

# Why has world trade grown faster than world output?

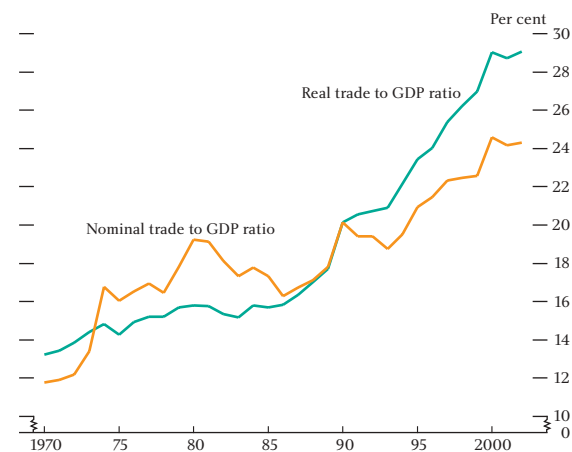
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*Between 1980 and 2002, world trade has more than tripled while world output has 'only' doubled. The rise in trade relative to output is common across countries and regions, although the relative growth in trade and output varies greatly. This article attempts to explain why the ratio of world trade to output has increased over recent decades. It provides a brief review of the key determinants of trade growth and identifies proxies that will enable us to quantify the relative importance of the different channels. We estimate this across a panel of ten developed countries. This will allow us to understand better the path of world trade and thus the demand for UK exports. Furthermore this approach will help us to distinguish between long-run trends in trade growth and cyclical movements around it.*

## Introduction

In the past few decades there has been an increasing integration of the world economy through the increase of international trade. The volume of world trade<sup>(1)</sup> has increased significantly relative to world output between 1980 and 2002 (see Chart 1). Some of this increase can be accounted for by the fact that traded goods have become cheaper over time relative to those goods that are not traded. However, even in nominal terms the trade to GDP ratio has increased over this period. This means other factors may also be contributing to the phenomenon.

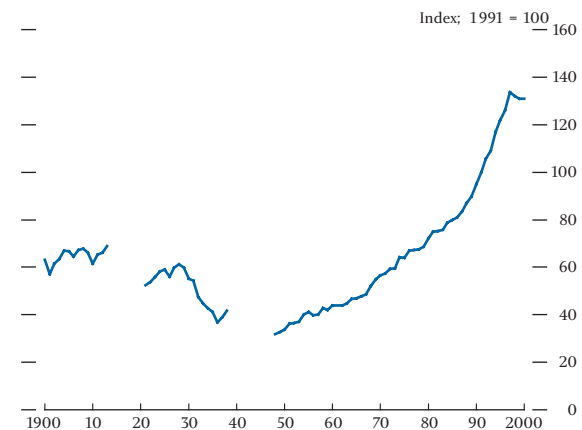
**Chart 1**  
World imports as a ratio of world GDP: nominal and real



Source: UN statistics.

The upward trend in the trade to output ratio is evident since the end of the Second World War, and seems to have accelerated in the past 20 years. Prior to that, trade fell as a proportion of output following the end of the gold standard (see Chart 2).

**Chart 2**  
Volume of world manufacturing trade as a ratio of world manufacturing output

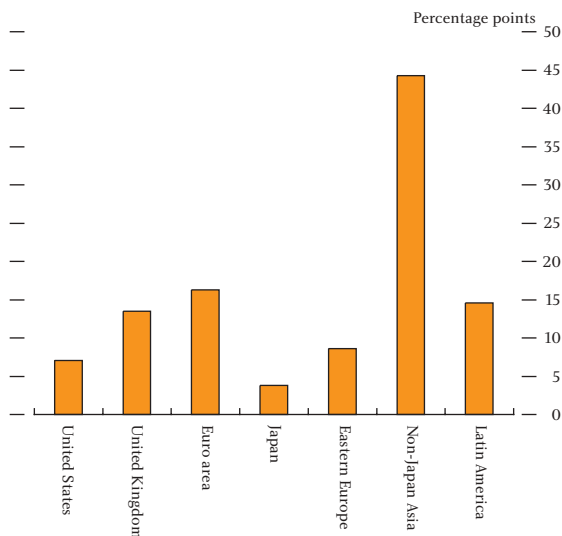


Source: UN Monthly Bulletin of statistics.

The trade to GDP ratio has increased in all major economies in the past 20 years, but as Chart 3 points out the scale of the increase has varied from region to region. It has risen by around 50 percentage points in non-Japan Asia, around 15 percentage points in the euro area, Latin-American countries and the United Kingdom, but by less than 10 percentage points in

(1) Defined in this article as world imports.

**Chart 3**  
**Increase in the real import share of GDP (1985–2003)<sup>(a)</sup>**



Source: IMF *World Economic Outlook* (April 2004).

(a) Eastern Europe: Albania, Bulgaria, Croatia, Estonia, Moldova, Poland, Russia, Slovak Republic and Slovenia. Non-Japan Asia: China, India, Malaysia, Maldives, Myanmar, Pakistan, Papua New Guinea, Philippines, Samoa, Singapore, Solomon Islands, Sri Lanka, Taiwan and Thailand. Latin America: Argentina, Barbados, Belize, Bolivia, Brazil, Chile, Colombia, Costa Rica, Dominican Republic, El Salvador, Guatemala, Haiti, Honduras, Mexico, Nicaragua, Paraguay and Peru.

Eastern-European countries, the United States and Japan.

Explanations for the increase in trade tend to fall into three categories:

- **Falling costs of trade.** Transportation, communication and search, currency exchange and tariffs are all examples of costs incurred when trading goods internationally. To the extent that these costs have fallen over the past 20 years, we would expect trade to increase.
- **Productivity growth in the tradable goods sector.** Many studies have noted that productivity growth tends to be higher in the tradable goods sector than in the non-tradable goods sector. Such a trend should have the effect of increasing the ratio of trade to output.
- **Increasing income per head.** As a country's income rises consumers tend to shift their spending away from basic food and clothing products and into manufacturing goods, which may offer more scope for product differentiation, diversification and international trade.

The next section describes these and other possible reasons for the increase in trade in more detail.

Despite the popularity of this topic in the recent trade literature, there are few empirical estimates on the impact of these channels, with two notable exceptions, Rose (1991) and Baier and Bergstrand (2001). Our aim in this article is therefore twofold: first, to provide a brief review of the key determinants of trade growth and developments in these variables over the past 20 years; and second, to draw some conclusions on the empirical importance of these factors through a model-based approach using panel data estimation techniques. This will allow us to understand better the path of world trade and thus the demand for UK exports. Furthermore this approach will help us to distinguish between long-run trends in the trade to output ratio and cyclical movements around it.

The structure of the article is as follows. The second section describes the main determinants of world trade, drawing on the existing trade literature, and identifies within the data available possible proxies for these. The third section explains how this information can be used to derive a model for trade growth and discusses the results. The last section presents conclusions.

### What determines how much a country trades with the rest of the world?

This section differentiates between inter and intra-industry trade, and explains what factors might be determining the level of trade in the economy as suggested by economic theory. It reviews developments in these variables over the past 20 years for a panel of countries. We have selected (*ex post* and given the available data) a sample of ten developed countries: seven from the European Union (Belgium, France, Germany, Italy, the Netherlands, Sweden and the United Kingdom), Canada, Japan and the United States.

#### Two different types of trade

Models of international transactions tend to differentiate between two different types of trade, that driven by inter-industry specialisation and that driven by intra-industry specialisation.

#### Inter-industry specialisation

Early models of trade focused on the form of specialisation that occurs when countries specialise in the production of different types of goods—for example country 'A' produces cars and country 'B' produces wheat. Countries will specialise in the production of goods that are relatively cheap for them to produce,

either because they have a technological advantage in the production of that good, or because they have an abundant supply of the factors that are used to produce it. Either reason would give the country a comparative advantage in the production of that good. Trade should *ceteris paribus* be greatest between countries that have the largest differences in technology or factor endowments.

One way to see how much an economy has specialised in the output of certain industries is to observe how employment is allocated across different industries at different points in time.<sup>(1)</sup> The OECD STAN database provides annual employment data disaggregated by industry. We calculate an annual measure of the dispersion of employment across 18 industries,<sup>(2)</sup> the coefficient of variation (standard deviation divided by the mean), for every country in our sample. Table A shows how these coefficients of variation have changed

**Table A**  
**'Coefficient of variation' for employment across industries**

|                | Coefficient of variation |      |                   |
|----------------|--------------------------|------|-------------------|
|                | 1971 (a)                 | 2001 | Percentage change |
| Belgium        | 0.97                     | 1.57 | 62                |
| Canada         | 1.28                     | 1.53 | 20                |
| France         | 1.02                     | 1.49 | 46                |
| Germany        | 0.89                     | 1.40 | 58                |
| Italy          | 1.06                     | 1.27 | 20                |
| Japan          | 1.19                     | 1.42 | 20                |
| Netherlands    | 1.14                     | 1.58 | 39                |
| Sweden         | 1.28                     | 1.70 | 33                |
| United Kingdom | 1.21                     | 1.57 | 30                |
| United States  | 1.54                     | 1.72 | 12                |

Source: OECD STAN.

(a) 1979 for the United Kingdom.

between 1971 and 2001. Dispersion across sectors has increased for all countries. The largest increases in the coefficient of variation have been in Belgium, Germany, France and the Netherlands. Such an increase would be consistent with an increase in inter-industry specialisation,<sup>(3)</sup> which should be positively related to the trade to output ratio; the higher the dispersion of employment across sectors, the more specialised an economy and the higher the level of trade relative to output.

### Intra-industry specialisation

Empirical evidence offers little support for models of trade based solely on comparative advantage.<sup>(4)</sup> The main problem is that there are two stylised facts that run contrary to the predictions of such models. First, most trade takes place between structurally similar industrial economies rather than between developed and developing countries: for example, 80% of OECD trade takes place with other OECD economies. Classical trade models would predict that most trade would take place between countries most different in their factor endowments and technology levels.

Second, a large and growing fraction of trade is made up of the exchange of goods produced within the same industry, which indicates the presence of intra-industry specialisation. This form of specialisation occurs when countries specialise in the production of different varieties of the same basic good. For example, both Japan and the United States produce passenger cars. Table B shows that the intra-industry trade share of manufacturing trade has increased gradually since the late 1980s across most of the countries in our sample.<sup>(5)</sup>

**Table B**  
**Share of intra-industry trade in total manufacturing trade (a)(b)**

|                     | 1988–91 | 1992–95 | 1996–2000 |
|---------------------|---------|---------|-----------|
| Belgium/ Luxembourg | 77.6    | 77.7    | 71.4      |
| Canada              | 75.5    | 74.7    | 76.2      |
| France              | 75.9    | 77.6    | 77.5      |
| Germany             | 67.1    | 72.0    | 72.0      |
| Italy               | 61.6    | 64.0    | 64.7      |
| Japan               | 37.6    | 40.8    | 47.6      |
| Netherlands         | 69.2    | 70.4    | 68.9      |
| Sweden              | 64.2    | 64.6    | 66.6      |
| United Kingdom      | 70.1    | 73.1    | 73.7      |
| United States       | 63.5    | 65.3    | 68.5      |
| Average             | 66.0    | 68.0    | 68.7      |

Source: 'Intra-industry and intra-firm trade and the internationalisation of production', *OECD Economic Outlook*, No. 71.

- (a) Intra-industry trade (*IIT*) is measured using Grubel-Lloyd indices based on commodity group transactions. For any particular product *i*, an index of the extent of intra-industry trade between A and B is given by the following ratio:

$$IIT_{i,AB} = \frac{(X_i + M_i) - |X_i - M_i|}{(X_i + M_i)} \times 100$$

This index takes the minimum value of 0 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. Bilateral indices for all goods and trading partners are obtained as a weighted average of the bilateral indices using as weights the share of total trade of A accounted for by B. These are then reweighted for all product classes *i*, with weights given by *i*'s share in total manufacturing trade.

- (b) The absolute level of summary statistics of intra-industry trade is in itself not very meaningful because it depends on the level of disaggregation chosen for the analysis. The focus here is on changes in intra-industry trade through time, which should be less affected by aggregation structures.

(1) A technique used by Imbs and Wacziarg (2001).

(2) We use ISIC Rev.3 1-digit disaggregation, except for the manufacturing sector, which is further disaggregated to the 2-digit level. This allows an employment split into 18 different categories. To get over the problem of reunification in Germany, we use data for Western Germany before 1993.

(3) Although employment shares have been widely used as a measure of sector size in the literature concerned with sectoral specialisation, it is worth noting that for example increases in the contracting out of certain tasks within a firm or industry could mean changes in the coefficient of variation that would not reflect changes in the outputs of a given country.

(4) See Helpman (1999) and Davis and Weinstein (2001).

(5) With the exception of Belgium/Luxembourg and the Netherlands.

These two empirical problems with trade theory based solely on comparative advantage encouraged new motivations for trade that could explain intra-industry specialisation. These new trade theories were based on firms that are able to differentiate their products within a given industry so that their outputs become imperfect substitutes in consumption (Dixit and Stiglitz (1977) and Helpman and Krugman (1985)). If consumers like variety, then differentiation gives firms monopoly power, so firms will seek product differentiation even within the same industry and thus create trade between apparently similar economies.

The differentiation of trade between intra and inter-measures is, in practice, somewhat subjective as the grouping of industries into different categories is arbitrary. As an example, people working in the 'Food, beverages and tobacco' industry might range from marketing consultants to industrial chemists. If one country chooses to specialise in marketing and another in industrial chemistry as a result of comparative advantage then our data would categorise this as intra rather than inter-industry specialisation. The breakdown of the production process of a specific product across countries—so-called vertical specialisation (see Feenstra (1998) and Hummels *et al* (2001))—could have made this problem more acute in recent years.

### Determinants of specialisation and trade

This section describes four specific determinants of the level of inter and intra-industry specialisation and trade. It also describes the data available in order to measure the size of these effects.

#### Country size

The relationship between country size and the level of trade comes from the assumption that larger countries produce a wider range of goods than smaller countries. Say the world has only two countries, one of which produces two thirds of all the different types of goods, and the other that produces one third. If preferences are the same across both countries, and people desire all good types equally, then the residents of the larger country will spend one third of their income on imported goods, while those in the smaller country will spend two thirds of their income on imports. The larger

country can provide a wider range of goods from domestic production than the smaller one. Though the above example is clearly stylised, the result persists in quite a wide class of theoretical frameworks. On a global level, the above result supports the argument that world trade should increase as country size becomes more equal for a fixed number of countries.<sup>(1)</sup> As a proxy for country size this analysis uses the IMF *World Economic Outlook* measure of a country's world output share.<sup>(2)</sup> These tend to be slow-moving; the largest change between 1970 and 2000 has been a 1.8 percentage point fall in the German share of world output.

#### Income per head

Levels of income per head might have a role in explaining trade, as suggested by Linder (1961). He observed that consumers with similar levels of income per head tend to consume similar bundles of goods.<sup>(3)</sup> Even if consumers' preference for variety is the same at different levels of income, budget constraints have an effect on consumption bundles. When income levels are low, consumers concentrate their spending on necessities, such as staple foods and basic clothing. In these sectors it is not possible for firms to create differentiated products, so there is little scope for intra-industry trade. As income levels rise, spending patterns shift towards manufacturing products. These tend to have more sophisticated production processes that allow for product differentiation and may prompt intra-industry trade. Higher incomes, however, also lead to higher expenditure on services, for example eating out in restaurants, which tend to be less traded. This shift could have an offsetting effect as income rises. To compare across countries we use a GDP per head<sup>(4)</sup> measure in dollars.<sup>(5)</sup> Development in this measure since 1980 varies greatly across countries, from a 200% rise in Japan to a 40% fall in Italy.

#### Costs of trade

There are many different ways in which international trade might incur costs over and above those incurred by domestic trade. Such costs include: transport costs and communication costs, imposed tariffs and non-tariff barriers, search costs, the cost of building and maintaining a network of customers, currency exchanges and exchange rate risk.

(1) This argument is developed more thoroughly in Helpman (1984).

(2) These series are calculated using a 'purchasing power parity' exchange rate measure that equalises prices of goods across countries to convert output figures to a common currency.

(3) Markusen (1986) formulated a model incorporating income-dependent consumer preferences, such that the share of income spent on manufactured products increases as income increases.

(4) Data source: IMF *World Economic Outlook*.

(5) As in Rose (1991) and Hunter and Markusen (1988).

Some of these frictional costs may have fallen over the past 20 years. Transport costs and communication costs may have fallen as technology improves. Tariffs and non-tariff barriers to trade have fallen through successive multilateral and bilateral trade agreements and might continue to do so as part of trade agreements such as the 'Uruguay Round'. Capital market liberalisation may also have reduced the cost of foreign currency transactions and have created the ability to hedge against exchange rate risk.

As the costs of trade fall, specialisation becomes more profitable and both inter and intra-industry trade should increase.<sup>(1)</sup> Furthermore, reductions in trade costs due to improvements in communication technology have also led to increases in trade in services such as consultancy advice or financial services often delivered through the internet. Many of these factors are, however, hard to quantify. This article therefore examines the effects of freight costs, tariffs, and exchange rate volatility.

#### *Transport costs, insurance and freight*

One of the most obvious costs to international trade is the cost of transporting goods from one country to another. Transport technologies are continually improving and transport services are also becoming cheaper through increased competition. The goods transported are also changing; some goods are now transported electronically, such as newspapers and magazines, due to improvements in communication technology and others are becoming lighter, for example mobile phones. All this should be reflected in lower transport costs.<sup>(2)</sup>

One way to measure transport costs is by comparing the cost of imports when delivered to the point of departure of the exporting country<sup>(3)</sup> with the cost of imports at the point of arrival in the destination country. The difference between the two prices should therefore be

the cost of transport and insurance for the exported items. Many studies use this ratio as a measure of transportation costs (for example Baier and Bergstrand (2001)) as the data are readily available for a large number of countries and over many years.<sup>(4)</sup>

Chart 4 shows the sample average for transport costs between 1970 and 2002. The available data suggest that transport costs have fallen gradually over the period in our study, from an average of 8% of total import costs in 1970 to about 3% in 2002.

**Chart 4**  
Transport, insurance and freight costs as a share of total import costs



Sources: Bank of England estimates and IMF *International Financial Statistics* (1995).

#### *Tariffs*

A second obvious frictional cost to trade arises from tariffs and non-tariff barriers such as quotas or import standards. Although all of these have been falling as part of multilateral and bilateral trade agreements, this section only quantifies tariff rates. The World Bank's 'World Development Indicators' provide tariff revenue as a share of import costs for the panel of ten countries in this article from 1975 to 1997. To complement these data up to 2001 we use average import tariff rates from the United Nations Conference on Trade and Development (UNCTAD).<sup>(5)</sup> Chart 5 shows how rates

(1) Falling frictional costs have been highlighted by many authors as a key driver in the growth of world trade. See for example Obstfeld and Rogoff (2000).

(2) Transport costs are also affected by the distance travelled, thus increases in intra-European or intra-Asian trade could also contribute to the fall in transport costs.

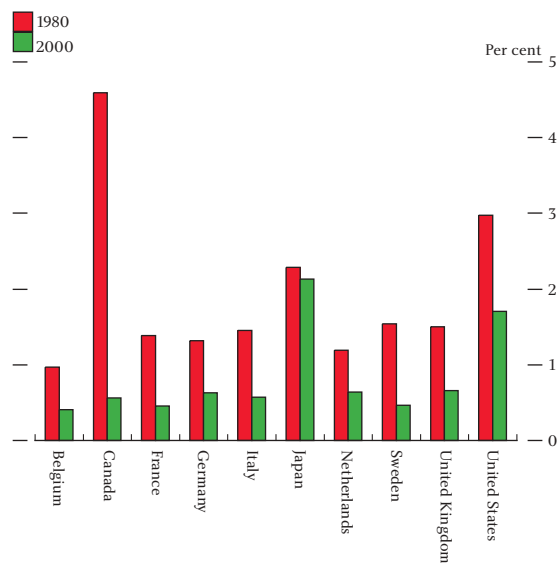
(3) Imports measured 'Free on Board (FOB)' relative to the cost as measured including 'Cost, Insurance, Freight (CIF)'.  
(4) The IMF *International Financial Statistics* (1995) reports CIF/FOB ratios for over 100 countries for the period 1965–94.

For France, Germany and the United States we can obtain annual transport costs up to 2002; we use the annual average growth rate of these to extend the sample period for the other nine countries and avoid it finishing in the mid-1990s. A statistical test for the equality of mean growth across countries cannot reject the hypothesis of the mean growth in transport costs for our set of countries being equal.

(5) Unfortunately, the World Bank measure only records tariff revenue collected by central government. This means that the data are not accurate for countries within the European Union, for whom tariff revenue from extra-European trade accrues to the EU itself. To circumvent this problem, we use tariff revenue for the euro area from the EU Commission (2000); the ratio of total tariff revenue to total trade is used to calculate a tariff rate of extra-EU trade. To turn this into a tariff rate for each country, we then multiply the EU tariff by the share of that country's imports that comes from outside the EU.



**Chart 5**  
**Tariff rates as a percentage of total import costs**



Sources: Bank of England estimates, EU Commission, United Nations, and World Bank.

have fallen in every country over the past 20 years; only in Japan has the tariff rate remained broadly unchanged.

*Exchange rate volatility*

Exchange rate volatility can increase uncertainty about prices for foreign transactions, and so acts as a cost to international trade. Thus, lower exchange rate volatility should lead to an increase in the level of cross-border trade.<sup>(1)</sup>

As a summary statistic of exchange rate volatility, Table C shows the average variance of the daily level of the nominal effective exchange rate in each country over the course of a year over the 1980s, the 1990s and 2000–03.

**Table C**  
**Average annual variance of daily nominal effective exchange rate**

|                | 1980s | 1990s | 2000–03 (a) |
|----------------|-------|-------|-------------|
| Belgium        | 1.79  | 1.39  | 0.40        |
| Canada         | 2.02  | 3.20  | 4.92        |
| France         | 3.57  | 1.47  | 0.58        |
| Germany        | 2.02  | 2.03  | 0.80        |
| Italy          | 3.91  | 4.60  | 0.29        |
| Japan          | 12.47 | 42.54 | 11.24       |
| Netherlands    | 1.60  | 1.30  | 0.51        |
| Sweden         | 9.71  | 4.98  | 2.64        |
| United Kingdom | 17.44 | 8.19  | 2.34        |
| United States  | 24.90 | 7.30  | 13.63       |

Source: Bank of England.

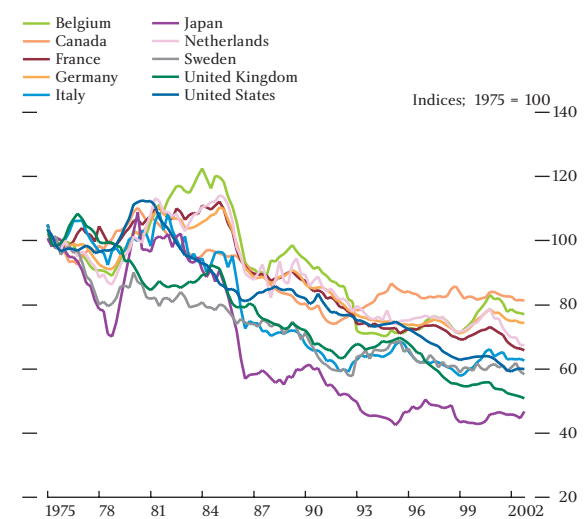
(a) For the euro-area countries' exchange rate the last year available is 2002.

In most countries volatility was lower in the 1990s than in the previous decade. Exceptions are Canada, Italy and Japan. In the euro-area countries we can observe a substantial fall in volatility in 2000–02, after the introduction of the euro in 1999.<sup>(2)</sup> Thus, less uncertainty around the level of the nominal exchange rate could have encouraged more trade.

*Productivity gains in the tradable sector*

Another long-run determinant of a country's import to output ratio is the productivity of the tradable goods sector relative to that of the non-tradable goods sector. Balassa (1964) argued that productivity growth tends to be higher in the manufacturing than in the services sector; to the extent that manufactures are more highly traded than services, this translates to faster productivity growth in the tradable goods sector than in the economy as a whole. If prices are set as a trendless mark-up over the costs incurred in production, this would lead to falling tradable prices relative to non-tradable prices. Such relative price changes should lead to substitution of tradable for non-tradable goods in consumption, and so increase the share of trade in expenditure. The price of goods in the tradable sector<sup>(3)</sup> has fallen relative to the price level of the economy as a whole by around 30% between 1975 and 2002 (on average in our sample) as shown in Chart 6. However, the direction of causality is not necessarily clear. It is possible that the price of these goods has fallen due to the increased competition brought about by increased trade.

**Chart 6**  
**Price of tradable goods relative to whole-economy prices**



Source: Thomson Financial Datastream.

(1) One can think of examples in which exchange rate volatility acts in the opposite direction. For example (although unlikely due to the implied search costs), in times of high exchange rate movements exporters might choose to hedge their risk by importing raw materials from the destination country, thus increasing trade.

(2) These data are available for the ten countries in our sample from 1979–2002/2003.

(3) We are approximating the price in the tradable sector as the domestic-currency import price plus the domestic-currency export price, giving export and import prices the same weight.

## Quantifying the relative importance of these factors

Having discussed some possible proxies for the determinants of international trade, we can attempt to quantify their relative importance through a panel regression across our ten developed countries. To the extent that the increase in trade is a global phenomenon, we would like to assess whether the drivers are also global in nature; to do this we are assuming that the determinants observed have an equal effect on all countries in the long run.<sup>(1)</sup> This should help us to get more precise parameter estimates.

The variable that we want to explain is the trade to total final expenditure ratio. A country's total final expenditure consists of household and government consumption, investment expenditure, exports and stockbuilding.<sup>(2)</sup>

The six potential variables we have identified as proxies for the determinants are listed below.<sup>(3)</sup> The signs in parentheses show the expected effect of each of the variables on import shares. For example an increase in tariffs would suggest a fall (-) in the trade to final expenditure ratio.

- share of world output (-);
- GDP per head (+);
- transport costs (-);
- tariff rates (-);
- exchange rate volatility (-); and
- price of tradable relative to non-tradable goods (-).

The equations are estimated as error correction mechanisms, which map short-run changes in the import to final expenditure ratio to changes in lagged imports, final expenditure and relative tradable prices and deviations from the long-run equilibrium, where the long-run determinants are the levels of all the variables above. The annex contains a full description of the specification.

Chart 7 plots the percentage change in the import to expenditure ratio implied by a 1% change in each of the determinants; statistically significant coefficients are shown in green while white bars indicate insignificant coefficients. The coefficients on exchange rate volatility, GDP per head, relative price of tradable goods, tariffs and share of world GDP are all correctly signed, and significant. The coefficients on transport costs are of the right sign but not significant.<sup>(4)</sup>

**Chart 7**  
Coefficient estimates of long-run determinants

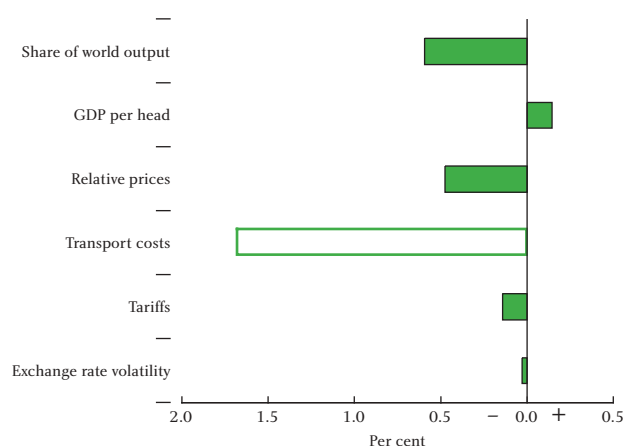


Chart 8 plots the contributions to the change in the world import to expenditure ratio<sup>(5)</sup> from 1980 to 2000, once we have excluded from the estimation the insignificant explanatory variables. The fall in the relative price of tradable goods relative to non-tradables and the fall in tariffs appear to be the largest contributors to the increase in the import to expenditure ratio (65%). Convergence in world output shares, increasing GDP per head and lower exchange rate volatility have all positively contributed to the rise in imports over that in final expenditure. Our estimation also suggests that around 14% of the rise in the import to expenditure ratio is not accounted for by our model.<sup>(6)</sup>

We can also see how the estimated trend in the world import to expenditure ratio based on our determinants

(1) As in Pesaran, Shin and Smith (1999). We test the restriction that the long-run coefficients are equal across countries using the Hausman test (Im, Pesaran and Smith (1996)); all coefficients are accepted to be equal except in the case of transport costs, so according to this test there is parameter homogeneity across most determinants in the ten countries.

(2) GDP equals total final expenditure minus imports. As import growth does directly depend on changes in these expenditure components, an increase in the ratio would reflect an increasing use of imports for consumption, investment or export production.

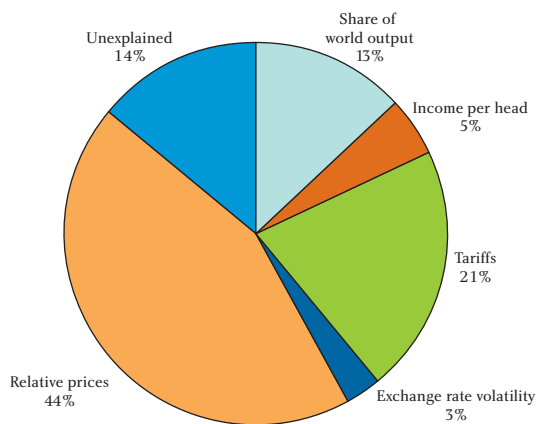
(3) We constructed a data set containing all these variables for the ten countries in our sample from 1979–2001.

(4) The insignificance of this coefficient may be due to the degree of measurement error in our proxy for transport costs. Hummels (1999) describes some of the problems associated with the CIF/FOB ratio.

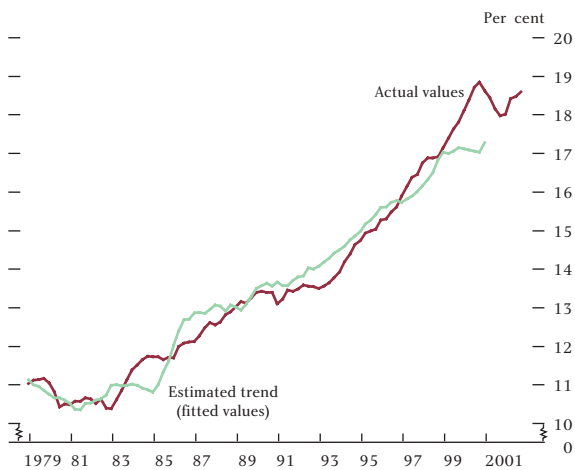
(5) In our estimation the world is defined as the ten countries in our sample weighted by their share in world imports.

(6) If we exclude exchange rate volatility from our specification in order to bring the sample back to the beginning of the 1970s, then GDP per head becomes insignificant over that larger sample period but the rest of the results remain unchanged.

**Chart 8**  
Contributions to the total change in the world import to expenditure ratio (1980–2000)



**Chart 9**  
Estimated (fitted) trend in the world import to expenditure ratio



has moved over time relative to the actual values. Chart 9 shows that, since the beginning of the 1980s, our estimated trend has moved closely in line with the actual import to expenditure share, with a large gap in historical terms between 1999 and 2000, although the actual ratio appears to have fallen back in recent years. Herzberg *et al* (2002) suggest that the composition of total final expenditure over those years could partly explain this diversion. The higher import content of business investment, in particular information, communications and technology (ICT) investment,

together with the strong growth in this investment category over 1999 and 2000 might partly explain the stronger growth in the actual import to expenditure ratio.

## Conclusion

The empirical analysis above has helped us to identify two main causes for the increase in trade witnessed over the past 20 years. First, productivity growth in the tradable goods sector has caused a fall in the relative price of such goods, and so increased trade. Second, tariff rates have fallen in most major economies, reducing the cost of international trade and increasing the returns to specialisation. Between them, these two effects account for about 65% of the increase in the trade to total final expenditure ratio in the past 20 years. There is also a lesser, but still significant role for falling exchange rate volatility, the convergence of country shares in world output and increasing GDP per head. We do not find a significant role for falling transport costs, but this may be due to the poor measurement of this variable.

Our results generally confirm those of previous empirical studies into the causes of trade growth. Rose (1991) finds a large, significant effect from tariff rates and a large but insignificant coefficient on transport costs. Baier and Bergstrand (2001) also find a large and significant role for tariff rates, and a smaller, but still significant role for transport costs.

Our determinants appear to be able to explain a large part of the increase in the import to expenditure ratio in developed economies over the past 20 years. The increase in the ratio between 1998 and 2001 not predicted by our equation may be due to cyclical increases in expenditure on investment and, in particular, ICT goods, as suggested by previous work (Herzberg *et al* (2002)). But since then, the import to total final expenditure ratio seems to have returned towards the more persistent trend implied by falling tariff rates and relative prices of tradable goods.



## Annex

We start the empirical estimation with the reduced-form combination of supply and demand determinants as in Rose (1991):

$$\Delta m/tfe_t = \alpha_t + \beta_1 \Delta m_{t-1} + \beta_2 \Delta m_{t-2} + \beta_3 \Delta tfe_{t-1} + \beta_4 \Delta tfe_{t-2} + \beta_5 \Delta rt_t + \beta_6 \Delta rt_{t-1} + \gamma (ECM)_{t-1}$$

$$ECM = m/tfe - \delta_1 evol - \delta_2 gdpph - \delta_3 rt - \delta_4 tc - \delta_5 ta - \delta_6 sh$$

where  $m/tfe$  denotes the import to total final expenditure ratio;  $m$  is total imports;  $tfe$  denotes real total final expenditure;<sup>(1)</sup>  $rt$  denotes the relative price of tradables to non-tradables;  $evol$  denotes exchange rate volatility;  $gdpph$  denotes GDP per head;  $tc$  denotes transport costs;  $ta$  denotes tariff rates; and  $sh$  the share of world output. All variables are in logs. Dynamic terms are included for all variables for which we have quarterly data.

### Statistical analysis

#### Unit root tests

For the above equation to be valid, if the data are  $I(1)$ , the ECM must form a cointegrating vector. To test for this we use the panel unit root tests suggested by Im, Pesaran and Shin (1997). The tests suggest that most of the variables are not  $I(0)$  in levels.<sup>(2)</sup> Given that we can more clearly accept stationarity when we difference our data, we assume that the data for the overall panel are  $I(1)$ .

#### Cointegration analysis

Pedroni (1999) constructs seven tests for cointegration in heterogeneous panels with multiple regressors—four are based on pooling within dimensions ('panel tests') and three based on pooling between dimensions ('group statistics'). In our full panel the test statistics allow us to reject the null of no cointegration in four out of seven tests.

### Estimation results

We estimate a system by using restrictions across the cross-sectional dimension in the long run as in Pesaran and Smith (1995) and Pesaran, Shin and Smith (1999). They propose estimation by either averaging the individual country estimates, or by pooling the long-run parameters and estimating the model as a system (pooled mean group estimator—PMG—consistent with the characteristics and size of our panel).

Long-run coefficients are shown in the table below. Using the SUR method, the error correction approach seems appropriate with negative and significant coefficients (at the 5% level) for all the countries in our sample except the United States. All the equation residuals are well behaved according to the LM-test for autocorrelation.

|                          | Loading coefficients |        |        |         |             |                 |             |        |                |               |
|--------------------------|----------------------|--------|--------|---------|-------------|-----------------|-------------|--------|----------------|---------------|
|                          | Belgium              | Canada | France | Germany | Italy       | Japan           | Netherlands | Sweden | United Kingdom | United States |
| ECM                      | -0.03                | -0.23  | -0.06  | -0.05   | -0.17       | -0.20           | -0.04       | -0.09  | -0.12          | -0.01         |
| <i>p</i> -value          | 0.05                 | 0.00   | 0.00   | 0.00    | 0.00        | 0.00            | 0.04        | 0.00   | 0.03           | 0.46          |
| Pooled coefficients      |                      |        |        |         | Coefficient | <i>p</i> -value |             |        |                |               |
| Exchange rate volatility |                      |        |        |         | 0.05        | 0.04            |             |        |                |               |
| GDP per head             |                      |        |        |         | -0.14       | 0.00            |             |        |                |               |
| Relative prices          |                      |        |        |         | 0.48        | 0.00            |             |        |                |               |
| Tariffs                  |                      |        |        |         | 0.14        | 0.00            |             |        |                |               |
| Share of world output    |                      |        |        |         | 0.59        | 0.00            |             |        |                |               |
| Transport costs          |                      |        |        |         | 1.68        | 0.07            |             |        |                |               |

*P*-values above 0.05 indicate insignificant coefficients at the 5% level.

(1) Import volumes and total final expenditure data are from the OECD.

(2) Variables that are stationary in levels over the sample period are 'exchange rate volatility' for Belgium, Canada, Germany, Japan, Sweden and the United States and the 'share of world output' for Belgium.

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