

VI. INTRA-INDUSTRY AND INTRA-FIRM TRADE AND THE INTERNATIONALISATION OF PRODUCTION

Introduction and summary

The growing “internationalisation” of production systems, which increasingly involve vertical trading chains spanning a number of countries, each specialising in a particular stage of production, is an important feature behind the changing nature and increasing scale of world trade. Although there is considerable anecdotal evidence concerning this phenomenon, there is surprisingly little in the way of data at the aggregate level to gauge its overall importance, and measurement problems attach to available macro data. Subject to these limitations, this chapter reviews recent evidence relating to the internationalisation of production over the past decade, firstly based on intra-industry trade data and then analysing intra-firm trade data.¹ The broader macroeconomic significance of these trends is also considered. Tentative conclusions are that: the impact of some shocks on output (as measured by value added) may be more dispersed internationally; the speed with which certain shocks are transmitted as well as the volatility of world trade may have increased; and trade may be less sensitive in the short-term to changes in price competitiveness.

Internationalisation of production has important effects on world trade

Intra-industry trade

Intra-industry trade involves the import and export of similar goods. While taking account of measurement limitations (Box VI.1), it would appear that the intra-industry share of manufacturing trade has increased significantly since the late 1980s across many OECD countries (Table VI.1).² This follows trend increases in intra-industry trade for all the major OECD economies between 1970 and 1990.³

Intra-industry trade has risen significantly in many OECD countries...

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1. Input-output tables can also be used to measure the usage of imported inputs in the production of export goods, although these are usually only available for snapshot years, often with a long time lag. Using input-output tables from ten OECD countries and four emerging market economies Hummels *et al.* (2001) calculate that this form of trade, which they refer to as “vertical specialisation”, accounted for 21 per cent of these countries’ exports in 1990 and 30 per cent of the growth in exports between 1970 and 1990. However, given the infrequent publication of input-output tables, for the major OECD countries the latest year included in their analysis is 1990.
 2. The absolute level of summary statistics of intra-industry trade are in themselves not very meaningful, because they depend on the level of disaggregation that is chosen for the analysis (see Box VI.1). Instead the focus here is on changes in intra-industry trade through time and comparisons across countries. This will also be affected by aggregation structures but may, nonetheless, to a larger extent than absolute levels reflect real economic developments and differences.
 3. See OECD (1994).

Box VI.1. The measurement of intra-industry trade

Intra-industry trade flows are conventionally defined as the two-way exchange of goods within standard industrial classifications. The extent of intra-industry trade is commonly measured by Grubel-Lloyd indexes based on commodity group transactions. Thus, for any particular product class i , an index of the extent of intra-industry trade in the product class i between countries A and B is given by the following ratio:

$$IIT_{i, AB} = \left[\frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \right] \cdot 100 \quad [1]$$

This index takes the minimum value of zero when there are no products in the same class that are both imported and exported, and the maximum value of 100 when all trade is intra-industry (in this case X_i is equal to M_i). The indices reported in this chapter have been computed according to [1] for each pair of trading partners and for each two-digit SITC revision 3 product class. Bilateral indices of intra-industry trade in the product class i between country A and all its trading partners are obtained as a

weighted average of the bilateral indices [1] for each partner country B, using as weights the share of total trade of A accounted for by trade with B. Bilateral indices of intra-industry trade between country A and country B for total manufacturing are the weighted average of the indexes in [1] for all product classes i , with weights given by the share of total trade of i over total manufacturing trade:

$$IIT_{AB} = \sum_i \left[\frac{X_i + M_i - |X_i - M_i|}{X_i + M_i} \right] \cdot \left[\frac{(X_i + M_i)}{\sum_i (X_i + M_i)} \right] \cdot 100 \quad [2]$$

A degree of caution must be used when comparing and interpreting intra-industry indices because their measurement crucially depends on the level of disaggregation chosen for the analysis. In the current context of assessing the importance of the division of the production process across countries, it should be recognised that, as well as measuring trade in intermediate goods at various stages of production, much intra-industry trade is trade in similar, but often highly differentiated, finished products.

... reflecting a number of different factors...

Different types of trade are captured in measurements of intra-industry trade: horizontal trade in similar products with differentiated varieties (*e.g.* cars of a similar class and price range); trade in vertically differentiated products distinguished by quality and price (*e.g.* Italy exports high-quality clothing and imports lower-quality clothing); and vertical specialisation of production that results in trade in similar goods at different stages of production.⁴ Horizontal intra-industry trade enables countries with similar factor endowments to benefit from economies of scale by specialising in “niche” products. Trade in vertically differentiated products may reflect different factor endowments, particular skills of the workforce or high fixed research and development costs.⁵ Vertical specialisation of production across countries may be driven by comparative advantage, for example to use cheap unskilled labour for assembly purposes or specialised personnel for research and development.⁶

The extent of intra-industry trade is typically much higher across categories of manufactured goods than it is across trade in non-manufactured goods, and highest for the more sophisticated manufactured products such as chemicals, machinery and

4. Arguably exchanges of goods at different stages of production should not strictly be classified as intra-industry trade, particularly because they would be excluded if the analysis was carried out at finer levels of disaggregation, see Fontagné and Freudenberg (2002). However, the current analysis (based on two-digit SITC classes) is intentionally not so highly disaggregated as to exclude this form of trade.

5. Standard calculations of intra-industry trade do not allow the causes of intra-industry trade to be identified. However, employing a more detailed disaggregated analysis that makes use of information on unit values, Fontagné and Freudenberg find that most of the increase in intra-industry trade in Europe over the 1980s and 1990s relates to trade in vertically differentiated products rather than horizontal trade, where the former is defined as being where import and export unit values differ by more than 15 per cent.

6. See OECD (1998).

Table VI.1. Manufacturing intra-industry trade as a percentage of total manufacturing trade

	1988-91	1992-95	1996-2000	Change
<i>High and increasing intra-industry trade</i>				
Czech Republic	n.a.	66.3	77.4	11.1
Slovak Republic	n.a.	69.8	76.0	6.2
Mexico	62.5	74.4	73.4	10.9
Hungary	54.9	64.3	72.1	17.2
Germany	67.1	72.0	72.0	5.0
United States	63.5	65.3	68.5	5.0
Poland	56.4	61.7	62.6	6.2
Portugal	52.4	56.3	61.3	8.9
<i>High and stable intra-industry trade</i>				
France	75.9	77.6	77.5	1.6
Canada	73.5	74.7	76.2	2.7
Austria	71.8	74.3	74.2	2.4
United Kingdom	70.1	73.1	73.7	3.6
Switzerland	69.8	71.8	72.0	2.2
Belgium/Luxembourg	77.6	77.7	71.4	-6.2
Spain	68.2	72.1	71.2	3.0
Netherlands	69.2	70.4	68.9	-0.3
Sweden	64.2	64.6	66.6	2.4
Denmark	61.6	63.4	64.8	3.2
Italy	61.6	64.0	64.7	3.1
Ireland	58.6	57.2	54.6	-4.0
Finland	53.8	53.2	53.9	0.1
<i>Low and increasing intra-industry trade</i>				
Korea	41.4	50.6	57.5	16.1
Japan	37.6	40.8	47.6	10.0
<i>Low and stable intra-industry trade</i>				
New Zealand	37.2	38.4	40.6	3.4
Turkey	36.7	36.2	40.0	3.3
Norway	40.0	37.5	37.1	-2.9
Greece	42.8	39.5	36.9	-5.9
Australia	28.6	29.8	29.8	1.2
Iceland	19.0	19.1	20.1	1.1

Note: Countries are classified as having 'high' or 'low' level of intra-industry trade according to whether intra-industry trade is above or below 50 per cent of total manufacturing trade on average over all periods shown and 'increasing' or 'stable' according to whether intra-industry trade increases by more than 5 percentage points between the first and last periods, as shown in the final column.

Source: OECD calculations, see Box VI.1 for details, based on OECD International Trade Statistics.

transport equipment, electrical equipment and electronics.⁷ This is because sophisticated manufacturing products are more likely to benefit from economies of scale in production and are easier to "differentiate" to the final consumer, and so facilitate trade in similar products. More complex manufactured products which rely on many components and/or processes may also benefit more readily from splitting up production across countries.

7. Across all OECD countries, and based on the measurement described in Box VI.1, intra-industry trade in more sophisticated products such as chemicals or machinery and transport equipment is typically around 60 or 70 per cent, whereas for manufactured goods involving simpler transformation processes, such as food products, it is typically around 40 per cent or less.

... and notably for those countries with a high trade share in GDP

Of particular interest when considering intra-industry trade and the internationalisation of production are those countries where exports and imports account for a very high proportion of GDP. There are currently eight OECD economies (Austria, Belgium, Czech Republic, Hungary, Ireland, Luxembourg, Netherlands, and Slovakia) where both imports and exports account for more than half of GDP.⁸ Although there is far from a perfect correspondence, these countries all tend to have relatively high intra-industry trade (upper two panels of Table VI.1); all but one (Ireland) having measures of intra-industry trade that are well above the average across all OECD countries and four of them being in the top eight countries for the period 1996-2000. Krugman (1995) argues that the emergence of such “*supertrading*” economies is essentially dependent on the “slicing up of the value added chain” on an international basis. This implies that the value of exports is substantially larger than the value added in the export industries, and so reconciles high trade exposure with the likelihood that the dominant shares of employment and value added are generated in non-tradable sectors. The number of these *supertrading* economies has doubled over the 1990s; Krugman reckoned that in 1990 there were six, but by 2000 there were at least twelve.⁹

It is high for economies where FDI inflows have risen sharply...

Among the countries with the most rapid increase in intra-industry trade over the 1990s are the Eastern European “transition economies” of the Czech Republic, Hungary, Poland and Slovakia (see top panel of Table VI.1). All of these countries are characterised by high and increasing inflows of foreign direct investment (FDI) over the 1990s, especially from Germany.¹⁰ The combination of rising intra-industry trade and high foreign direct investment inflows is consistent with the increasing extent to which multinational firms have located parts of their production operations in these countries.¹¹ Partly reflecting the trends in these countries, and the fact that there has been a steady increase in foreign direct investment outflows over the 1990s, Germany has also experienced a relatively rapid increase in intra-industry trade over the 1990s.

... and for Mexico where NAFTA has strengthened production linkages

Mexico is another country with a rapid increase in intra-industry trade since the late 1980s (see top panel of Table VI.1). This reflects the importance of its trading links with the United States that have been strengthened following implementation of various stages of the North American Free Trade Agreement. In terms of broad product categories, the two largest US exports to Mexico, namely electrical machinery and appliances and motor vehicles, are also the most important exports from Mexico to the United States.¹² The elimination of tariff barriers and Mexico’s relatively low labour costs has led to the set-up of a plethora of plants known as “*maquiladora*”, which are under foreign control, located in the border region with the United States and devoted to the assembly and re-export of goods. Their operations have become especially concentrated in ICT products, accounting for more than half of total *maquiladora* production in 2000.¹³

8. Historical disaggregated manufacturing trade data is not readily available for Luxembourg separately, but Luxembourg is combined with Belgium for the analysis of intra-industry trade summarised in Table VI.1.

9. Krugman’s six *supertrading* economies in 1990 were Belgium, Hong Kong, Ireland, Malaysia, the Netherlands and Singapore, (although he appears to have omitted Luxembourg). In 2000 there are at least twelve; in addition to the eight OECD countries mentioned in the text, Thailand has joined the three non-OECD countries in Krugman’s original list (with the Chinese Taipei and Philippines close to qualifying).

10. See OECD (2000a).

11. For example, in the Czech Republic, Hungary and Slovakia the largest exporting firm is owned by the German Volkswagen group. See OECD (2000b and 2001).

12. See Vargas, 2000a.

13. See Vargas, 2000b.

The extent of intra-industry trade in Japan and Korea is comparatively low, although in both countries it has risen relatively rapidly over the 1990s, (third panel of Table VI.1). The low level of intra-industry trade in these countries is consistent with the substantial trade surpluses these countries have generated in particular manufacturing products such as electrical machinery and appliances, “high tech” goods and transport equipment. Over the course of the 1990s imports of electrical machinery and appliances and “high tech” goods have, however, risen in relation to exports. In the case of Korea this partly reflects the gradual relaxation of import restrictions on specific manufacturing products, and for Japan it partly reflects the increasing importance of intra-firm imports from Japanese foreign affiliates located elsewhere in Asia, as discussed in the following section.

Intra-industry trade is relatively low but rising in Japan and Korea...

Most of the countries that have relatively low and stable intra-industry manufacturing trade (lower panel of Table VI.1), are also those that are most heavily dependent on non-manufactured goods in total exports.¹⁴ This indicates that the low share of intra-industry trade reflects a tendency for a high proportion of these countries’ manufactured exports to consist of relatively simple transformations of the raw materials with which the country is endowed, and that such transformations are not suited to division across different countries.

... and low for those economies specialising in non-manufactures

Intra-firm trade

Cross-border trade between multinational companies and their affiliates, often referred to as “intra-firm” or sometimes “related party” trade, accounts for a large share of international trade in goods, although aggregate data are only available for a few countries, most notably the United States and Japan. Intra-firm trade accounts for around one-third of goods exports from Japan and the United States, and a similar proportion of all US goods imports and one-quarter of all Japanese goods imports (Table VI.2).¹⁵ In the case of the United States these shares have been broadly stable over the last decade, but in the case of Japan they have increased substantially. Moreover, given the increasing importance of foreign direct investment relative to both world trade and output, it is likely that the importance of intra-firm trade has increased at the global level.

Intra-firm trade accounts for a substantial share of US and Japanese trade

The nature and extent of intra-firm trade seem to vary systematically with the income level of the trading partners:¹⁶

- Much intra-firm trade between high-income countries is probably of nearly finished goods destined for affiliate companies that are mainly involved in marketing and distribution with little additional manufacturing processing taking place. For example, about two-thirds of US intra-firm imports by multinationals with a foreign-based parent company is to an affiliate primarily

Much intra-firm trade involves little additional processing...

14. For Australia, Iceland, New Zealand and Norway non-manufactures were at least 40 per cent of the total value of exports in 2000, more than double the world average, see Le Foulmer *et al.* (2001).

15. There are, however, differences in the level and, to a lesser extent, trend movements in US intra-firm trade reported by different US sources. In particular, data reported by the US Department of Commerce (2001) suggest that the level of intra-firm (or related party) trade was 32 per cent of goods exports and 47 per cent of goods imports in 1998, compared to the corresponding figures of 36 per cent and 39 per cent from the Bureau of Economic Analysis source cited in Table VI.2. The Department of Commerce figures also suggest greater stability in the share of both intra-firm exports and imports than those of the Bureau of Economic Analysis.

16. The discussion in this paragraph draws heavily on the analysis of US intra-firm trade by Zeile (1997).

Table VI.2. **The importance of intra-firm trade for the United States and Japan**

Share of all goods trade

	Exports			Imports		
	1990	1999 ^a	Change	1990	1999 ^a	Change
United States	32.8	36.2	3.4	43.7	39.4	-4.3
<i>of which</i>						
Domestically-based parent company	23.1	27.7	4.6	16.1	17.2	1.1
Foreign-based parent company	9.7	8.6	-1.1	27.6	22.2	-5.4
Japan	16.6	30.8	14.2	14.7	23.6	8.9
<i>of which</i>						
Domestically-based parent company	14.5	28.6	14.1	4.2	14.8	10.6
Foreign-based parent company	2.1	2.2	0.1	10.5	8.8	-1.7

a) For United States data are for 1998 not 1999.

Sources: Lowe (2001); Japanese Ministry of Economics, Trade and Industry; OECD calculations.

involved in marketing and distribution. In these cases, the share of intra-firm imports in total imports from the partner country is strongly related to the GDP/capita of the trading partner country. This suggests that the local presence of affiliates is often required for the marketing of sophisticated manufacturing products, which tend to be from, and sold to, higher income countries.

- Even when the affiliate receiving the goods is primarily involved in further manufacturing, it is likely that much of the production is destined for local markets. This is consistent with the finding that the export share of US multinationals to manufacturing affiliates is also positively correlated with per capita GDP of the trading partner country. For Japan, around 95 per cent of the sales of Japanese affiliates located in North America and Europe were within the same region in 1999,¹⁷ while the share of intra-firm imports of Japanese parent companies from North America and Europe remains very low (Table VI.3).
- There are, however, some middle-income countries where intra-firm trade with rich countries accounts for a high share of their bilateral trade. The primary role of the foreign affiliates located in such countries is more likely to be manufacturing to produce goods that are destined for other markets, including the country of the parent company. For example, in the year 2000, two-thirds of US imports from Mexico were intra-firm due to the extensive *maquiladora* operations. This type of phenomenon is reflected in the absence of any positive correlation between the share of US intra-firm imports by US parent companies in total goods imports from a trading partner country and the per capita/GDP of that country. For Japan, the share of intra-firm imports of domestic based multinationals in total goods imports is much

... which is more important between rich and middle-income countries

17. In both cases about half of the intermediate goods used in production were from within the same region where the Japanese affiliate was located, with most of the remaining share coming from Japan.

Table VI.3. **Intra-firm trade of Japan, where parent company is Japanese, with main trading blocs**

As a per cent of all goods trade with partner region

	1990	1999	Change
Exports			
Total	14.5	28.6	14.1
Rest of Asia	10.1	22.4	12.3
North America	20.9	36.8	15.8
Europe	12.0	29.0	17.0
Imports			
Total	4.2	14.8	10.6
Rest of Asia	6.3	22.5	16.1
North America	3.1	6.8	3.7
Europe	1.1	3.9	2.9

Sources: Japanese Ministry of Economy, Trade and Industry, OECD.

higher from the rest of Asia than from North America or Europe (Table VI.3). Moreover, in contrast to Japanese affiliates located in Europe and North America, a significant share (about one-third in 1999) of the sales of Japanese affiliates in the rest of Asia are to countries outside the region in which they are located (mainly back to Japan).

Table VI.4. **Intra-firm trade of the United States, with selected trading partners**

As a per cent of all goods trade with partner country

	Level 1999	Change, 1992-99
Imports		
Japan	73.7	-1.3
Mexico	66.4	3.1
Korea	49.3	22.5
Canada	43.1	-2.9
Eastern Europe	32.1	20.1
Taiwan	20.8	4.9
China	17.6	7.1
Total	46.7	1.7
Exports		
Mexico	44.3	5.6
Canada	42.4	-2.9
Japan	36.3	0.1
Taiwan	16.0	6.0
Eastern Europe	12.3	2.6
China	11.6	5.0
Total	32.1	1.2

Note: Partner countries shown are those with the highest level of intra-firm trade in 1999 or the largest increase over the period 1992-99.

Source: United States Department of Commerce (2001).

- There is some evidence to suggest that the importance of this form of intra-firm trade between rich and middle-income countries, which is most directly related to the internationalisation of production, has been increasing over the 1990s. For the United States, while the aggregate share of intra-firm trade has remained relatively stable over the 1990s, those countries where the share has increased most, such as China, Korea, Mexico, Taiwan and those of Eastern Europe have all tended to be low- or middle-income countries (Table VI.4). For Japan, intra-firm imports from the rest of Asia have increased by much more than from other regions over the 1990s.

The manufacturing products subject to a high degree of intra-firm trade are also those with a high degree of intra-industry trade, in particular the more sophisticated manufacturing products. Thus, US intra-firm trade is particularly concentrated in transportation equipment, computer and electronic products, machinery and chemicals (Table VI.5).¹⁸

Table VI.5. US trade in products with a high degree of intra-firm trade

	<i>per cent</i>	
	<i>Share of total imports/exports</i>	<i>Intra-firm trade</i>
Imports		
Transportation equipment	17.7	75.6
Computer & electronic products	20.8	66.3
Chemicals	6.4	59.3
Machinery, except electrical	6.6	50.3
Electrical equipment, appliances & components	3.3	50.0
Exports		
Transportation equipment	15.6	41.2
Plastics & rubber products	2.2	40.7
Chemicals	9.9	39.3
Computer & electronic products	20.7	36.9
Electrical equipment, appliances & components	3.3	35.1

Source: United States Department of Commerce (2001).

Macroeconomic significance

Increasing internationalisation of production...

A large part of intra-industry trade reflects trade in “similar” but highly differentiated products, and a large part of intra-firm trade is of finished goods with foreign affiliates mainly engaged in marketing and distribution activities. Nevertheless, the increasing importance of foreign direct investment flows, particularly to low- or middle-income countries from the most advanced economies,¹⁹ and the increasing number of *supertrading* economies, together suggest that the trends in intra-industry and intra-firm trade also partly reflect the increasing importance of the internationalisation of production.

18. The concentration of intra-firm trade in particular product categories is reflected in the fact that of the 31 product categories distinguished in the three-digit North American Industrial Classification System code, only five are above the average for total exports and imports.

19. The share of world-wide FDI received by the developing and transition economies increased from one-quarter in the period 1988-93 to one-third in the period 1994-99, see Navaretti *et al.* (2002).

To the extent that a country's trade is dominated by goods that are part of a vertically-integrated production chain spread across more than one country, the correlation between changes in exports and imports is likely to be high. This is supported by the positive relationship between intra-industry trade and the correlation between movements in export and import volumes over the 1990s (Figure VI.1). Changes in export and import volumes are most strongly aligned for the established *supertrading* nations, Austria, Belgium, Ireland and Netherlands (Figure VI.2). Moreover, while such correlation is less apparent for the Eastern European economies on average over the 1990s, it is clear that movements in import and export volumes have become increasingly aligned over the period as intra-industry trade has expanded and the trade share of GDP increased (Figure VI.2).

... implies increasing correlation between exports and imports...

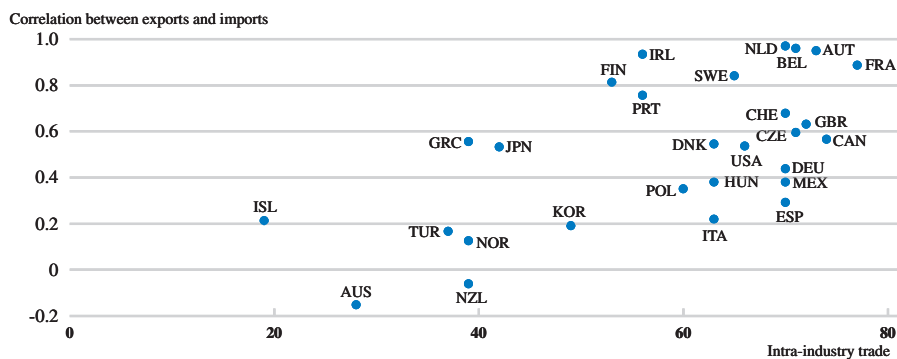
If movements in export and import volumes are closely aligned, then changes in net export volumes will be small, which complicates any assessment of the vulnerability of countries to cyclical movements in their main trading partners. For example, the very high share of Mexican exports going to the United States exaggerates the initial impact of a slowdown in US demand on Mexican GDP, because there is likely to be a coincident downturn in Mexican imports of components. Hence the impact effect on value added produced in Mexico may be smaller than might otherwise be expected. Nevertheless, sustained weakness in US demand may have more important "second round" implications for Mexico if, for example, it leads to falling employment and cutbacks in foreign direct investment inflows.

... which may dampen the impact of downturns in trade on GDP

More generally, the internationalisation of production may mean that the initial consequences for value added of any shock to demand are more dispersed across countries. A corollary is that world trade at the global level is likely to be more responsive to the state of the world economy than in the past. For example, the recent global slowdown has been accompanied by a severe downturn in world trade growth unprecedented since the first and second oil shocks, although the downturn in global

World trade may become more volatile...

Figure VI.1. Relationship between intra-industry trade and the correlation of export/import movements over the 1990s

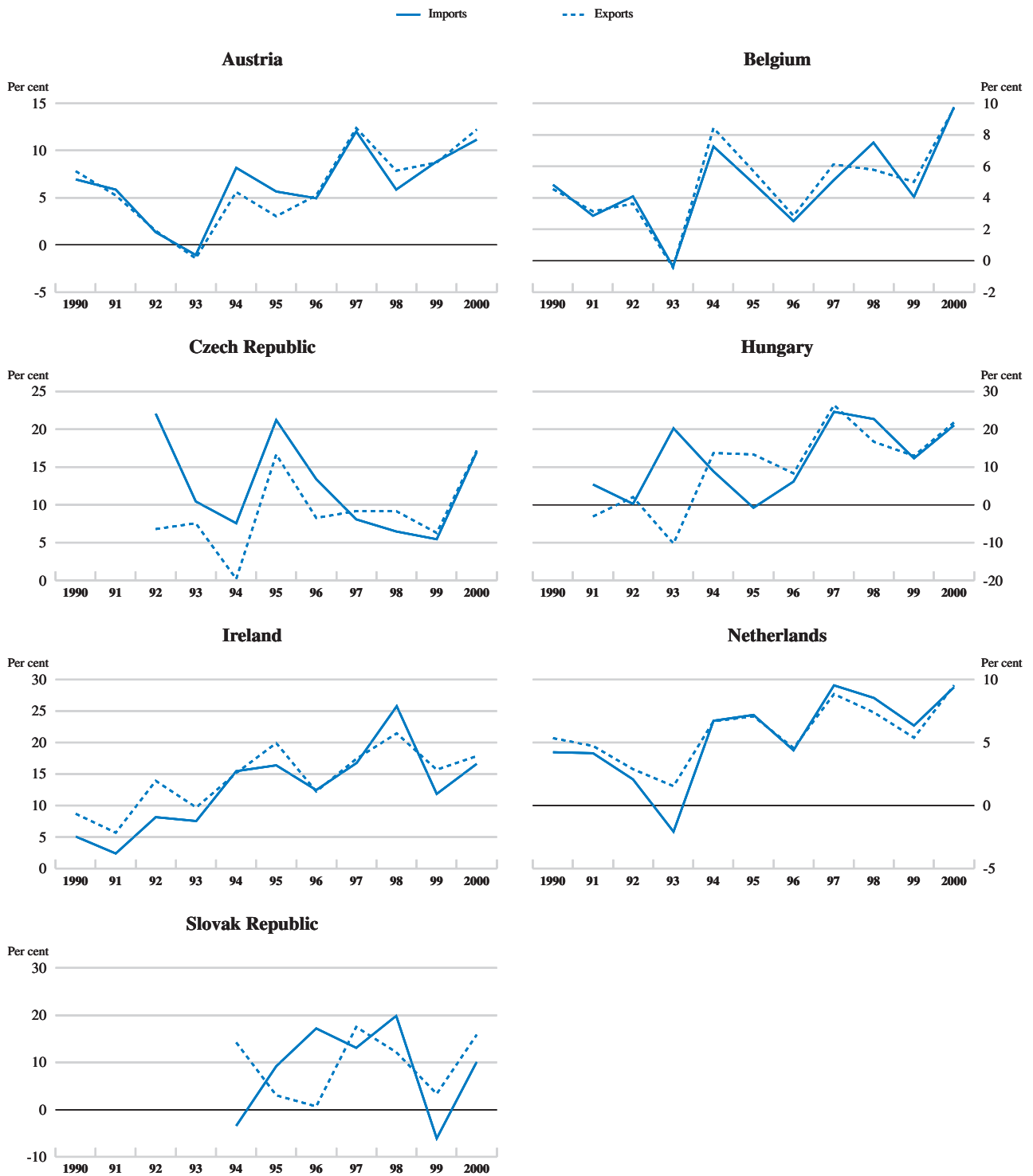


Note: The horizontal axis measures the average manufacturing intra-industry trade as reported in Table VI.1. The vertical axis measures the correlation coefficient between annual changes in export and import volumes of trade in goods and services from 1990 to 2000.

Source: OECD.

Figure VI.2. Correlation between export and import volume growth for OECD "supertrading" economies

Goods and services trade volumes, national accounts, percentage changes over previous year



Note: Scales differ accross countries.
Source: OECD.

GDP growth has so far been relatively modest.²⁰ Thus, past historical relationships may be a misleading guide to interpreting current and future movements in world trade, and these trends also caution against using world trade as a leading indicator.

The concentration of intra-industry and intra-firm trade in particular products means that the international transmission of certain industry- or product-specific shocks may be especially rapid. An obvious recent example of this is the speed of the collapse in trade in ICT products, particularly as regards bilateral trade between the United States and certain Asian countries, and also between the United States and Mexico.

... the transmission of certain shocks may become more rapid...

These trends may also mean that trade is less responsive to short-term changes in price competitiveness than in the past. If an increasing proportion of trade is in intermediate goods as part of an international production chain, then it is unlikely that short-term movements in costs or exchange rates will be allowed to disrupt it.²¹ However, persistent exchange-rate realignments or permanent shifts in relative unit labour costs may eventually lead to the relocation of entire plants to more cost competitive countries. There is also evidence that imports do not “discipline” wages or domestic prices, in terms of keeping down price-cost margins, when they are intra-firm.²²

... and trade less sensitive to changes in price competitiveness

20. Following the first oil shock, world trade growth fell by 6 percentage points in 1974 and a further 8 percentage points in 1975, with OECD real GDP growth falling over 5 percentage points in 1974 and further in 1975. While the recent fall in world trade growth amounts to nearly 12 percentage points in 2001 (compared to 2000), OECD growth is estimated to have fallen by only 2¾ percentage points.

21. There is evidence that intra-firm imports are less price elastic than other imports (see Jarrett, 1985).

22. See Jarrett (1979).

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