communications equipment and office and computing machinery.<sup>19</sup> These three sectors grew by an average of above 10% per annum and, according to the OECD (2005) classification, all have a high technological content. The coefficient of variation (defined as

<sup>19</sup> As these data are measured in value terms, and given the generally falling prices of ICT goods, the rise in world trade in ICT goods in volume terms may have been growing at even faster rates.

**Table 3 Summary statistics on world imports by sector**

(average 1993-2004, unless otherwise specified)

	Average growth %	Standard deviation	Coefficient of variation Index	Share of world imports %
<i>High-technology industries</i>	10.0	7.9	0.8	22.8
Aircraft and spacecraft	4.3	10.6	2.5	1.8
Pharmaceuticals	15.1	7.6	0.5	3.3
Office, accounting and computing machinery	10.2	9.0	0.9	5.5
Electronics and communications equipment	11.9	13.0	1.1	8.8
Medical, precision and optical instruments	7.9	10.1	1.3	3.4
<i>Medium-high-technology industries</i>	7.6	8.3	1.1	35.5
Electrical machinery and apparatus	9.3	9.4	1.0	5.1
Motor vehicles, railroad and transport equipment	7.5	7.3	1.0	10.9
Chemicals excluding pharmaceuticals	7.9	9.5	1.2	6.7
Machinery and equipment, n.e.s.	7.1	9.1	1.3	12.7
<i>Medium-low-technology industries</i>	8.3	12.2	1.5	14.5
Building and repairing of ships and boats	7.4	7.9	1.1	0.8
Rubber and plastic products	8.8	9.9	1.1	4.4
Other non-metallic mineral products	5.6	8.2	1.5	1.5
Basic metals and fabricated metal products	8.9	15.8	1.8	7.7
<i>Low-technology industries</i>	5.8	7.2	1.2	27.3
Wood, pulp, paper and paper products	6.1	11.4	1.9	3.0
Agriculture, food products, beverages and tobacco	4.6	8.8	1.9	9.1
Textiles, clothing and footwear	4.8	6.8	1.4	6.9
Not elsewhere specified products (n.e.s.)	9.2	11.5	1.3	8.3
<b>Total</b>	<b>7.6</b>	<b>8.0</b>	<b>1.1</b>	<b>100.0</b>

Sources: CHELEM and ECB calculations.

Table 4 Balassa index of revealed comparative advantage across regions

(index, average 1993-2004, based on USD values)

	euro area	USA	United Kingdom	Japan	China	Other emerging Asia	CEECs
<i>Memo item:</i>							
<i>Share in total world exports of goods</i>	17.5	12.0	5.0	8.6	4.4	11.7	5.3
<i>High-technology industries</i>							
Aircraft and spacecraft	<b>1.1</b>	<b>3.2</b>	<b>2.5</b>	0.2	0.1	0.2	0.3
Pharmaceuticals	<b>1.6</b>	0.9	<b>2.0</b>	0.3	0.4	0.2	0.5
Office, accounting and computing machinery	0.7	1.0	<b>1.4</b>	<b>1.4</b>	<b>1.4</b>	<b>2.5</b>	0.2
Electronics and communications equipment	0.7	1.1	0.9	<b>1.7</b>	<b>1.1</b>	<b>2.5</b>	0.3
Medical, precision and optical instruments	<b>1.1</b>	<b>1.7</b>	<b>1.2</b>	<b>1.7</b>	0.9	0.7	0.3
<i>Medium-high-technology industries</i>							
Electrical machinery and apparatus	1.0	1.0	0.9	<b>1.5</b>	<b>1.4</b>	<b>1.1</b>	1.0
Motor vehicles, railroad and transport equipment	<b>1.1</b>	0.9	0.8	<b>1.9</b>	0.2	0.4	0.7
Chemicals excluding pharmaceuticals	<b>1.3</b>	<b>1.2</b>	<b>1.2</b>	0.8	0.6	0.6	1.0
Machinery and equipment, n.e.s.	<b>1.4</b>	<b>1.2</b>	1.0	<b>1.4</b>	0.6	0.6	0.9
<i>Medium-low-technology industries</i>							
Building and repairing of ships and boats	1.0	0.3	0.5	<b>2.9</b>	0.9	<b>1.8</b>	<b>1.4</b>
Rubber and plastics products	1.0	1.0	0.8	0.8	0.7	1.0	0.9
Other non-metallic mineral products	<b>1.2</b>	0.7	0.8	0.7	<b>1.4</b>	0.6	<b>1.9</b>
Basic metals and fabricated metal products	0.7	0.6	0.7	0.8	0.5	0.7	<b>2.6</b>
<i>Low-technology industries</i>							
Wood, pulp, paper and paper products	1.0	1.0	0.8	0.2	0.4	0.7	<b>1.1</b>
Agriculture, food products, beverages and tobacco	0.8	1.0	0.7	0.1	0.8	0.7	<b>1.1</b>
Textiles, clothing and footwear	0.9	0.4	0.5	0.2	<b>3.6</b>	<b>1.7</b>	<b>1.5</b>
Not elsewhere specified products (n.e.s.)	<b>1.1</b>	0.8	<b>1.4</b>	0.7	<b>1.1</b>	0.7	<b>1.1</b>

Sources: CHELEM and ECB calculations

Notes: A value higher than 1 (marked in bold) indicates a comparative advantage in that sector. Euro area exports exclude intra-euro area trade. Total exports exclude exports of energy-related products. For a list of the countries included in each geographical area, see Annex A.

the standard deviation of annual growth of world imports by sector, normalised by the average growth of world imports in the respective sector) shows that the volatility of import growth for these sectors (in particular pharmaceuticals) was also among the lowest over the 1993-2004 period. After the 2000 recession, however, world import demand for information and communication technology (ICT) goods fell sharply (though it recovered in 2003-04), suggesting that a specialisation in these sectors could perhaps explain weaknesses in export performance in recent years.

In contrast to these rapidly growing industries, world demand in four sectors – including aircraft and spacecraft; agriculture, fishing, food, beverages and tobacco; textiles, clothing and footwear; and other non-metallic mineral products – has grown at only around half this rate. Three of these sectors have either a low or

medium-low technological content. Moreover, these sectors were also more prone to fluctuations over time in the 1993-2004 period. Overall, it seems that import demand in most high-tech sectors is faster growing and more stable than in low-tech sectors, aside perhaps from the aftermath of the 2000 recession.

Against this background, how does the euro area export sector fare in the most dynamic sectors of world demand? Table 4 shows the Balassa index of the euro area's revealed comparative advantage in the 17 sectors of the technology classification in comparison with its main developed and emerging market competitors (for a discussion of export specialisation across individual euro area countries, see Box 3). Three key stylised facts emerge, some of which can provide an explanation as to why the euro area's export

market share has held up relatively well vis-à-vis the other large developed economies (as seen in Charts 5 and 6 above). First, on average, the euro area specialises in medium-tech industries, most notably motor vehicles, railroad and transport equipment; chemicals; and machinery and equipment – all sectors in which imports are growing at a rate close to the world average. As for high-tech industries, the euro area tends to have an uneven record, as it concentrates on just a few of these sectors (two of which, i.e. pharmaceuticals, and medical, precision and optical instruments, are among the fastest-growing sectors of world demand, however). In others, such as computers and electronics, it has a low revealed comparative advantage, which perhaps explains why the euro area has not suffered as much of a loss in export market share following the bursting of the ICT bubble in 2000. Moreover, its specialisation in medium-low and low technology industries is also relatively weak.

Second, the Balassa indices computed for the euro area (except perhaps for pharmaceuticals) are relatively close to the index for all sectors, suggesting that the specialisation is spread fairly evenly across industries. This could reflect the fact that, as a relatively large region, the euro area has a more diversified production and export structure than other countries, thus leading to an exhaustion of economies of scale for a larger number of industries. The advantage of this more diversified production structure would be that the euro area is perhaps less

strongly affected by a downturn in demand in any single sector than other economies. But such a structure to some extent also reflects different specialisations of individual euro area countries (see Box 3), which could pose the risk of asymmetric shocks in the event of a downturns in particular sectors.

Third, the revealed comparative advantages of the euro area are largely concentrated in sectors where the emerging market competitors are still relatively weak. The latter have mainly entered low and medium-low technology sectors (more specifically textiles, clothing and footwear and basic metals and fabricated metal products as well as other non-metallic mineral products). Emerging Asia is also specialised in electrical machinery and apparatus – the only medium-tech sector on which euro area exports are not strongly focused – and the ICT-related sectors. The euro area thus stands in sharp contrast to other developed economies, which may on average be more exposed to competition from the Asian emerging countries in the ICT sectors.

This is not to say that competition in sectors of traditional euro area stronghold may not become more intense in the future, however. Indeed, the export specialisation of the CEECs, and to a lesser extent also emerging Asia, has already started to increase over the past decade in the medium-high-tech sectors motor vehicles and transport equipment as well as other machinery and equipment, albeit to a generally smaller extent than for the high-tech sectors.

### Box 3

#### EXPORT SPECIALISATION OF EURO AREA COUNTRIES

The export specialisation of the euro area as a whole hides considerable differences between individual euro area economies. The euro area's overall strong specialisation in medium-high-tech exports can largely be explained by the export structures of Germany, France and Italy, which all have their strongest specialisation in medium-high-tech sectors. Some countries, however, are much more specialised in high-tech goods than the euro area average and have benefited from the change in the composition of world trade towards more high-tech products: these include Ireland and the Netherlands. Within high-tech goods, both countries have a revealed comparative advantage in exports of pharmaceuticals; medical, precision and optical



Table Export specialisation by euro area country and export sector

(Balassa index of revealed comparative advantage)

	HEA <sup>1)</sup>	of which: DE	FR	IT	NL	ES	IR	B/LUX	FI	AU	PT	GR
<i>Memo item:</i>												
<i>Share in total world exports</i>	30.8	0.5	0.3	0.8	0.2	0.2	0.0	0.3	0.0	0.1	0.1	0.0
<b>High-technology industries</b>	<b>0.7</b>	<b>0.7</b>	<b>1.0</b>	<b>0.5</b>	<b>1.1</b>	<b>0.4</b>	<b>1.9</b>	<b>0.5</b>	<b>0.9</b>	<b>0.5</b>	<b>0.4</b>	<b>0.3</b>
Aircraft and spacecraft	0.8	0.6	2.6	0.4	0.3	0.5	0.2	0.2	0.1	0.2	0.2	0.4
Pharmaceuticals	1.4	1.3	1.7	1.1	1.2	0.9	4.4	1.9	0.3	1.4	0.4	0.9
Office, accounting and computing machinery	0.7	0.5	0.5	0.3	1.9	0.3	3.8	0.3	0.4	0.2	0.2	0.1
Electronics and communications equipment	0.5	0.5	0.6	0.3	0.8	0.3	0.8	0.4	1.7	0.5	0.6	0.2
Medical, precision and optical instruments	0.9	1.2	0.8	0.7	1.2	0.4	1.1	0.4	0.8	0.7	0.3	0.2
<b>Medium-high-technology industries</b>	<b>1.2</b>	<b>1.4</b>	<b>1.1</b>	<b>1.2</b>	<b>0.8</b>	<b>1.3</b>	<b>0.8</b>	<b>1.0</b>	<b>0.8</b>	<b>1.2</b>	<b>0.9</b>	<b>0.4</b>
Electrical machinery and apparatus	0.9	1.1	0.9	0.7	0.6	0.8	0.6	0.5	1.1	1.3	1.4	0.5
Motor vehicles, railroad and transport equipment	1.2	1.6	1.3	0.8	0.5	2.3	0.1	1.4	0.4	1.0	1.2	0.1
Chemicals excluding pharmaceuticals	1.2	1.2	1.4	0.6	1.5	0.8	3.1	1.5	0.7	0.5	0.5	0.6
Machinery and equipment, n.e.s.	1.2	1.5	1.0	1.9	0.6	0.9	0.3	0.6	1.0	1.7	0.7	0.4
<b>Medium-low-technology industries</b>	<b>1.0</b>	<b>1.0</b>	<b>1.0</b>	<b>1.1</b>	<b>1.0</b>	<b>1.2</b>	<b>0.2</b>	<b>1.4</b>	<b>1.2</b>	<b>1.2</b>	<b>0.8</b>	<b>1.5</b>
Building and repairing of ships and boats	0.6	0.5	0.6	1.0	0.5	1.3	0.0	0.1	2.9	0.1	0.4	0.8
Rubber and plastics products	1.3	1.3	1.2	1.1	1.6	1.2	0.3	2.0	0.7	1.2	0.8	0.8
Energy products	1.1	1.0	0.0	1.1	1.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Other non-metallic mineral products	1.3	0.9	1.1	2.3	0.7	2.4	0.5	1.4	0.9	1.5	2.5	3.0
Basic metals and fabricated metal products	0.9	0.8	0.9	0.7	0.8	0.9	0.1	1.3	1.3	1.3	0.5	1.7
<b>Low-technology industries</b>	<b>1.0</b>	<b>0.7</b>	<b>0.9</b>	<b>1.2</b>	<b>1.2</b>	<b>1.0</b>	<b>0.9</b>	<b>1.1</b>	<b>1.2</b>	<b>1.0</b>	<b>1.6</b>	<b>2.0</b>
Wood, pulp, paper and paper products	1.2	1.0	1.0	0.8	0.9	1.1	0.3	1.0	7.8	2.4	2.8	0.5
Agriculture, food, beverages and tobacco	1.0	0.5	1.3	0.7	2.2	1.6	1.2	1.0	0.7	0.7	0.8	3.1
Textiles, clothing and footwear	0.9	0.5	0.7	2.1	0.6	0.9	0.2	0.9	0.2	0.8	3.6	2.9
Not elsewhere specified products (n.e.s.)	0.9	1.1	0.5	1.0	0.6	0.5	1.3	1.6	0.3	1.1	0.3	0.5

Sources: CHELEM and ECB calculations.

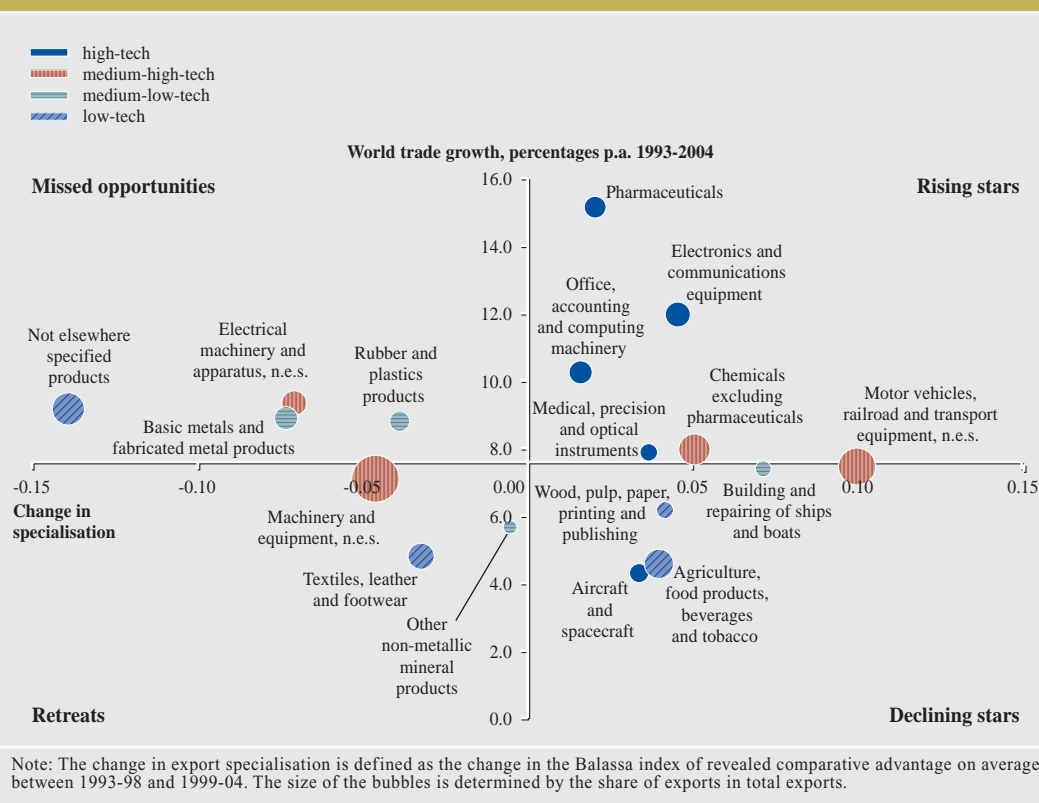
1) EA stands for euro area. In this table, it includes intra- and extra-euro area exports.

instruments; and office, accounting and computing machinery, although in the case of the Netherlands, the specialisation in latter sector may largely reflect re-exports, as the Netherlands is an important logistical centre for ICT exports to other European countries.

Countries with predominantly low-tech export specialisations include Greece and Portugal. The specialisation of these countries is particularly strong in the export of textile products. In this context, Italy – in addition to its specialisation in medium-high-tech products – also stands out as being relatively specialised in low-tech sectors, largely due to its large textile export sector. Unless these countries are able to differentiate their products and exploit high-end markets for textiles, it may happen that these sectors will decline over time in the face of strong competition from exporters in countries with lower labour costs.

The highest specialisation index in any given sector occurs for Finland, which is strongly specialised in the production of wood, pulp, paper and paper products. This can be explained by forestry being the country's most important natural resource and by the fact that this industry cluster is exploiting economies of scale.

Chart 10 Change in euro area specialisation and world trade growth



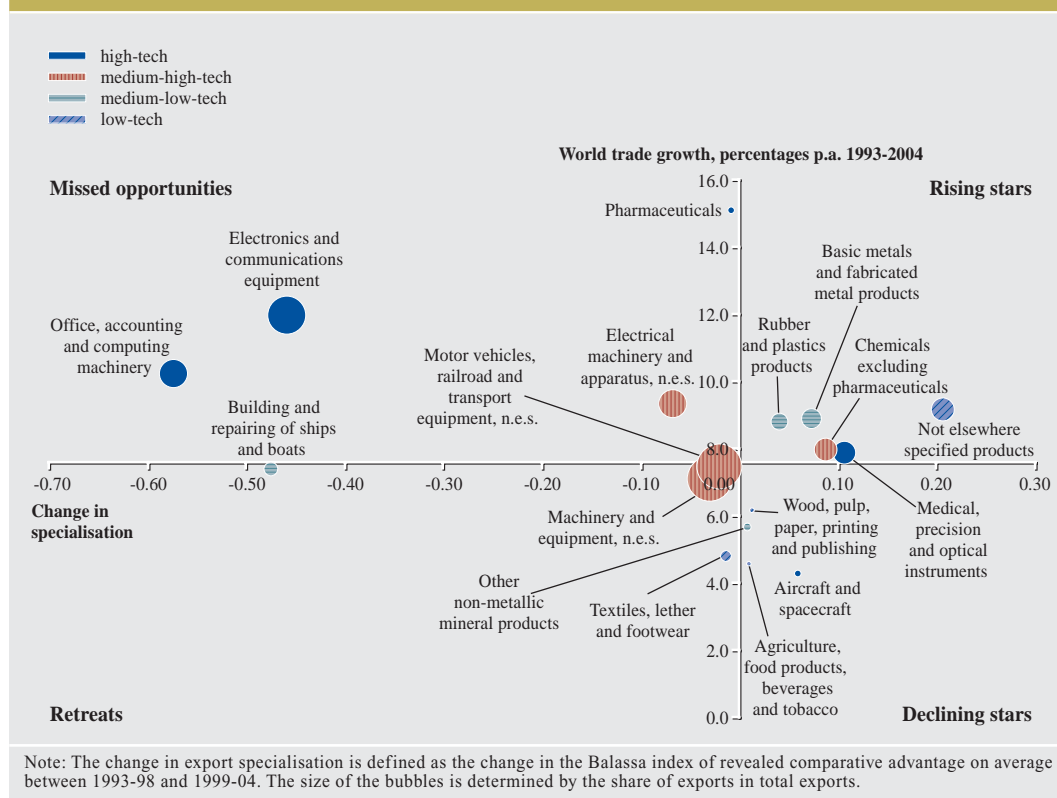
In what follows we aim to gauge whether the sectoral specialisation of the euro area is moving into the most dynamic sectors of world demand, and how it compares with the sectoral specialisation of its competitors. Charts 10 to 13 thus bring together evidence on recent changes in export specialisation across countries in the last few years and the development of world import growth for the main sectors.<sup>20</sup> Using as a discrimination criterion the growth of world imports in a specific sector vis-à-vis the average total world import growth of 7.6%, we can distinguish sectors of increasing specialisation as “rising stars” or “declining stars”, depending on whether they are growing at, respectively, higher or lower rates than world trade average. Alternatively, they are defined as “missed opportunities” or “retreats”, when a falling specialisation in a sector is associated with, respectively, higher or lower import growth than the world average.

Comparing two periods in time (1993-98 and 1999-2004) it would appear that among the fastest-growing sectors of world demand, the euro area has increased its specialisation in pharmaceuticals; electronics and communications equipment; as well as in office, accounting and computing machinery; medical, precision and optical instruments; and chemicals, albeit all to a relatively small extent.<sup>21</sup> These developments would appear to augur well for euro area prospects as all such sectors are intensive in high or medium-high technology and have relatively dynamic world demand, which

20 These charts are based on charts produced by the International Trade Centre, see <http://www.intracen.org/>.

21 This finding mirrors earlier findings by the Monetary Policy Committee (MPC) task force of the European System of Central Banks (ESCB) (2004) that the sectoral specialisation of European production had only experienced relatively small changes in over time, and, when changes in specialisation occurred, they happened relatively slowly. The paper found that the speed of reallocation of resources across value added sectors was higher in the United States than in the EU.

Chart 11 Change in Japan's specialisation and world trade growth



suggests that the euro area is trying to adapt to changes in the competitive environment. At the same time, however, their relative weights in total exports are mostly fairly modest, as illustrated by the size of the bubbles in the chart. The euro area is retreating, by contrast, in some products of lower technological content such as textiles, non-metallic mineral products and machinery and equipment, the latter still representing still a large share of total exports, therefore signalling the likelihood of persistent adjustment costs in the future.

As a comparison, Japan seems to be following a different adjustment strategy, largely retreating from most fast-growing high-tech sectors. One explanation for this is that Japan is off-shoring some of the production of these goods to other Asian countries, which are then used as export platforms.<sup>22</sup> Meanwhile, market share losses in the medium-high-tech goods category, which forms the most important sector for Japan in

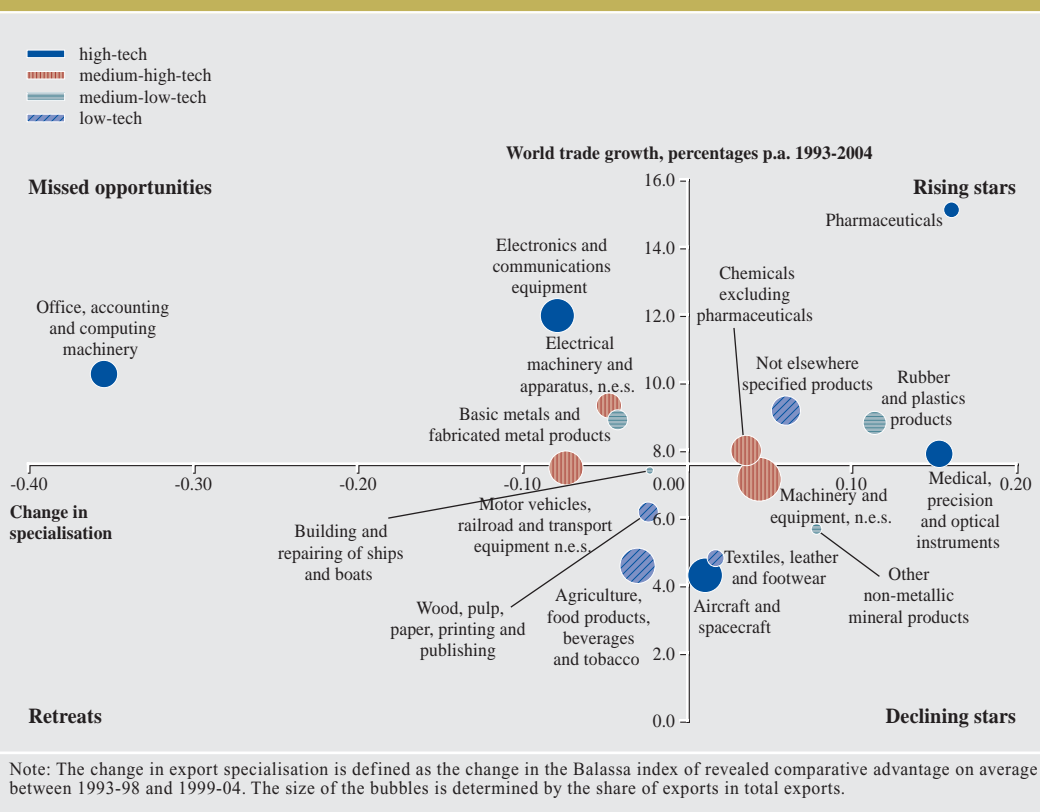
terms of size, have been relatively contained. Interestingly, Japan has increased its export specialisation in some of the fast-growing low-tech products in the rubber and plastic products and basic and fabricated metal products industries.

The United States and the United Kingdom<sup>23</sup> are also retreating from their specialisation in the ICT sector, where competition from emerging Asia is likely to be intense and may have squeezed profit margins. By contrast, both

22 See Abe (2003).

23 This result stands somewhat in contrast with the findings of Buisan et al (2006), which indicate that the United Kingdom has increased its export market share in office machinery and computers as well as radio, TV and communications equipment in volume terms. These results can be reconciled by the fact that the rise in the export market share of ICT goods in volume terms can largely be explained by a fall in relative export prices of these goods, see Buisan et al (2006); our results, by contrast, are based on values data, thus hiding developments in volumes versus relative prices.

Chart 12 Change in the United States' specialisation and world trade growth



countries have increased their specialisation in the fast-growing high-tech pharmaceutical sector and in chemicals, and the United States additionally in medical, precision and optical instruments as well as rubber and plastic products – the latter a relatively dynamic sector of lower technological content.

#### 2.2.4 EXPORT SPECIALISATION AND PRODUCTIVITY GROWTH

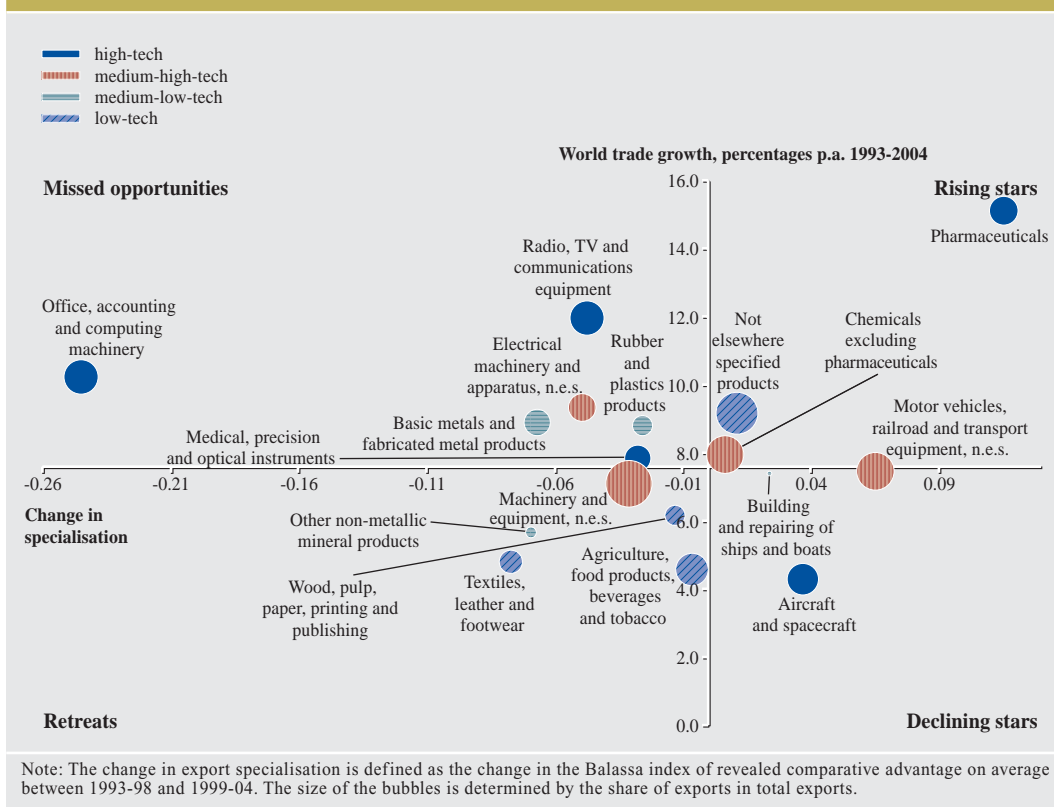
A further benchmark we use to assess adjustments in euro area trade is whether the euro area is increasingly specialising in the sectors where productivity growth is strong. Fast productivity growth allows firms to compete internationally and increase their exports, as productive firms tend to choose to export. Clerides et al. (1998) model the interaction between exports and productivity, considering sunk costs of entry into foreign markets.<sup>24</sup> In their model, only the relatively

productive firms will choose to pay the costs to enter foreign markets; less productive firms cannot recover them, not being able to compete with their more productive competitors. There is also a large empirical literature on the relationship between exports and productivity. The evidence generally supports the hypothesis that exporting producers are more productive than non-exporters, with most evidence pointing to a causal link from productivity to exports via the choice of more efficient producers to engage in exporting.<sup>25</sup>

24 They include in particular: (i) costs associated with gaining an understanding of the foreign market and the competition therein; (ii) the cost of adjusting product characteristics and (iii) marketing costs.

25 Evidence of a link between productivity and exporting in the other direction (i.e. based on the idea that exporters acquire knowledge, technology and skills that increase productivity) is more mixed. See Bernard and Jensen (2001), Marin (1992), Kunst and Marin (1989), Proudman and Redding (1998), Clerides et al. (1997) among others.

Chart 13 Change in the United Kingdom's specialisation and world trade growth



In this section, we thus evaluate first whether euro area exporters are specialised in the sectors with the strongest productivity growth and second, whether they have increased their specialisation in those sectors where productivity growth is high relative to other large developed economies,<sup>26</sup> while moving out of sectors where productivity growth is relatively weak. Ideally, one should look at estimates of total factor productivity, controlling for the quality of labour and abstracting from capital deepening. At a sectoral level, total factor productivity is inherently difficult to measure, however, a reason for which we focus on labour productivity (which implicitly assumes homogeneous skills and which can be influenced by changes in the capital/labour ratio), defined as value added per employee.<sup>27</sup>

As shown by Chart 14, the euro area largely specialises in export sectors with high

productivity growth overall. Notably, for pharmaceuticals and other chemicals, motor vehicles and transport equipment and other machinery and equipment goods – the sectors of strongest revealed comparative advantage – productivity growth is relatively high in relation to other sectors.<sup>28</sup>

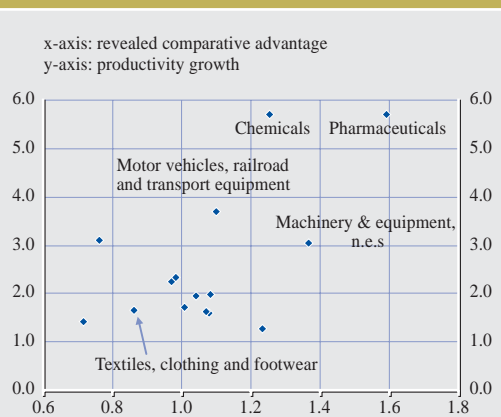
Turning to the cross-country comparison, although, as widely known, whole-economy labour productivity growth in the euro area has

26 Ideally, we would also like to compare euro area productivity growth with that in developing economies but are prevented from doing so by data limitations.

27 The productivity data used are from the Groningen Growth and Development Centre, 60-Industry Database, October 2005. Deflators for industry or region aggregates are computed using the Tornqvist index. For the methodology, see GDDC <http://www.ggdc.net>.

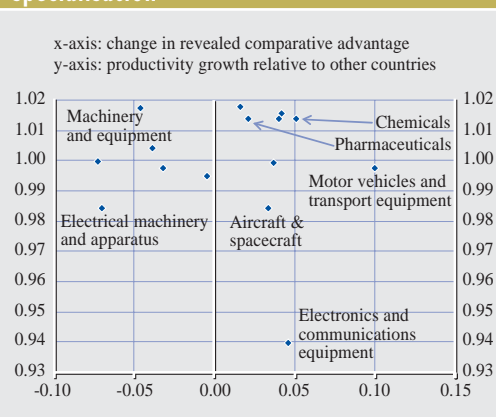
28 In this chart, we exclude office, accounting and computing machinery as well as electronics and communications equipment, for which productivity growth was much higher in all countries than for other sectors.

**Chart 14 Euro area sectoral productivity growth and export specialisation**



Sources: Groningen Growth and Development Centre, 60-Industry Database, October 2005, and ECB calculations.  
Note: Productivity growth is for the period 1993-2003 and the index of revealed comparative advantage for 1993-2004.

**Chart 15 Euro area relative sectoral productivity growth and change in export specialisation**



Sources: Groningen Growth and Development Centre, 60-Industry Database, October 2005, and ECB calculations.  
Notes: The change in revealed comparative advantage is measured as the absolute change in the Balassa index between 1993-98 and 1999-2004. Relative productivity growth (average 1993-2003) is measured as an index, where 1 is the average of all four developed economies, with an index value greater than 1 (smaller than 1) denoting higher (lower) than average productivity growth.

lagged behind that of the United States in the last decade, in some sectors productivity growth was relatively strong in the euro area during 1993-2003 compared with the United States, United Kingdom and Japan (see Table 5).<sup>29</sup> These include chemicals and pharmaceuticals;<sup>30</sup> medical precision and optical instruments; motor vehicles and transport equipment; machinery and equipment; wood and paper products; as well as agricultural and food products. In all of these sectors except for machinery and equipment, the euro area has increased its export specialisation. However, the increase in export specialisation in some of the high-tech industries – including aircraft and spacecraft, as well as electronics and communication equipment – cannot be explained by higher productivity growth.

Chart 15 summarises this information for the euro area: it shows that, overall, the relationship between relative sectoral labour productivity growth and changes in export specialisation – between 1993-98 and 1999-2004 – is very weak. While there is evidence that the euro area has increased its focus on some export sectors in

which productivity growth is high, this is not true for all sectors. In part, the weakness of this relationship may be due to the aggregate nature of these data, which obviously cannot take into account the considerable heterogeneity of firms within the same sector.<sup>31</sup>

### 2.3 EURO AREA EXPORTS – SUMMARY

This section has shown that over the past decade, structural factors that could be associated with globalisation have had an impact on global export market shares. An analysis of exports by factor intensity shows that the euro area's specialisation is relatively balanced and evenly distributed over predominantly capital-intensive, research-

29 For a comparison of labour productivity growth between Europe and the United States, see for instance van Ark (2005).

30 No breakdown is available to allow a separate analysis of these two sectors.

31 Recent trade literature has increasingly pointed out that firm heterogeneity within sectors is often as large as that across sectors. In particular, Bernard et al. (2003) show that within about 450 four-digit sectors, firms one standard deviation away from the median firm are 66% more productive than the median firm, while the dispersion of firms across sectors is only very slightly higher.



**Table 5 Sectoral labour productivity growth in the developed economies**

(average annual percentage change over the period 1993-2003, unless otherwise specified)

	euro area	United States	United Kingdom	Japan
Aircraft and spacecraft	1.6	0.4	4.3	6.5
Pharmaceuticals and chemicals	5.7	4.2	4.7	2.4
Office, accounting and computing machinery	75.4	83.8	82.4	47.6
Radio, TV and communications equipment	22.9	40.8	22.5	37.0
Medical, precision and optical equipments	2.0	1.6	3.5	1.2
Electrical machinery and apparatus	2.2	4.7	-0.1	8.8
Motor vehicles, trailers, railroad and transport equipment	3.7	4.9	1.8	5.3
Pharmaceuticals and chemicals	5.7	4.2	4.7	2.4
Machinery and equipment	3.0	1.6	2.2	-1.8
Building and repairing of ships and boats	1.7	1.9	11.3	11
Rubber and plastic products	2.0	4.3	0.4	-0.4
Other non metallic mineral products	1.3	2.3	2.5	1.1
Basic metals and fabricated metal products	1.4	3.1	1.0	0.3
Wood, pulp, paper products, printing and publishing	2.3	-0.5	0.7	0.5
Agriculture, fishing, food, beverages and tobacco	3.1	0.8	1.9	1.0
Textiles, textile products, leather and footwear	1.6	4.8	2.8	-1.7
Not elsewhere specified products	1.6	2.2	-0.9	2.1

Sources: Groningen Growth and Development Centre, 60-Industry Database, October 2005 and ECB calculations.

Note: For Japan, the average of labour productivity growth is for the period 1993-2002 due to the unavailability of data.

intensive and labour-intensive goods, the latter in contrast to other developed economies. Moreover, this relatively high labour-intensive export specialisation has not fallen in recent years despite the fact that labour-abundant countries such as China are increasingly penetrating world trade markets. On the basis of the traditional theories of comparative advantage, this would suggest that more adjustment in euro area export structures may be likely. On a more positive note, this relative specialisation of the euro area in industries broadly classified as labour-abundant might partly indicate that euro area producers use their endowment advantage over low-wage countries to produce vertically superior varieties of a good at higher prices. To our knowledge there is not yet empirical evidence for the extent to which this happens in the euro area, however some recent studies show that this is a prevailing strategy among US producers. Bernard et al. (2003), for instance, find that, within industries, US firms tend to reallocate production away

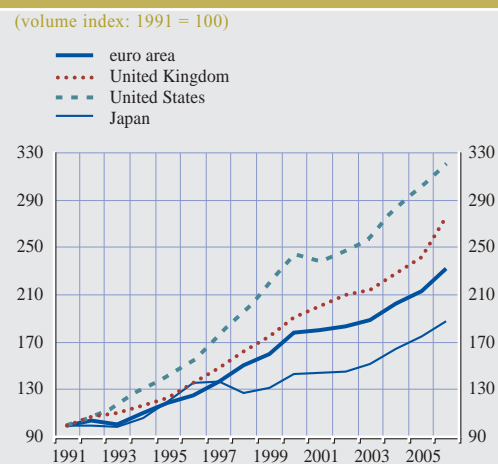
from labour-intensive plants into capital-intensive plants as import competition rises.

A more detailed breakdown of exports into 17 sectors has shown that, while its main focus is on medium-tech products, the euro area also specialises in some of the fast-growing dynamic sectors of world demand, such as pharmaceuticals. The specialisation in some slower-growing sectors, however, such as aircraft and spacecraft and non-metallic mineral products, is also quite strong. Overall, the euro area does not have an extreme specialisation but is relatively diversified in its export structure compared with other industrialised economies. This possibly shelters it from periods of weak world demand in any single sector. Over time, euro area exporters appear to have increasingly moved towards some of the high-technology sectors (such as pharmaceuticals, and medical, precision and optical instruments, as well as the ICT sectors), where world demand is growing robustly. By contrast, other developed countries,

such as Japan or the United States, which have a much larger concentration in the ICT sectors, have been decreasing their specialisation in this field. This possibly reflects a squeeze on profit margins due to intense competition from emerging Asia. Looking ahead, while the emerging market countries have largely moved into selected high-tech and low and medium-low-tech sectors so far, there is no reason why they may not increase their specialisation in medium-high-tech sectors in the future, which would expose some of the euro area's traditional stronghold sectors to more competition. Indeed, there are signs that this is already happening. A consequence of this would be potentially large future adjustments in some of the main industry sectors of the euro area. Finally, the analysis of sectoral productivity has shown that euro area firms have increased their export specialisation in several sectors where productivity growth has been strong relative to other large developed economies, although overall, the relationship between relative productivity growth and changes in export specialisation is quite weak.

On balance, these results are a sign that some adjustments in the euro area's trade structure and sectoral specialisation have occurred over the past decade, although at face value perhaps less than in some of the other industrialised economies, which may have been more exposed to direct competition from the emerging markets due to their export structures. Possible further adjustments in the export and industry structures of the euro area may therefore take place in the future. Nevertheless, it is also important to explicitly consider import penetration and the composition of imports across countries, which are also likely to have changed in recent years, partly as a response to globalisation. We turn to these issues in the next section.

**Chart 16 Import penetration in the industrialised countries**



Source: IMF World Economic Outlook.  
Note: Euro area imports refer to intra-euro area trade plus extra-euro area trade.

### 3 SPECIALISATION AND IMPORTS OF INTERMEDIATES<sup>32</sup>

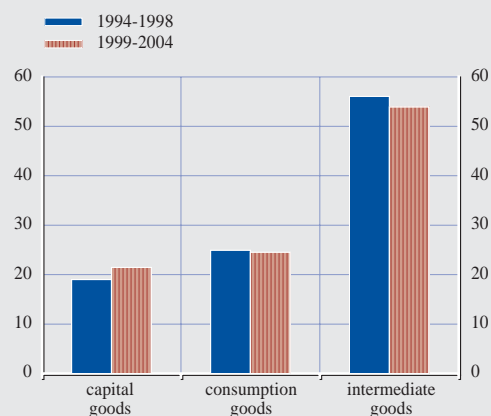
#### 3.1 MOTIVATION

The increasing fragmentation of production across countries, associated with globalisation, has tended to raise the overall import content of euro area exports (see ECB (2005)). But while a higher import content of exports lowers the trade surplus for the same level of exports, efficiency gains from relocating economic activity abroad may actually induce higher overall exports and/or stimulate domestic activity via productivity channels, which together may more than compensate for the higher import content. After a discussion of import penetration and recent changes in the structure of euro area imports, this section provides evidence on international sourcing of production inputs in the euro area, using imports of intermediate goods as a proxy. The results of the analysis are then used to construct an alternative indicator of trade specialisation, complementing the export analysis in Section 2. Finally, changes in intermediate imports from low-cost countries are related to

32 We are grateful for contributions to this section by D. Taglioni.

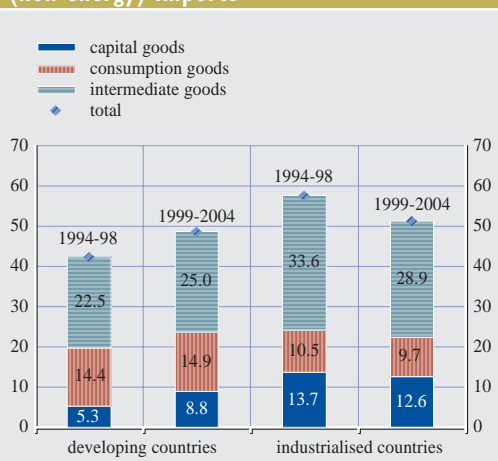
**Chart 17 Euro area imports of goods by stage of production**

(percentages of total non-energy import values)



Sources: CEPII BACI database and ECB calculations.  
Note: The data are classified using the United Nations Broad Economic Classification.

**Chart 18 Euro area goods import values by stage of production as percentage of total (non-energy) imports**



Sources: BACI and ECB calculations.

changes in value added shares across sectors to provide some tentative evidence on whether increasing delocalisation is consistent with a rise in value added.

### 3.2 GENERAL TRENDS IN IMPORT PENETRATION

The opening up of international markets, trade liberalisation and expansion of international production networks have contributed to a sharp increase in import penetration for the main industrialised economies over the past decade. Between 1991 and 2005 the ratio of imports of goods and services to GDP in volume terms more than tripled in the United States and almost doubled in Japan, while developments in the euro area and the United Kingdom stand somewhere in between (Chart 16).

Looking in particular at the euro area, the import composition is skewed towards intermediate goods, which represent about half of total imports. Such imports include parts and components as well as other non-finished goods. The other two main categories of imports – i.e. capital and consumption goods – have a much smaller share (around 20% and 25% respectively). This import structure has hardly changed over the last decade,

possibly with a relatively marginal substitution of intermediate for capital goods imports (see Chart 17).<sup>33</sup> This relative overall stability in import patterns hides, however, a fairly large shift in euro area imports from developed to developing countries, clearly related to very competitive sourcing prices in the developing countries (Chart 18).<sup>34</sup>

Such a shift has been particularly noticeable for intermediate and capital goods, while the shares in consumption goods imports have remained virtually unchanged (see Chart 18). This signals that emerging economies have been used more intensively – at the expense of industrialised economies – as providers of inputs for production processes, possibly in part as a result of an increasing relocation of euro area production processes to those countries.<sup>35</sup> It is important to note in this context

<sup>33</sup> However, for the world, Jones et al. (2004) find that imports of parts and components – a subsection of intermediate imports – have grown faster than total world trade over the past decade.

<sup>34</sup> The definition of low-income or developing versus industrialised or developed economies is based on the definition applied in the IMF's World Economic Outlook.

<sup>35</sup> Box 4 discusses the import patterns of the largest three euro area countries and Box 5 provides some evidence that imports of manufactures from selected low-cost countries have actually partially displaced intra-euro area imports.

that – since we are using data in value terms – we are very likely underestimating the already very clear shift towards imports from emerging economies that is taking place in the euro area. As unit import prices of those countries are considerably lower and have risen more slowly than those of industrialised economies, the extent to which the import share of developing

countries has increased in volume terms is likely to be even higher than in value terms, possibly by a substantial amount if we consider consumption goods imports.<sup>36</sup>

<sup>36</sup> However, the available data are, at the required level of disaggregation, not sufficiently reliable to fully prove this point.

#### Box 4

##### THE PATTERN OF IMPORTS IN GERMANY, FRANCE AND ITALY

Imports of the euro area as a whole show a clear pattern of increasing penetration from developing economies and declining shares of industrialised countries. This development is evident for imports of goods at all stages of production, i.e. consumer, capital and intermediate goods. In what follows, we look at developments in the three largest economies of the euro area – Germany, France and Italy – together accounting for almost 60% of the total value of euro area imports.

A first look at the shares of different import suppliers in the three countries reveals that Germany is more open to extra-euro area imports than France and Italy. Germany's import penetration from developing countries is particularly strong (above 30% of total intra-euro area plus extra-euro area imports), which can partly be explained by its geographical proximity to CEECs and the new EU Member States.

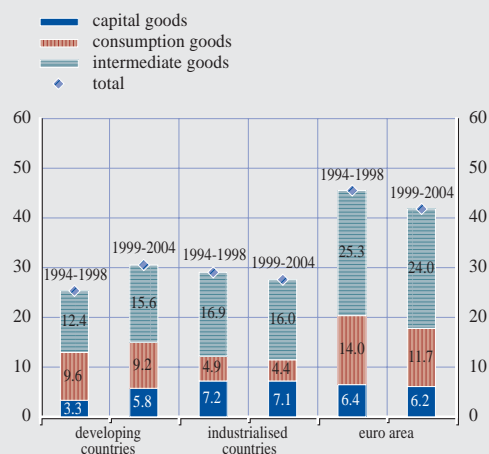
Notwithstanding the cross-country differences, the pattern of trade relationships seems to be undergoing rapid changes, the direction of which is broadly similar across the three countries. Increasing import penetration from developing countries and falling shares of developed countries (including other euro area countries) are the major trends not only for the euro area as a whole but also for the largest individual euro area countries. Moreover, these trends also seem to be roughly common across goods of different stages of production.

Imports of intermediate goods clearly show the trend described above for all the three countries, which suggests the general presence of a fragmentation of production and the relocation of production stages to low-cost economies. In this respect, Germany stands out slightly, having recorded the largest increase in the share of developing countries in intermediates imports.

Imports of consumption and capital goods have undergone similar changes. Nevertheless, while the rise in developing countries' shares in consumption goods imports was quite strong in France and Italy, Germany experienced a slight fall in those shares. Though this characteristic perhaps reflects sluggish German consumption growth over the period and does not rule out substantial flows of low-cost consumption imports having entered the German market, it may suggest that, as compared to France and Italy, Germany's low-cost import penetration may arise more from the fragmentation of industrial production than from inflows of low-priced consumer goods.

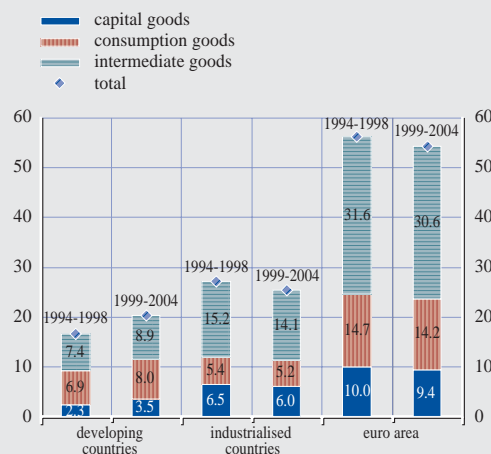
**Chart A German imports of goods by source country**

(as a share of total non-energy imports, in values)



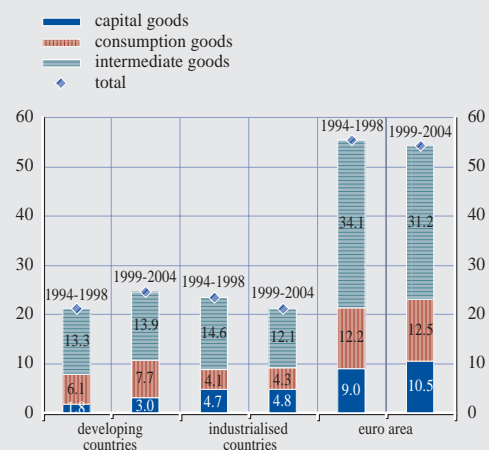
**Chart B French imports of goods by source country**

(as a share of total non-energy imports, in values)



**Chart C Italian imports of goods by source country**

(as a share of total non-energy imports, in values)



Sources: BACI and ECB calculations.

Note: Total imports include both intra-euro area and extra-euro area imports. The calculation excludes imports of energy-related intermediate goods.

In sum, like the euro area as a whole, the three largest euro area economies seem to have experienced increasing import shares of developing economies. However, cross-country analysis reveals differences as to the extent to which import penetration relates to fragmentation of production.

### 3.3 IMPORTS OF INTERMEDIATE GOODS

A phenomenon often cited as one of the driving factors behind the overall increase in import penetration is the growing international fragmentation of production, which increasingly involves developing countries, partly due to cost considerations. The extent to which the fragmentation of production has occurred is difficult to measure, as it assumes a variety of forms, which are summarised in Appendix B. In this paper, we will focus on one measure of international sourcing, intermediate goods imported. While having the advantage of good comparability across countries, this measure clearly also has its limitations. In particular, aside from excluding services, it omits a number

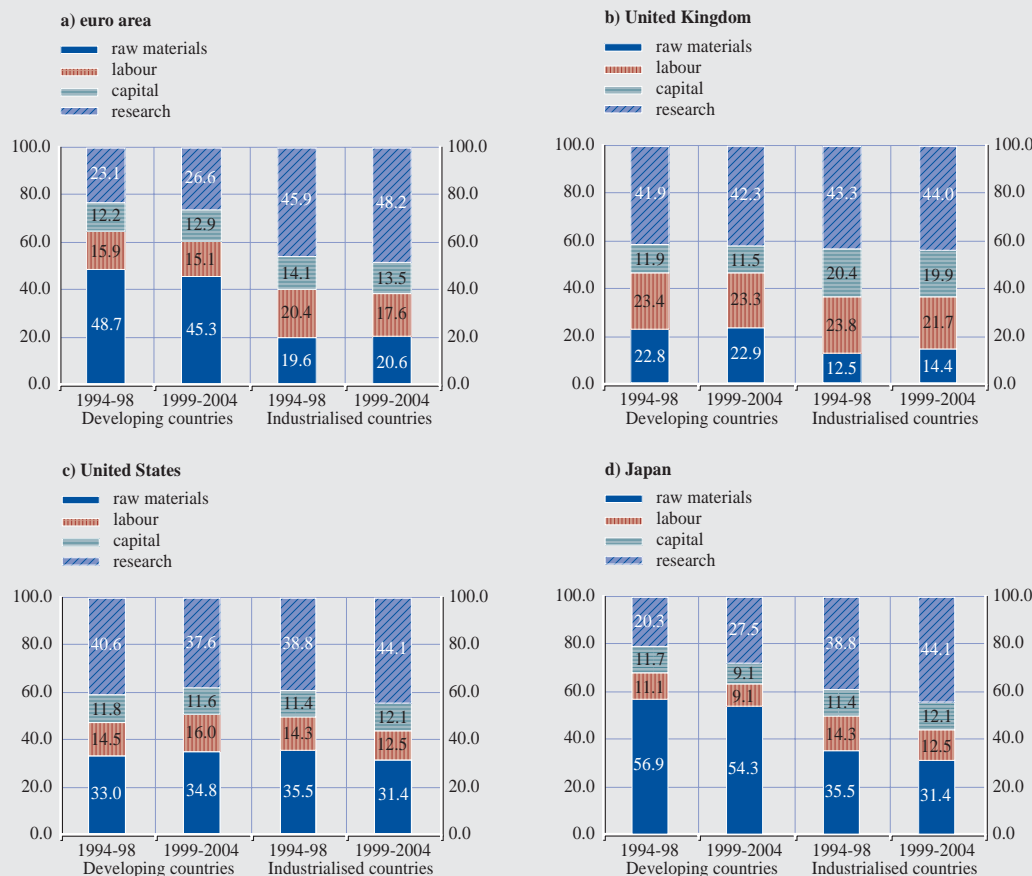
of possibly important types of offshore activities.<sup>37</sup> The analysis below thus needs to be read with caution, but it should, nevertheless, provide sufficient input to complement the export only-based analysis in Section 2.<sup>38</sup>

<sup>37</sup> Five types are omitted: assembly activities; imports of final goods used in domestic production; imports of final goods that are sold under the brand-name of a domestic firm; imports of final goods that could potentially be produced domestically but are not; and imports of goods that could potentially be produced domestically for export purposes but are produced abroad and exported to third markets.

<sup>38</sup> It may be preferable to use input-output tables to obtain a broader measure of international sourcing (that includes offshoring and arms-length trade), where intermediate *inputs* can be related to gross output across sectors. For the euro area, however, there are severe limitations in using these data for a time series analysis of recent trends, as the most recent input-output tables available are for the year 2000.

**Chart 19 Structure of intermediate goods imports by factor intensity**

(percentages of total import values by source region)

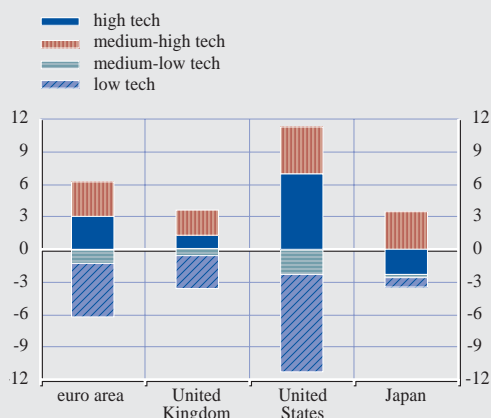


Sources: BACI and ECB calculations.



**Chart 20 Changes in intermediate import shares by technology content**

(percentage point changes in shares in total intermediate imports between 1994-98 and 1999-2004)



Sources: BACI and ECB calculations.

Starting with the structure of intermediate imports across the developed economies, Chart 19 provides insights into the production inputs, classified by factor content, that are imported from low-income economies and whether these are in line with comparative advantages across countries (the caveats applying to the classification of goods by factor intensity mentioned in Section 2 should be borne in mind). Two main points should be noted here: first, all countries – except the United States – have increased the share of research-intensive imports that comes from the developing countries. This demonstrates that the developing countries are not just providers of labour-intensive production inputs but increasingly specialise in research-intensive products, corroborating previous evidence drawn from the analysis on export specialisation in Section 2. Actually, none of the industrialised countries mainly imports predominantly labour-intensive intermediate goods from emerging markets. Second, imports of raw materials-intensive intermediates constitute the largest share of imports from developing countries in the euro area and Japan, which is due to the relative lack of raw materials in those areas.

Turning to the technology breakdown of intermediate imports, Chart 20 shows that all of the developed economies – except for the United States<sup>39</sup> – increasingly import intermediate goods of high and medium-high technology content, while importing relatively fewer medium-low and low-tech goods. This could reflect a general shift in these countries towards higher technology industries, which in turn require a larger share of intermediate inputs, or, alternatively, an increased high-tech specialisation of other countries.

In sum, this section has shown that import penetration into the industrialised economies has been rising at a very fast pace over the past decade. Moreover, there has been a relative shift from industrialised to developing countries as providers of intermediate (and other) goods. This has occurred not only for raw materials-intensive and labour-intensive goods but also for research-intensive goods in most developed countries. Finally, for the developed economies we observe a shift towards high-tech and medium-high-tech intermediate imports, possibly reflecting changes in the overall industry structures.

### 3.4 DOES THE TRADE SPECIALISATION CHANGE WHEN IMPORTS ARE NETTED OUT OF EXPORTS?

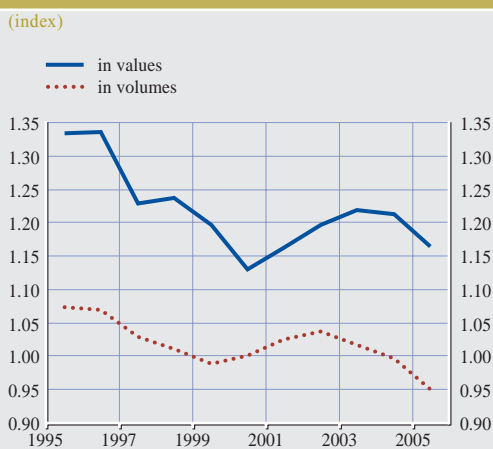
This section examines whether the international sourcing of production inputs has an impact on trade specialisations across countries, by looking at an index of trade specialisation that nets out intermediate imports of exports and comparing this with the earlier results reported in the section on exports. To do so, we use a slightly modified version of the Lafay index of revealed comparative advantage for each industry. This indicator – which is described in more detail in Annex C – compares the actual trade balance of each product group to a

<sup>39</sup> In the United States, the share of high-tech intermediate imports has fallen over time, driven almost entirely by a fall in the share of electronics and communications equipment in intermediate imports. The export specialisation of the United States in this sector has also fallen over time, as noted in Section 2.

### ARE IMPORTS OF MANUFACTURES FROM LOW-COST COUNTRIES DISPLACING INTRA-EURO AREA IMPORTS?

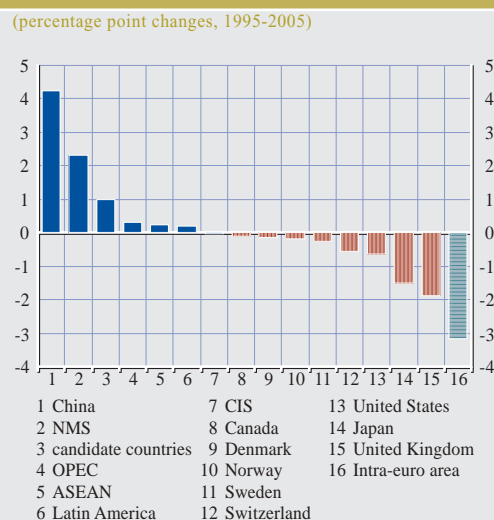
Both intra-euro area and extra-euro area imports of manufactured goods showed robust growth in the past decade, recording average annual growth rates in volume terms of around 5% and 6%, respectively, in the period 1995-2005. Two main factors, both connected to monetary integration, are likely to be behind such developments. First, intra-euro area trade has been stimulated by the elimination of exchange rate volatility across euro area countries and by additional regional integrating factors – sometimes known as “Rose effects” from the name of the author of the seminal paper that started the literature on the trade effects of monetary unions. Second, there is evidence that the creation of the euro – by generating a larger and less fragmented market – has facilitated import penetration from outside the euro area, thus fostering extra-euro area trade.<sup>1</sup> Somewhat surprisingly, however, the growth rate of extra-euro area imports exceeded that of intra-euro area imports in both value and volume terms, which shows up in a decline in the ratio of intra- to extra-euro area imports of manufactures, see Chart A.

**Chart A Ratio of intra- to extra-euro area imports in manufactures**



Sources: Eurostat and ECB calculations.  
Note: Intra-euro area trade is defined as the average of intra-euro area imports and intra-euro area exports.

**Chart B Changes in euro area manufacturing import shares by country of origin**



Sources: Eurostat and ECB calculations.  
Notes: Based on trade in value terms. Share of euro area imports from a given country/region divided by total (intra-plus extra-euro area) imports. NMS stands for new EU Member States; candidate countries include Bulgaria, Romania and Turkey.

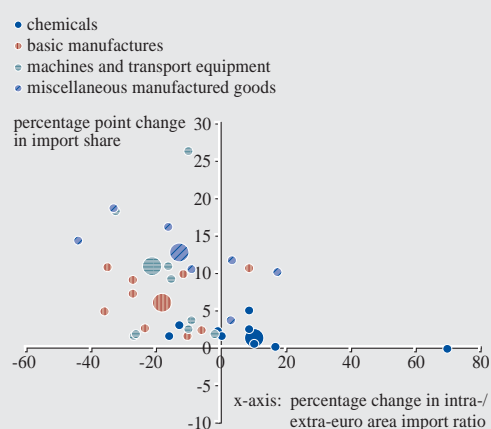
This decline in the ratio (while not having any particular significance as regards the integrating effects of Monetary Union in the euro area) shows clearly that potent factors in addition to those associated with Monetary Union are playing a role in shaping trade developments in the euro area. The most critical factor is, without doubt, the recent acceleration in the process of globalisation and the enlargement of the EU. For the euro area this has meant higher imports of low-cost manufactured consumption goods and higher trade in intermediates related to the process of industrial delocalisation to low-cost countries. As Chart B shows, in the past decade

<sup>1</sup> For a discussion of the euro's effect on euro area trade, see Baldwin (2006).

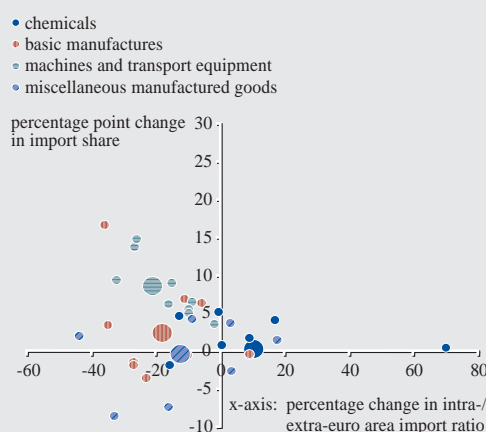
the shares of low-cost countries in euro area imports of manufactures – particularly those of China and the new EU Member States – have increased considerably, accompanied by a loss in the import shares of both intra-euro area traders and high-cost extra-euro area importers (the United States, Japan and the United Kingdom).

A sectoral analysis of the import penetration from China and the new EU Member States offers additional important insights into the unfolding impact of globalisation on the euro area. First, there is an evident negative correlation between the import penetration from low-cost suppliers and the changes in the intra-euro area/extra-euro area import ratio (Charts C and D), suggesting an extensive substitution of trade between euro area countries with imports from China and the new EU Member States. A notable exception is the chemicals sector, where intra-euro area trade rose sharply.

**Chart C Change in China's share in euro area imports and the declining intra-/extra-euro area import ratio in manufactures**



**Chart D Change in the share of the new EU Member States in euro area imports and the declining intra-/extra-euro area import ratio in manufactures**



Source: Eurostat, Comext database, and ECB calculations

Note: Based on two-digit SITC sectors categorised under the following selection of broader one-digit sectors: 5 (chemicals), 6 (basic manufactures), 7 (machinery and transport equipment) and 8 (other manufactured goods).

Second, there is a considerable difference between China and the new EU Member States in terms of their supplying patterns to the euro area. China has gained markets in the euro area throughout the spectrum of sectors, including non-labour-intensive sectors such as office machinery or telecommunications equipment. Gains for the new Member States, by contrast, seem more or less restricted to one – though the largest – category of manufactures, i.e. machinery and transport equipment, which suggests a considerable relocation of capital-intensive and research-intensive production from the euro area to these countries. However, while turning their production structure towards higher-tech sectors, the new Member States have recorded substantial losses in their share in euro area imports of some highly labour-intensive products (namely clothing and footwear) in favour of China.

Overall, alongside the the trade-creating effect of European Monetary Integration, globalisation and the strengthening of international competition have greatly influenced recent developments in euro area imports. In particular, imports of manufactures from low-cost countries are seen to have displaced part of the imports from both intra-euro area and high-cost extra-euro area importers. Among the low-cost trading partners, China and the new EU Member States stand

out as having recorded substantial growth in import shares in the euro area over a wide range of manufacturing products in the past decade. Nevertheless, while China's gain seems to be across a range of different manufacturing products, the gain of the new Member States is predominantly concentrated in machinery and transport equipment.

hypothetical trade balance, which is constructed by multiplying the trade balance for all goods by the share of each product group in total trade. The specialisation index is derived as the difference between the actual and the hypothetical trade balance relative to total trade, and abstracts from variations in trade balances of individual countries linked to the business cycle. A positive value indicates that an industry has a structural surplus and a negative value that it has a structural deficit. In contrast to the standard index, however, we use intermediate imports instead of total imports in the calculation of this indicator, which is likely to better reflect the extent of international production sharing across countries.

Looking first at the breakdown of goods by factor intensity, Table 6 shows that there are no major changes in the pattern of specialisation across countries compared with the earlier results.<sup>40</sup> In particular, the specialisation of the euro area in predominantly capital-intensive, research-intensive and labour-intensive products is confirmed, with very little change over time. Notable for the United States is the increase in the specialisation in research-intensive exports and the fall in that in

raw-materials-intensive and labour-intensive products over time.

Before turning to the detailed sectoral breakdown, it is important to underline a caveat relating to the subsequent analysis. While a more detailed sectoral breakdown allows us to gain further insights about specialisation patterns across sectors, the more disaggregated these specialisation indices are constructed, the more significant are also the limitations of this approach. In particular, relating intermediate imports to the exports of a sector implicitly assumes that the intermediate imports will be used in the same sector. Although this is likely to be the case to a certain extent in some sectors, it may be very misleading in others (e.g. imports of intermediate goods in the electronics sector may well be used on a large scale in the production of cars or other equipment goods).<sup>41</sup>

40 The results in this section are based on the average for the period 1994-2004, as data on imports for 1993 were not available.

41 These limitations also apply to the standard Lafay index of sectoral revealed comparative advantage that is based on total rather than intermediate imports.

**Table 6 Revealed comparative advantage by factor intensity**

(index<sup>1</sup>; average 1994-2004 and change between 1994-98 and 1999-2004)

	euro area		United States		United Kingdom		Japan		China		Other emerging Asia		CEECs	
	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change	Average Change
Raw-materials-intensive	-109	-6	-60	-31	-15	-5	-191	-1	-55	-12	-23	-30	15	-2
Labour-intensive	22	-1	-13	-4	-21	-1	-1	7	101	2	33	-4	-1	-3
Capital-intensive	39	3	-1	5	3	0	74	19	-25	-4	-20	21	18	-5
Research-intensive	48	4	74	30	32	6	118	-25	-20	14	10	13	-31	10

Sources: CHELEM and BACI, and ECB calculations

1) Modified Lafay index of revealed comparative advantage

**Table 7 Revealed comparative advantage by industry**

(index,<sup>1</sup> average 1994-2004 and change between 1994-98 and 1999-2004)

	euro area		United States		United Kingdom		Japan		China		Other emerging Asia		CEECs	
	Average	Change	Average	Change	Average	Change	Average	Change	Average	Change	Average	Change	Average	Change
<b>High-technology industries</b>	<b>-10.3</b>	<b>4.8</b>	<b>24.1</b>	<b>24.2</b>	<b>38.5</b>	<b>11.1</b>	<b>10.4</b>	<b>-29.7</b>	<b>3.4</b>	<b>1.1</b>	<b>15.4</b>	<b>-16.3</b>	<b>-9.9</b>	<b>8.3</b>
Aircraft and spacecraft	-4.1	-1.7	20.8	3.3	1.6	3.2	-5.1	-2.2	-3.1	0.0	-4.4	-2.0	0.5	1.3
Pharmaceuticals	5.0	4.9	3.8	4.2	14.4	9.0	-4.3	1.2	2.2	-0.6	-1.1	1.0	-1.7	-0.1
Office, accounting and computing machinery	-5.7	-0.3	-3.9	-3.8	12.2	-5.8	8.2	-12.4	20.9	20.4	38.8	-5.2	-1.0	4.3
Electronics and communications equipment	-12.4	0.3	-12.7	15.1	1.1	3.9	0.5	-16.5	-20.3	-17.1	-17.8	-9.1	-8.4	1.3
Medical, precision and optical instruments	6.8	1.7	16.2	5.5	9.2	0.7	11.1	0.3	3.6	-1.5	-0.1	-1.0	0.7	1.5
<b>Medium-high-technology industries</b>	<b>39.1</b>	<b>-10.9</b>	<b>-7.1</b>	<b>-16.7</b>	<b>2.5</b>	<b>-11.3</b>	<b>90.7</b>	<b>-13.1</b>	<b>-24.7</b>	<b>18.3</b>	<b>-24.9</b>	<b>18.9</b>	<b>-25.2</b>	<b>21.1</b>
Electrical machinery and apparatus	-4.0	-3.8	-12.0	-2.4	-4.2	-0.1	11.2	-6.0	3.9	3.3	-5.3	-0.1	-7.1	2.7
Motor vehicles, railroad and transport equipment	31.1	2.2	7.6	-3.0	9.8	1.7	63.4	3.5	2.0	0.3	10.5	6.1	14.5	14.4
Chemicals excluding pharmaceuticals	-14.4	3.9	-11.2	-7.0	-13.2	-2.7	-23.2	-0.6	-35.2	-1.4	-27.4	6.6	-24.5	-1.3
Machinery and equipment, n.e.s.	26.4	-13.2	8.6	-4.3	10.0	-10.2	39.3	-9.9	4.5	16.0	-2.7	6.3	-8.1	5.4
<b>Medium-low-technology industries</b>	<b>-40.5</b>	<b>2.0</b>	<b>-38.8</b>	<b>0.6</b>	<b>-52.9</b>	<b>-2.1</b>	<b>-37.9</b>	<b>7.3</b>	<b>-69.5</b>	<b>-8.7</b>	<b>-43.2</b>	<b>18.1</b>	<b>-7.2</b>	<b>-22.9</b>
Building and repairing of ships and boats	3.3	0.2	1.0	-0.1	1.7	0.0	7.8	-1.5	2.9	-0.5	7.1	0.8	5.0	0.2
Rubber and plastic products	-3.2	0.6	-0.6	-0.7	-16.3	1.4	0.8	-1.6	-23.9	-1.3	-2.8	2.7	-21.0	-3.5
Other non-metallic mineral products	-1.5	-0.5	-6.2	-1.5	-3.2	-2.1	-4.5	0.5	4.1	-3.5	-5.2	2.1	-4.1	-1.5
Basic metals and fabricated metal products	-39.1	1.7	-32.9	2.8	-35.0	-1.4	-42.0	9.9	-52.7	-3.4	-42.4	12.4	12.9	-18.0
<b>Low-technology industries</b>	<b>11.7</b>	<b>4.0</b>	<b>21.7</b>	<b>-8.1</b>	<b>11.9</b>	<b>2.2</b>	<b>-63.2</b>	<b>35.5</b>	<b>90.8</b>	<b>-10.8</b>	<b>52.8</b>	<b>-20.7</b>	<b>42.2</b>	<b>-6.6</b>
Wood, pulp, paper, paper products	-8.8	2.6	-12.7	-3.0	-18.7	1.3	-15.6	2.5	-15.4	6.4	-3.1	1.0	-10.0	0.4
Agriculture, food products, beverages and tobacco	-8.6	10.1	23.9	-3.1	5.4	-0.3	-55.0	22.2	-6.8	0.9	7.8	-3.3	8.6	-3.9
Textiles, clothing and footwear	10.8	-0.6	1.7	0.4	0.6	2.2	-3.8	2.2	76.2	-15.1	34.7	-11.1	9.7	-1.4
Not elsewhere specified products (n.e.s.)	18.3	-8.0	8.8	-2.3	24.6	-0.9	11.2	8.6	36.9	-3.0	13.4	-7.3	34.0	-1.7

Sources: CHELEM and BACI, and ECB calculations.

1) Modified Lafay index of revealed comparative advantage.

A number of additional insights can be gained from the specialisation indices after intermediate imports have been netted out of exports (see Table 7).<sup>42</sup> First, the euro area is confirmed to be highly specialised in its traditional stronghold medium-high-tech sectors, despite increasingly

<sup>42</sup> In some sectors (in particular, electronics and communications equipment, chemicals and basic metals, and fabricated metals products), the above-mentioned caveat that intermediate imports may go into the exports of other sectors seems to apply strongly, as intermediate imports were very high in relation to exports. This is reflected in negative or flat revealed comparative advantage indicators for almost all of the countries shown.

sourcing intermediate imports from abroad. An important point is, however, that the revealed comparative advantage in motor vehicles, railroad and transport equipment has barely changed over time. This suggests that an increase in intermediate imports in this sector appears to have led to part of the previously found rise in export specialisation. The fall in the specialisation in machinery and equipment for the euro area over recent years is confirmed by this indicator.

Second, this indicator also shows that, among the high-tech sectors, the euro area specialises in pharmaceuticals and in medical, precision and optical instruments, although not in aircraft and spacecraft.<sup>43</sup> However, on the basis of this measure, and contrary to the findings in Section 2, the euro area has not increased its specialisation in office, accounting and computing machinery in recent years when intermediate imports are considered (which is more in line with the weaker productivity growth in these sectors compared with some of the other developed economies). This could, however, suggest an effective use of intermediate goods sourcing from abroad in order to maintain export market shares.

The comparison between the net exports and exports only-based indicators also offers additional insights for other developed economies. In particular, when exports are netted out the United States and the United Kingdom show a stronger revealed comparative advantage in some of the medium-tech industries (e.g. motor vehicles, railroad and transport equipment and other machinery and equipment) and, for the United States, in pharmaceuticals, due to a lower share of intermediate imports in these compared with other industries.

In sum, international production sharing is an important feature of today's trade structures and should not be neglected when analysing trade specialisation structures across countries. A number of differences from the previous (export only-based) assessment of revealed comparative advantage are worth mentioning: (i) for the United States, a higher specialisation

in predominantly research-intensive products and (ii) for the euro area, a less pronounced specialisation in aircraft and spacecraft, as well as a smaller increase in the specialisation in office, accounting and computing machinery and motor vehicles. The caveats given in previous sections also apply here.

### 3.5 INTERMEDIATE IMPORTS AND VALUE ADDED

An important question when analysing the relocation of previously domestic production to low-cost countries is whether this leads to an increase in domestic value added as resources are used more efficiently. To investigate this, we relate changes in sectoral value added shares to changes in sectors' shares in intermediate imports from developing countries.

Chart 21 shows the results: there is evidence of a positive correlation between changes in the sectoral shares in value added and in intermediate imports from developing countries.<sup>44</sup> This tentatively suggests that those industries which have increased their share of imports of intermediate goods from developing countries are likely to have an increasing share of total value added in the euro area.

In particular, this is the case for the machinery and equipment, vehicles and transport equipment and electronics and communications equipment industries. While of course simple correlations cannot lead to conclusions about causality, this result is at least consistent with the idea that increasing sourcing of production inputs from low-cost countries can have beneficial effects in terms of overall value added.

43 The lack of specialisation in aircraft and spacecraft on the basis of this indicator is due to a large share of intermediate imports from other industrialised economies. If only the intermediate imports of low-cost countries are considered (which was done as a robustness check), the euro area's specialisation in this sector remains.

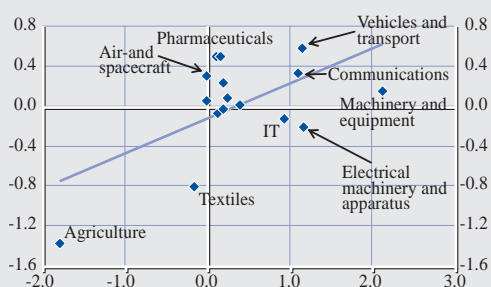
44 This result also holds when changes in total intermediate imports are used rather than in intermediate imports from developing countries.



**Chart 21 Sectoral value added shares and intermediate imports from developing countries**

(percentage point changes in shares, in current prices, between 1994-98 and 1999-2004<sup>1)</sup>)

x-axis: change in the share of intermediate imports from developing countries  
y-axis: change in the share of value added



1) For value added, the change is between 1994-98 and 1999-2003.

## 4 CONCLUSIONS

This paper has aimed to improve our understanding of the impact that globalisation is having on trade patterns across countries and to examine the direction in which euro area trade is moving, in comparison with notional definitions of comparative advantage as well as with respect to other developed economies.

Trade theory suggests that globalisation and the closer integration of emerging markets into the world economy can have a large impact on the pattern of global trade, which is reflected both in falling export market shares for the developed economies over and above relative export price developments and in increasing import penetration. Trade relationships between developed and emerging countries are becoming ever more important and complex in terms of the range and variety of goods traded. A further complication originates from the increase in fragmentation of production across countries due to cost and efficiency considerations. This means that, increasingly, existing trade models – taken in isolation – have a limited ability to explain world trade patterns. Indicators of trade performance need to be studied with caution, as changes in trade patterns might be taking place at a level that was until recently considered irrelevant or hidden to the researcher.

An important finding of the paper is that some low-wage countries are becoming important export competitors for the euro area not only in the field of low-tech and labour-intensive industries – as largely expected on the basis of traditional trade theories – but increasingly also for higher-tech and capital-intensive goods, by rapidly climbing the technology ladder.

As for the euro area, substantial trade adjustments have been taking place in recent years. These are a response to increased competitive pressures determined either by technological change, by increasing globalisation or by their interaction. In particular, (i) the export specialisation of the euro area is increasing in some medium-high or high-tech sectors where productivity growth is strong and demand robust, such as pharmaceuticals, while declining in lower-tech sectors such as textiles; and (ii) the euro area appears to be increasingly importing goods from low-cost countries. Since a large share of these imports are intermediates, the increased import penetration is likely to be motivated by cost-savings and is perhaps aimed at helping euro area producers to focus on the higher value-added stages of the production chain.

Nevertheless, there are also signs that further adjustments may take place. The first is that the export sector of the euro area is, in relative terms, more specialised in labour-intensive goods than the other three developed economies considered. This has hardly changed over time, even when labour-intensive intermediate imports are considered. This could partly reflect a specialisation in higher-quality labour-intensive products, but may well also be a sign of more regulated product and labour markets, especially compared with the United Kingdom and the United States. In comparison with the euro area, the United States appears to be moving more decisively towards research-intensive products, while retreating from labour-intensive and raw-materials intensive sectors. Second, there is evidence that the euro area is losing ground in one of its traditionally strong sectors – machinery and equipment – since higher intermediate imports are associated

with stagnant exports, which could be a sign of deindustrialisation in this field. This is corroborated by the strong rise in imports of capital goods (particularly machinery and transport equipment) from the new EU Member States, which appears to be partly displacing intra-euro area imports.

Against this background, there appears to be a need for a continuation of structural reforms of euro area product and labour markets. These should be aimed at removing rigidities and enhancing flexibility while fostering R&D spending, which remains low by international standards.

# ANNEXES

## ANNEX A: DATA CLASSIFICATIONS

**Table A1 Definition of country groups**

Country/region	Countries included
euro area	12 euro area member countries excluding Slovenia; data for the euro area exclude intra-euro area trade flows
United Kingdom	United Kingdom
United States	United States
Japan	Japan
China	China
Other emerging Asia	India, Indonesia, Hong Kong SAR, Singapore, South Korea, Taiwan, Malaysia, the Philippines, Thailand
CEECs	The Commonwealth of Independent States (Armenia, Azerbaijan, Belarus, Georgia, Kazakhstan, Kyrgyzstan, Moldova, Russia, Tajikistan, Turkmenistan, Ukraine, Uzbekistan), Estonia, Lithuania, Latvia, Former Yugoslavia (now Bosnia and Herzegovina, Croatia, Macedonia, Serbia, Montenegro and Slovenia), Albania, Bulgaria, Former Czechoslovakia (now the Czech Republic and Slovakia), Hungary, Poland, Romania, Turkey.

**Table A2 Product classification by technological intensity**

<b>High-technology industries</b>	Aircraft and spacecraft Pharmaceuticals Office, accounting and computing machinery Electronics and communications equipment Medical, precision and optical instruments
<b>Medium-high-technology industries</b>	Electrical machinery and apparatus not elsewhere specified (n.e.s.) Motor vehicles, trailers and semi-trailers, railroad and transport equipment n.e.s. Chemicals excluding pharmaceuticals Machinery and equipment n.e.s.
<b>Medium-low-technology industries</b>	Building and repairing of ships and boats Rubber and plastic products Other non-metallic mineral products (including mining and quarrying) Basic metals and fabricated metal products (including mining and quarrying)
<b>Low-technology industries</b>	Wood, pulp, paper, paper products, printing and publishing Agriculture, fishing and food products, beverages and tobacco Textiles, textile products, leather and footwear Not elsewhere specified products (n.e.s.)

Source: Based on the OECD Science, Technology and Industry Scoreboard 2005, pp. 181-3

**Table A3 Product classification by factor intensity**

**Predominantly raw-materials-intensive**

Fertilisers  
 Iron ores  
 Non-ferrous ores  
 Unprocessed minerals n.e.s.  
 Coals  
 Crude oil  
 Natural gas  
 Coke  
 Refined petroleum products  
 Cereals  
 Other edible agricultural products  
 Non-edible agricultural products  
 Cereal products  
 Fats  
 Meat  
 Preserved meat/fish  
 Preserved fruits  
 Sugar  
 Animal food

**Predominantly labour-intensive**

Cement  
 Ceramics  
 Glass  
 Yarns, fabrics  
 Clothing  
 Knitwear  
 Carpets  
 Leather  
 Wood articles  
 Furniture  
 Paper  
 Printing  
 Miscellaneous manufactured articles  
 Metallic structures  
 Miscellaneous hardware  
 Arms  
 Plastics  
 Jewellery, works of art

**Predominantly capital-intensive**

Iron, steel  
 Tubes  
 Non-ferrous metals  
 Vehicle components  
 Cars and cycles  
 Commercial vehicles  
 Paints  
 Toiletries  
 Rubber articles (including tyres)  
 Electricity  
 Beverages  
 Manufactured tobaccos

**Predominantly research-intensive**

Consumer electronics  
 Telecommunications equipment  
 Computer equipment  
 Basic inorganic chemicals  
 Basic organic chemicals  
 Pharmaceuticals  
 Plastic articles  
 Engines  
 Agricultural equipment  
 Machine tools  
 Construction equipment  
 Specialized machines  
 Precision instruments  
 Clockmaking  
 Optics  
 Electronic components  
 Domestic electrical appliances  
 Electrical equipment  
 Electrical apparatus  
 Ships  
 Aeronautics

**Not classified**

Non-monetary gold  
 Products n.e.s.

Source: Based on Yilmaz (2003), slightly modified by authors.

## ANNEX B: DEFINITIONS OF INTERNATIONAL SOURCING

Table Most common sources of sectoral measures of international sourcing

<b>Customs statistics</b>	Information based on customs arrangements in which tariff exemptions or reductions are granted in accordance to the domestic input content of imported goods.
Coverage	Narrow measure
Main advantages	Trace very closely the geographical source of the input content
Main disadvantages	Do not cover processing abroad and direct exports to third countries
International comparability and consistency across time	Scarce
Best use	To understand the determinants of outsourcing
Examples of datasets	US Offshore Assembly Programme and the EU Outward Processing Trade
Example of studies that use this measure	Görg (2000), Egger and Egger (2001) and Feenstra et al. (2000)
<b>Input-Output tables</b>	Statistics providing import penetration measures for given sectors, from information on supplier-buyer relationships across industries, based on survey data
Coverage	Broader measure, including offshore outsourcing and arm's length trade in intermediate inputs
Main advantages	Covers all economic activities, including services, and allows for linkages across sectors
Main disadvantages	Does not cover export substitution. Furthermore, outsourcing indices based on I-O tables are not able to identify appropriate measures of import penetration (as these latter include finished goods and further assume that the share of imports in the intermediate inputs purchased from sector j by all other industries is identical across countries, which seems unlikely to be the case).
International comparability and consistency across time	Difficult international comparability, irregular and untimely but consistent across time
Best use	For monitoring developments and changes in the production linkages across sectors
Examples of datasets	Eurostat and OECD Input-Output tables
Example of studies that use this measure)	Wixted et al. (2006) and Hummels et al. (2001)
<b>International trade statistics</b>	Measures focusing specifically on relevant trade shares in various categories of goods imported (exported) at different stages of production (or with different characteristics identifiable with trade classifications) by a specific country or group of countries from(to) specific trading partners and regions.
Coverage	Narrow measure
Main advantages	Timely information, permitting the identification of specific bilateral trading partner relationships and analysis of the evolution across time
Main disadvantages	The measures relate only to trade in goods, and also omit five particular types of outsourcing: assembly activities; imports of final goods used in domestic production; imports of final goods that are sold under the brand-name of a domestic firm; imports of final goods that could potentially be produced domestically but are not; and imports of goods that could potentially be produced domestically for export purposes, but are produced abroad and exported to third markets
International comparability and consistency across time	Very good
Best use	Useful basis for monitoring the direction and composition of relevant trade flows consistently over time and across countries
Examples of datasets	Comext, Comtrade at finest sectoral breakdown (and derived datasets, eg. CHELEM, BACI)
Example of studies that use this measure	Yii (1999)
<b>Data on transnational enterprises</b>	These data provide information on the distribution of employees and production by country as well as where different industries are located
Coverage	Narrow measure
Main advantages	Information about intra-firm distribution of employees and production
Main disadvantages	Very uneven coverage across time and countries

### Table Most common sectoral measures of international sourcing (cont'd)

International comparability and consistency across time	Easy but incomplete international comparability. Untimely information but fair consistency across time
Best use	Monitoring the distribution of employees and production between mother company and affiliates
Examples of datasets	UNCTAD FDI Datasets, AFA and FATS statistics and national national sources
Example of studies that use this measure	Criscuolo (2005)
<b>Other sources: press-reviews, layoff statistics and sample surveys</b>	Useful to gather focused information on relocation, on the direct effects on unemployment and on the indirect effects on labour productivity while sample surveys also give a good insight into the motives behind and consequences of such activities



### ANNEX C: DEFINITION OF THE LAFAY INDEX

For a given country,  $i$ , and for any given product,  $j$ , the Lafay index is defined as:

$$LFI_j^i = 1000 * \left( \frac{x_j^i - m_j^i}{x_j^i + m_j^i} - \frac{\sum_{j=1}^N (x_j^i - m_j^i)}{\sum_{j=1}^N (x_j^i + m_j^i)} \right) \frac{x_j^i + m_j^i}{\sum_{j=1}^N (x_j^i + m_j^i)}$$

where  $x_j^i$  and  $m_j^i$  are, respectively, exports and imports of product  $j$  of country  $i$  to/from the rest of the world, and  $N$  is the number of goods or sectors.

According to the index, the comparative advantage of country  $i$  in the production of item  $j$  is measured by the deviation of the product  $j$  normalised trade balance from the overall normalised trade balance. The normalisation of each sector is obtained by weighting each product's contribution by its importance in trade, i.e. the share of product  $j$  (imports plus exports) in total trade.

Given that the index measures each product's contribution to the overall normalised trade balance, the sum of the Lafay index over all sectors or products for each country is zero. Positive values of the Lafay index thus indicate the existence of a comparative advantage; the larger the value, the higher the degree of specialisation. Similarly, negative values indicate no specialisation in a given sector or product.

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