



HARVARD Kennedy School

MOSSAVAR-RAHMANI CENTER
for Business and Government **30** YEARS

Structures in the world economy

Eoin Gahan

August 2015

M-RCBG Associate Working Paper Series | No. 49

The views expressed in the M-RCBG Fellows and Graduate Student Research Paper Series are those of the author(s) and do not necessarily reflect those of the Mossavar-Rahmani Center for Business & Government or of Harvard University. The papers in this series have not undergone formal review and approval; they are presented to elicit feedback and to encourage debate on important public policy challenges. Copyright belongs to the author(s). Papers may be downloaded for personal use only.

HARVARD KENNEDY SCHOOL

Structures in the world economy

Working Paper

Eoin Gahan, Senior Fellow, Mossavar-Rahmani Center for Business and Government

13 August 13, 2015

This paper discusses ideas of economic structure as applied to the world economy today. It sets out propositions on what kinds of changes are likely in the future, given the underlying forces at work in business strategy and government cooperation. It uses input-output data for some major economies to see which are changing and in what degree. It finds significant differences in the high-tech area, in particular.

Economic Structures

The word "structure" has a nice solid sound to it. We think of a structure as something that might provide shelter, give a new perspective, be usable for storing things safely, or something to take us to the other side. The word structure is often used in economics. In macroeconomic policy, for instance, there are references frequently made to something called a structural deficit in government finances, which means that the institutions and the relationships between them in a society are so rigid that they cannot easily be changed by the traditional tools of government economic and monetary policy. In econometrics, the structure of a set of equations is given by the parameters, the fixed parts, as opposed to the variables.

However we have to be careful in talking about the world economy. Structural changes in the world economy can refer to changes in the relative importance of the economies of different countries in the total of the world economy. It can also refer to changes in the relationships between those countries and regions, in terms both of trade (exports and imports) and investment (inward and outward). Or it can refer to the sectoral composition of the economy in question, that is the share in different economic sectors (or different economic commodities) in the total for the economy concerned, compared for instance to that of another economy, or in terms of the world total of all activity.

Even to mention the possible interpretations of the word "structure" at the world level shows that we are on rather shaky ground. The reason is that such measures are inherently time-dependent and many of them can change within a few years. It is true that wealthy countries tend to remain wealthy. The original founding members of the OECD are still there today, including the United States, the European economies, and Japan. But they have been joined this by other wealthy countries, such as Mexico, Chile, some of the Eastern European countries, Korea and Israel. It is also true that the European countries and Japan have seen slow economic growth for many years. Clearly the relative importance in terms of the world economy of these different countries has changed and is continuing to change. The growth of China, the wealth of the Middle East, the resources of Russia are all obvious indicators of how much the world has changed.

Turning to the questions of international trade and investment, it is obvious that the "structure" will also change. First of all there is the question of price. The relative prices of different goods and services will change due to changes in consumer demand, changes in technology, and resource depletion. These will all affect the relative importance of different goods and services and thus the range of exports and imports that takes place between different countries and different world agents. These are also some of the forces at work that are encouraging foreign direct investment. By its nature investment is "lumpy", which means it does not grow or decline in a very smooth way. This means that the structure of capital flows will tend to change more noticeably here and there from year to year.

More generally the whole process of globalisation has increased in scale, its scope, and its pace. People want to buy new things and often more of the old things also. They want better services. They want to live in better houses and walk or travel in more comfort and ease. The pressures on the world production system are thus continuing to grow and also to vary, and thus past patterns of trade and investment will not be a good predictor of how these will develop in the future. The flow

of information, the simplified movement of goods and services, and the movement of people themselves all combine to generate new patterns of expenditure and thus of production. Beyond this, there is an even more complex pattern of technological change, with new machines using new materials to make new things. There is ceaseless research and development for food products, for pharmaceuticals, textiles, materials, for better use of energy, for more complex financial instruments, for safer means of transport, for weapons, and for sharper understanding of the lives of individuals. Technology and the structure of the world economy are closely linked, are interdependent, and are growing ever more intense in their activity.

What is changing in the structure, given that so much of what is happening means that it is certainly changing? Let's think about a number of propositions or hypotheses:

- 1. The changes are growing:** For instance, the EU share of total world exports stayed in or around 40-41 per cent between 1995 and 2004, but then began a decline that reached 31 per cent in 2012.
- 2. Changes in the sectoral and geographical structure of world trade are greater than the changes in production structures.** This means, essentially, that the linkages between world economies are more flexible than the internal economies themselves. This is because export and import patterns can shift quite easily and in fact the global marketplace is almost conducted under a searchlight, as a 24-hour activity where minds are changed and choices are made. For instance, the geographical structure of US exports in the period 1995-2011 changed more than did the US production structure.
- 3. Changes in the total structures of economies may be greater than in the domestic structure.** This means that economies themselves are indeed changing as a result of international pressures and also because they have international content. Typically, the machines and the raw materials used do not only derive from domestic producers but from the international market. The super-flexible international market has already seeped into and influenced the domestic structures.
- 4. Changes in the total structures of economies may be less than in the import structure.** This is a corollary of the previous point. Since the national economy is essentially a weighted average of domestic and external activity it follows that its alterations will partly reflect that dynamism at the international level, even if there is no internal dynamism (unlikely)
- 5. Changes in the import content of economic sectors are increasing** as trade becomes more open, more and more products and services are available on international markets and thus the purchasers in individual countries have a wider range of choice and are more likely to shift their sources of supply and bring new products and services onto their domestic markets. In the United States, for instance, the import content of almost all sectors increased between 1995 and 2011, from an average of 3 per cent to 5.3 per cent. Only one sector (electrical and optical machinery) saw a small decline.
- 6. Changes in the import content of economies may not continue at the same pace** as technology becomes more dominant and as suppliers become more concentrated. This of course is a contradiction of the previous point. Clearly both cannot always be true but it may be that 5 is valid for some goods and services but 6 is valid for others. We may have an idea of a perfect market, given that the world is so large and yet so interconnected. But in practice the number of suppliers is more likely to be restricted

both by their access to the necessary goods and services required for their production and also by the growth of larger firms and suppliers. It is not to be expected that a tendency towards concentration will easily be countered. While many countries have competition authorities and antimonopoly commissions, they take different views of their subject matter and in practice the degree of concentration will continue.

- 7. Changes in world production structure are less than in national production structures.** Here we imagine that the intense economic activity at a national and regional level is to some degree a reflection of changes in comparative advantage. Thus some of what is happening at the international level is the structural change as a result of some countries becoming more efficient at producing goods and services and others becoming less so. An obvious example is the movement of large-scale electronics production, especially in the consumer goods field, with Asia the principal growth field and declines in the United States and Europe. There is a somewhat similar relocation of automobile production, although complicated by joint ventures and the need in some cases to be close to consumer markets. Aggregating the world structure, however, would show less dramatic change since some of the production is simply shifted from one region to another.
- 8. National production structures are becoming more alike.** This contention arises from a recognition that technology and consumer tastes are becoming global, readily diffusing, with associated information flows facilitated by widespread access to media and the Internet. It does not mean that all countries are becoming more similar in their sectoral shares of GDP but it means that in so far as they produce a particular good or service they are more likely to do it in a more similar way than they were in the past.
- 9. Competing economies have converging production structures.** This simply means that if countries are competing in certain sectors, there are physical limits to the degree in which they can do so in very different ways. Producing automobiles for instance requires a range of engineering and materials handling skills and to be competitive it also needs intense R&D. There are many variations in the techniques used, the degree of automation, the use of particular metals and the detailed design of engines and control systems but, as competition intensifies, the best methods will replace the less successful.
- 10. Cooperating economies maintained divergent production structures.** Cooperating economies are those that are in a complex relationship of supply. A good example is that of Japan, Korea, China and Taiwan: a simplified summary of the system is that Japan produces capital goods and Korea intermediate goods, for production in China and/or Taiwan. In this case, the same pressures for technology upgrading will not be as strong as in the case of competing companies and therefore their production structures (for the same sector) will not be as close.
- 11. The services sector is not as internationally linked as is the manufacturing sector.** There are two main reasons for this. The first is that services trade has not been liberalised to the same degree as goods trade. For instance, under the WTO, far fewer countries have signed the General Agreement on Trade in Services (GATS) than have signed the tariffs agreement. There are more and more restrictions on services trade and because of the fact that these are usually nontariff measures the total effect is more difficult to assess. The second reason however, is that a lot of services require presence

in the market concerned: offices, staff, equipment will be needed. But this will probably call for a degree of investment in the target market that a manufacturing exporter, for instance, does not need to make.

12. The services sector is becoming internationally linked at a more rapid rate than is manufacturing. Obvious reasons for this include the fact that information diffusion is increasing, and that some services can be delivered remotely, through call centres or over the internet. . Again services technologies can sometimes be transferred more easily than capital goods. Finally the risk of piracy of services technologies may be lower than that of piracy of materials technologies and accordingly both have developed good business models and practices that are more likely to be spread around the world as part of international investment in services.

Basics of economic structure

If we want to talk about how the world economy is changing, we need some simple way to describe its different parts and the way they relate to each other. Using graphs as a way of visualising the information we are trying to process, we find ourselves very often restricted to just two numbers to describe each thing we are talking about. This is because, although there have been some ingenious methods of including more than two dimensions on a two-dimensional page, in practice the visualisation of change is limited, by the flatness of a piece of paper or a screen. So let us try to consider two variables to examine how the world production system is changing. The first is one that measures the degree to which the different parts of an economy are dependent on each other, the level of internal linkages of an economy. The second measures its linkage with the rest of the world

But what indicators will we use to capture these two concepts? To explore this question further we are going to rely on information derived from what are called input-output tables, which we will discuss below. The data we are analysing here was prepared by the University of Groningen on behalf of the European Commission.¹ The project was an ambitious attempt to provide comparable data for the major economies of the world for a number of years (1995 to 2011).

An input-output table gives the inputs and outputs of the sectors of an economy. The outputs are what is produced, and the inputs are what is needed to produce them; the tables allow us to see the interconnections between the different sectors and the degree to which they depend on one another.

We're used to measuring economies by GDP. This is either the sum of final demand (consumption plus investment plus exports minus imports) or alternatively the sum of value-added, which is the total output of each sector less the cost of goods and services used in its production. These are simplified statements but give a rough idea of how the different size of different economies is measured. But input-output tables allow us to look more deeply into the internal structure of an economy. We can see not only how much the individual sectors sell to consumers or to other countries, but how much they sell to each of the other sectors within the economy. And so using

¹ <http://www.rug.nl/research/ggdc/activities/projecten/world-input-output-database-%28wiod%29>

them, it is also possible to see the direct and also the indirect linkages between the sectors. This allows us to see degree of internal integration of the economy, the extent to which the different parts of it depend on one another. We can look at an index of linkage derived from the so-called Leontief inverse, $(I-A)^{-1}$. This matrix summarises the degree of linkage between the sectors of an economy by showing the production response of each sector to a unit increase in demand in each sector. We use the sum of all the elements in the matrix to give a summary indication of the degree of internal linkage of the economy in question.² This is a very simple way of summarising the matrix, and many other more elaborate measures of the interrelationships have been proposed over the years.

For the international linkage question, we can address it through imports. Modern input-output tables separate out the imported inputs from the domestically produced inputs. This means that we can for instance construct a ratio of total imported inputs as a share of total intermediate inputs. This allows us to measure how much the economy is linked to the rest of the world and in particular how much it depends upon it. This is taking a different view of trade. Typically if we think of a country's international dependence we look at its exports and perhaps assess their size in relation to GDP. But this overlooks the fact that the only reason that most countries are exporting is to pay for the imports that they need. Looking at the imports that are used in the producing sectors of an economy shows us to what extent the economy in question is dependent on the rest of the world. Thus with these two simple indicators, we have been able to encapsulate a huge amount of information to give us a very short and sharp perspective on the world economy.

It's important to note that the two indicators are more or less independent of one another. A country can increase its international linkages while also increasing its internal linkages. A broader and richer variety of economic activities can be pursued, and these will be activities that need inputs both from other countries as well as from other firms within the economy. The suppliers may be new businesses as well as existing ones.

The first table here takes a group of key world economies for which the necessary data is available and gives us a picture of how they stood with respect to each other in 1995. The group contains the G-7, the BRICS countries (except South Africa), and a few other significant Asian countries (Indonesia, Korea, and Taiwan). A simple quadrants picture is given to see which countries are above or below the average for the group.

Looking at the first ratio, measuring internal linkage, we can see that the value is high for some advanced countries but low for others. It is lower than average for Japan, Canada, France Italy and Mexico, all OECD countries. The second measure, of international linkage, has below average values for three OECD countries, Australia, Japan and USA. Only two countries, Brazil and Japan, find themselves in the category with low internal linkage and low international linkage.

Turning to the date of 2011 in the second table what is really striking about it is that only three countries have moved from one quadrant to another. Most countries have not in general altered

² This measure will have a value at least as high as n , where n is the number of sectors. Since in the data we are using there are 35 sectors, we subtract this from each observed value so as to scale the indicator and better capture differences between countries.

their relative positions in terms of internal or international linkages. Those that have high or low values, i.e. above or below average values for domestic and international linkage in 1995, have in general the same positioning in 2011. The three exceptions are Italy, UK and USA. Italy now has an above-average degree of internal linkage while in 1995 it was below average. For the US and the UK, however, it is a different story, with both of these moving from above average to below average internal linkage, perhaps reflecting the reduction in manufacturing activity or its off-shoring and the growth of a single sector, financial intermediation. (In the United Kingdom, financial intermediation grew from 6.4 per cent to 7.9 per cent of total output between 1995 and 2011. In the United States, this sector grew from 6.9 per cent of total output in 1995 to 9.4 per cent in 2011.)

The large developing countries China and India have not altered their position as countries with low international linkages and high internal linkages. This is partly because of the size of the economy which in itself makes it more likely that internal linkages will develop, as well as the movement of manufacturing activity from advanced countries.

Table 1: Domestic and international linkage in 1995

1995	International Linkage		
	Low	High	
Internal linkage	High	Australia, China, India, Russia, USA	Germany, Korea, UK
	Low	Brazil, Japan	Canada, France, Indonesia, Italy, Mexico, Taiwan

Table 2: Domestic and international linkage in 2011

2011	International Linkage		
	Low	High	
Internal linkage	High	Australia, China, India, Russia	Italy, Korea
	Low	Brazil, Japan, USA	Canada, Germany, France, UK, Indonesia, Mexico, Taiwan

Looking only at whether these indicators are above or below average for the group of countries examined is of course only a first attempt to summarise the position. The graph below shows the

actual values of the indicators in 1995, and there are some important points to be made about it. The first is that the position of China is really different from the rest of the world. Its internal linkages are much stronger than those for any of the other countries. Part of the reason for this is China's size as an economy. Although incomes in 1995 were far below developed country levels in 1995 (and are still well below today) the economy was already fairly advanced or at least well diversified in manufacturing terms. Thus from the international linkage point of view, China could source some input requirements internally and the vast range of products and services that it had to import for its export production was nevertheless overwhelmed by the even vaster range of items that it could find more cheaply domestically. Thus China was pursuing, consciously or unconsciously, a narrower and more selective import strategy than those of advanced countries, because it was able to find so many (although not all) of the things it needed on its own home market at the lowest price. Other countries (including developed countries) found that while they needed to import some things that they did not produce locally, they also found that an awful lot of things that they did produce locally could nevertheless be imported from China far more cheaply.

The most noticeable change over the sixteen year period is the way in which the countries that were outliers in 1995 such as China, Mexico and Taiwan have become more so in 2011. China in particular is following a unique path of low international linkage together with even higher internal linkage. This is in spite of its ever-increasing role on world export markets, and the growth of FDI into China. By a process of rapid development its internal structure has become ever more elaborate, and its dependence on imported inputs for its production has been maintained at one of the lowest levels.

The other outliers in 1995 have varied in their evolution. Japan is little changed. Its international linkage has increased, while its internal linkage has in fact declined somewhat. Canada's position has changed quite a lot. An outlier in 1995, it is near the centre of the group in 2011. Its international linkages have declined, and its internal linkages have increased, presumably due to the combined effects of NAFTA and the raw materials and energy growth. Russia, in a more central position in 1995 has become almost an outlier by 2011, mainly because of the fall in its international linkage.

Figure 1: Internal and international linkage values in 1995

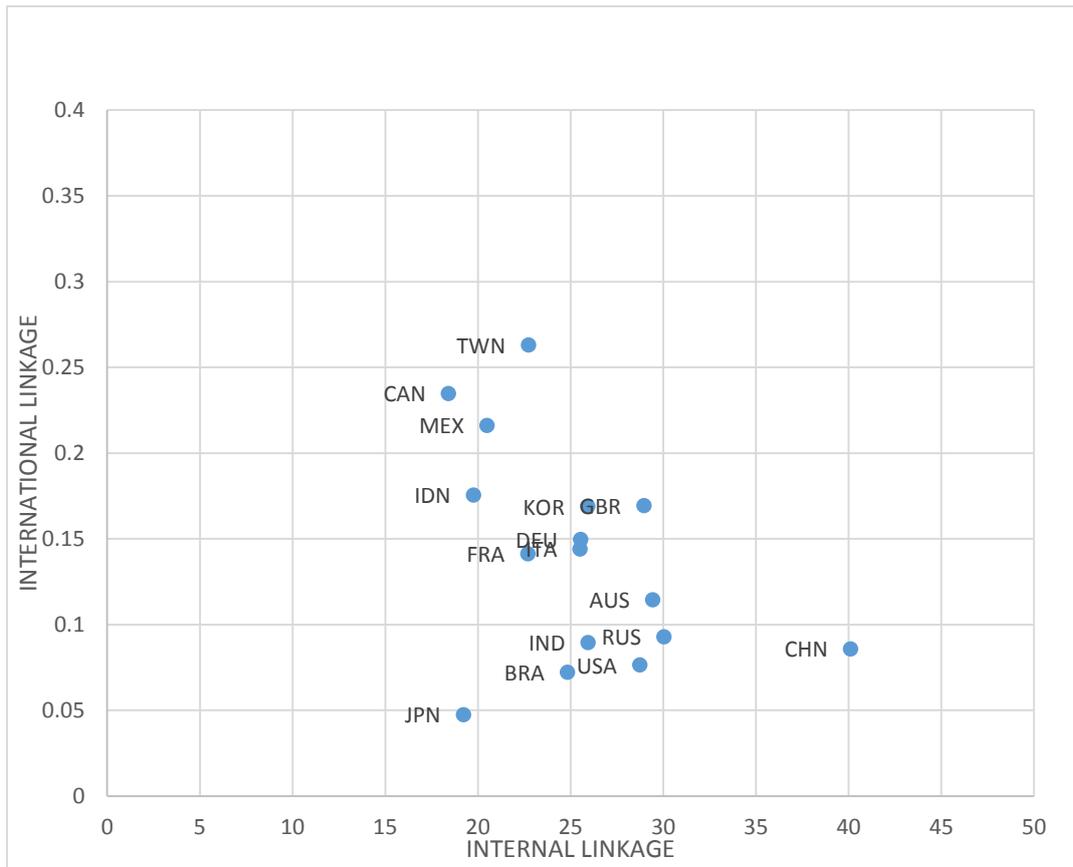
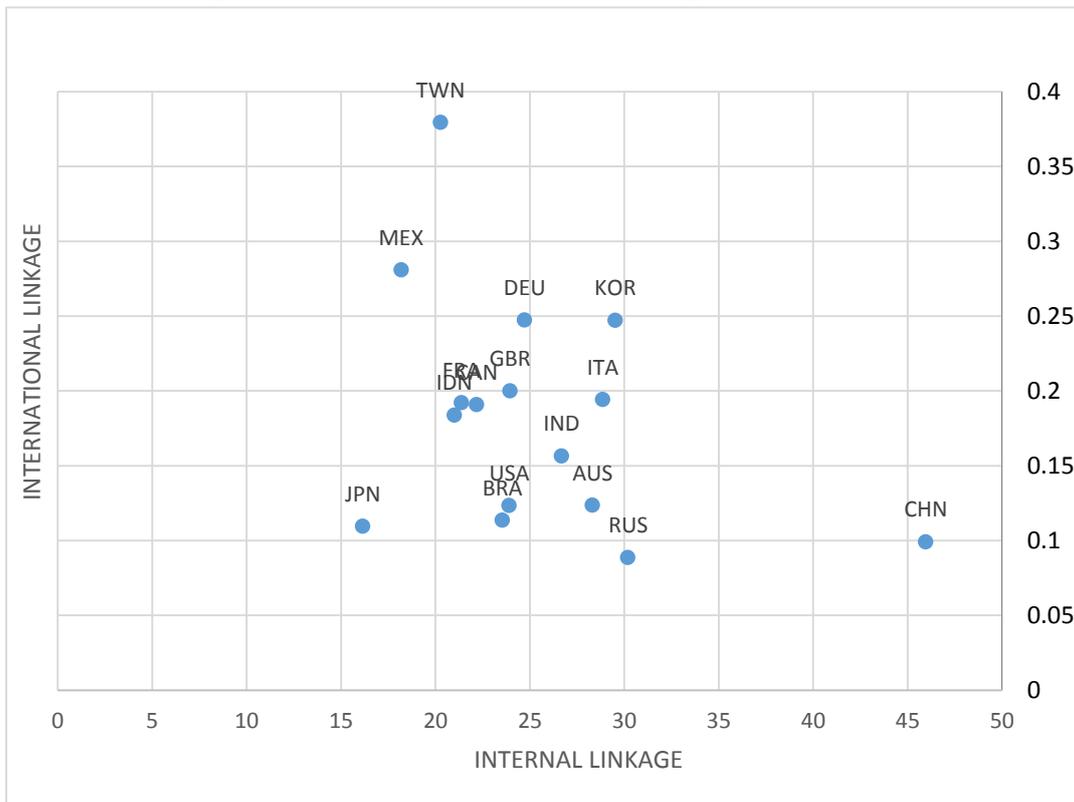


Figure 2: Internal and international linkage values in 2011



The rise in position of Korea and Germany, due to their increase in international linkage, reflects the continuing growth and diversification of their industries and services sectors, with increased requirements for inputs from other countries. At the same time their values for internal linkages have been maintained and in Korea's case slightly increased.

There is no uniformity with respect to internal linkage: it decreased in nine countries and increased in the remaining seven. The largest absolute change is in China, where the increase was 5.8, but the next largest changes are in the UK and the United States, where the declines were 5.0 and 4.8.

On the other hand, the general growth in international linkage is reflected in almost all of the countries: only Canada and Russia can be seen to have decreased international linkage, and this almost certainly reflects the rapid growth in the energy sector in both countries which has the effect of crowding out the significance of intermediate imports to the rest of the economy. Putting it another way, the import content of energy resource production is relatively low, and the size of this activity has greatly increased: the weight of energy in the economies is such that the ratio of imports to total activity has declined.

Looking at the biggest and smallest values for each of the countries give some surprising results. For instance, China was the country with the highest internal linkages both in 1995 and 2011. The lowest internal linkages in 1995 were in Canada, but in 2011 it is Japan that has the lowest internal linkages. Japan had the lowest international linkages in 1995 and Taiwan the highest. Taiwan kept its leading position in 2011 while Russia has the lowest value.

The indicators used here have of course their limitations. Looking at the graph for 2011, and seeing countries such as India and Indonesia in among the developed countries certainly looks anomalous to the casual observer. Are we really saying that the economies of India and Indonesia are similar to those of the UK, Canada, Australia, and Japan? The answer is yes but not in an obvious way. We are not suggesting, for instance, that the levels of income, equality, diversity of infrastructure, educational attainment, health systems and sophistication of manufacturing and services are the same in all these countries. Nor are we saying that in fact India and Indonesia, even today, have the same qualities of public administration, of ease of doing business, and of judicial integrity, as are found in the other countries. But there is nevertheless a sense in which these economies are similar to some extent in the way in which their economies depend on those of other countries, and similar also in the way in which their economic sectors are linked to each other.

The measure of international linkage does not mean that all the countries with similar values for this measure are importing the same kinds of goods to the same degree, or that they can all afford to do so, or that they are might not be better off importing different goods, or that they might be even better all by producing more of the things themselves, or by reducing their consumption of things such as oil or coal. But it does mean that productive activities are undertaken in a way which have similar dependencies on imports, whether goods or services, from outside. In that sense they have made similar choices with regard to integration with the rest of the world economy, insofar as these choices have been open to them. And this means that they have taken similar steps towards integration into what is a globalised world.

Given, however, that these indicators refer to the economy as a whole, it must also be remembered that a wide range of different economic activities is covered in the total. The detailed sectoral breakdown of India's activities, or those of Indonesia, will be very different from those of Japan or of Canada. However this is the first step and in the next section we will look in more detail at some of the sectoral stories to be told and the way in which structures are changing on the ground, again using the same data source.

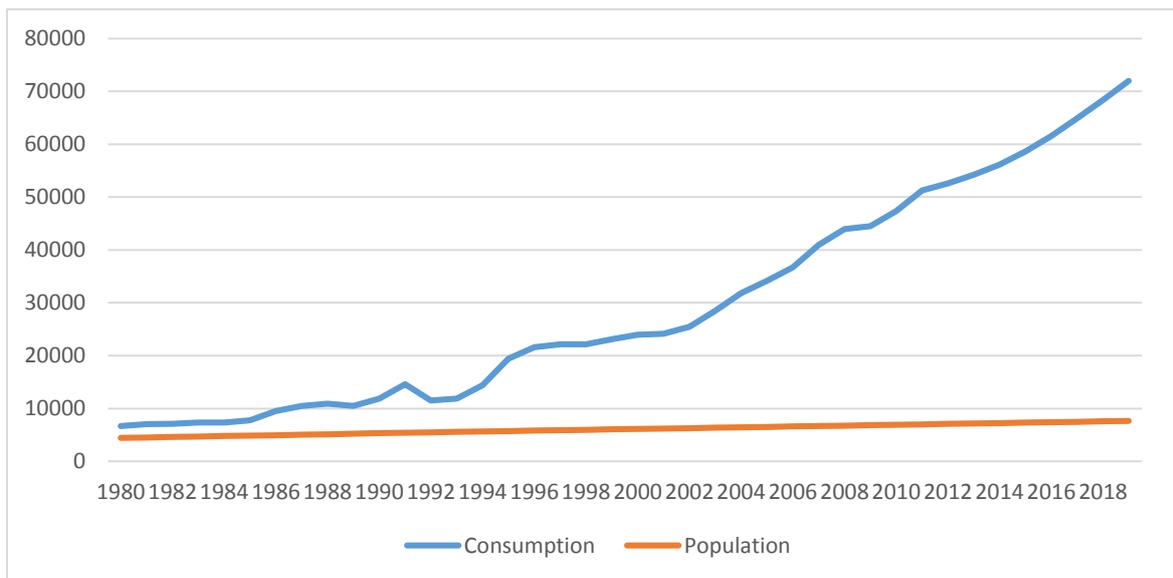
Consumption

The economist's use of the word "consumption" is a rather strange one. It is used to describe the total of goods and services that are used up, or it can be the activity of using them up, whether this is by households, businesses or governments. But of course we may remember the old name for tuberculosis, a wasting disease of the lungs, and a very unpleasant scourge that is on the increase. Consumption sounds very unattractive. Yet for most economists, consumption is a good thing, because the using up of goods and services shows that people want them and so more of them are likely to be produced, giving more employment, more spending, more tax paid to government and profits to investors. Thus consumption leads to more consumption.

Consumption cannot be measured directly: we cannot look through everyone's drinks cabinet to see how much is left of the bottles that they bought, so consumption statistics are based on spending. This is never a completely accurate measure: if you eat vegetables that you have grown yourself this will not appear in the statistics. And in some developing countries there are people who grow their own food and live off it, using no cash transactions at all. The key point about consumption is that it keeps increasing at a global level and as the graph shows the trend is very much upwards, with the exception of a dip in the early 1990s. There are several reasons for this.

The first is population growth: world population continues to increase and will keep doing so for a very long time to come. It was 2.5 billion in 1950 and is projected to be 9.5 billion in 2050. Although the rate of increase is expected to decline, it is still seen as reaching 10.5 billion in 2100. Clearly, more people can lead to more consumption, although birth rates are higher among the poor, so the total of consumption may not be proportionately affected. But what the graph shows clearly is that in fact world consumption has been growing much more than has population.

Figure 3: Growth of world consumption 1980-2018



Source: *Population (millions): United Nations, Department of Economic and Social Affairs, Population Division (2013). World Population Prospects: The 2012 Revision - Special Aggregates, DVD Edition; Consumption (US\$ billions, deflated): Author's calculations based on IMF World Economic Outlook 2014 database*

The end of the chain: the consumer

The conventional view of global value chains (GVCs) is that they involve producers. We see businesses deciding on the best sources for the inputs that they need, the best locations to carry out their production and the best markets for their output. The most sophisticated businesses do not treat these as separate problems to be separately solved. Instead they see it as a single complex problem to be solved dynamically, taking account of changes in supply, changes in technology, and changes in consumer wants, and all of the analysis taking into account the infrastructure, the regulatory environment and political considerations. But remember it is the consumer who is at the end of the chain. Without the consumer, all the other considerations are irrelevant. If there is no demand, production will cease. Consumption is the cause of economic activity.

We can see a number of factors at work that affect global consumption. The first is that of rising living standards in households. As people get more money, they are inclined to save more. But they will still spend more money in absolute terms. Moreover, they will spend it on a wider range of goods and services. When they are very poor, they will think only of basic needs: food, clothing, shelter. As incomes rise other things come into the shopping basket. People start to buy things not because they need to but because they want to. The clothes they bought last year (or last week) seem no longer attractive (or perhaps, because more food has been eaten, they no longer fit). Services are outsourced, meaning more business for gardeners, hair dressers, child minders, and golf instructors. And not just personal services, but a wide range of internationally traded services, such as banking, insurance transport, entertainment and tourism. Further increases in income may lead to patronage of the arts but perhaps to less attractive patterns of expenditure that include cocaine or the purchase of politicians.

Moving beyond basic human needs to consumer goods and services is, however, the biggest driver of growth in consumption. And huge amounts of business research are based on that idea. Because of higher growth rates in the Asia Pacific region compared to those in the United States or Europe, a lot of expectations have been raised. Rising incomes in Asia Pacific have not only led to higher consumer expenditure but also changes in consumption patterns. Asian consumers are shifting towards greater discretionary spending, especially spending on communications, education and health goods and medical services. Communications is the fastest growing consumer spending category in Asia Pacific over the 2007-2012 period, with a real period growth of 52.4 per cent, compared to the total consumer market growth of 27.2 per cent. Health goods and medical services growth was 51.7 per cent, and, in China, the growth was 114.3 per cent in real terms over the same period. Education is another growth area, and between 2007 and 2012, consumer expenditure on education rose by 93.8 per cent in real terms in China, by 90.7 per cent in Indonesia and by 53.0 per cent in India.³

These changes in household consumption patterns will arise from a number of factors, including increasing knowledge diffusion through traditional media, through the internet, and through travel, because all these help to develop a taste for international goods and services. All three factors are growing stronger:

- Literacy rates worldwide are increasing, from 76 per cent for adults in 1990 to a projected 86 per cent in 2015. East Asia and the Pacific is seeing even bigger increases, with the adult rate of 82 per cent in 1990 projected to be 96 per cent in 2015. And the future looks even better, with youth literacy rates approaching 91 per cent worldwide in 2015.⁴
- In 2014, about 36 per cent of households in Arab states and in Asia and the Pacific had internet connections. The numbers using the internet in the population have risen significantly: in the Arab states it is 41 per cent, and in Asia and the Pacific it is 32.4 per cent, up from 8.3 and 9.4 in 2005.⁵
- Chinese tourism abroad has increased almost tenfold between 2000 and 2013, and China is now the largest country in terms of tourism expenditures. Tourist arrivals from Asia and the Pacific were 250 million in 2013, about a quarter of the world total, well behind Europe, which still accounts for more than half of tourist origins, but well ahead of the Americas which accounted for 172 million.⁶

³ An Hodgson, "Regional Focus: Asia Pacific's Changing Consumption Patterns Spur New Opportunities" Euromonitor International, 2 April 2013 <http://blog.euromonitor.com/2013/04/regional-focus-asia-pacifics-changing-consumption-patterns-spur-new-opportunities.html>

⁴ UNESCO Institute for Statistics. UIS Fact Sheet. "Adult and Youth Literacy", September 2014. <http://www.uis.unesco.org/literacy/Documents/fs-29-2014-literacy-en.pdf>

⁵ ITU http://www.itu.int/en/ITU-D/Statistics/Documents/statistics/2014/ITU_Key_2005-2014_ICT_data.xls

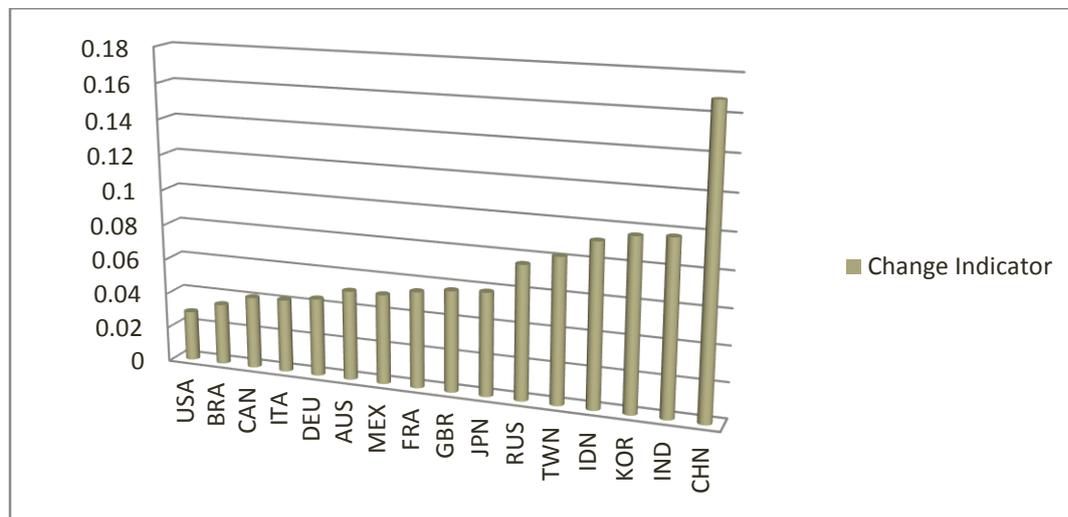
⁶ World Tourism Organisation (UNWTO) Tourism Highlights 2014 http://dtxtq4w60xqpw.cloudfront.net/sites/all/files/pdf/unwto_highlights14_en.pdf

And these are passive causes of increased consumer interest in new goods and services. But multinational marketing also helps. Fast-moving consumer goods (FMCG) are a field where branding is now playing a key role globally.⁷ Similarly, luxury goods are now of interest to all world regions.⁸

Converging consumer expectations are not limited to better food and better TV. People in most countries want their governments to provide better services also. People have aspirations with respect to the quality of life as determined by the schools and universities, the hospitals and clinics, the roads, the water supply, the sewage and waste disposal. Thus government consumption will be increasingly determined by expectations of government services (health, education, infrastructure maintenance, and administration (including government use of IT services.) Using input-output data we can look at how the sectoral composition of total (i.e. households plus government) consumption is changing over time. We can also see whether that structure is getting closer to that of other countries.

The graph below shows how the structure of consumption has changed in a set of countries over the period 1995-2011. China’s consumption structure has changed the most, and the US the least.⁹ Apart from China, the countries with most change in consumption structures are India, Korea, Indonesia, Taiwan and Russia. Apart from the United States, the country with least change in consumption structure is Brazil. Separate analysis indicates¹⁰ that China’s consumption structure (the sectoral breakdown of consumption) is tending more and more towards that of the United States, rather than towards that of other countries.

Figure 4: Change in the sectoral structure of total consumption, by country



⁷ Kantar World Panel. “2014 Brand Footprint Report”.
http://www.brandfootprint-ranking.com/media/ugc/files/brand-footprint-report_6.pdf

⁸ Deloitte. “Global Powers of Luxury Goods 2014”
<http://www2.deloitte.com/global/en/pages/consumer-business/articles/global-powers-of-luxury-goods-2014.html>

⁹ Using standard deviations

¹⁰ See Appendix 1.

Structures and sectors

The ways of breaking down economic activity at a national level into something closer to making things or providing services vary. Some economists divide the economy up into primary, secondary and tertiary, with activities such as agriculture and mining in the first category, manufacturing in the second, and services in the third. Many economists have discussed how economic development seems to involve each of the three sectors taking it in turn to be the largest, starting with primary or rudimentary economic activity, moving on through industry, and finally with a peak in the services sector. (Here we are using the terms “manufacturing” and “industry” more or less interchangeably, although in fact industry includes manufacturing, and also mining as well as utilities.)

This view has to be modified for at least two reasons. Firstly, there is the growing integration of the world economy which means that national economic development in one country interacts with that in other countries. Straightforward sectoral progression of the idealised kind described above will not happen if it has not already happened and may be arrested if it is not complete, simply because it will be affected by other progressions in other parts of the world.

The second problem is that sectoral classification is not as straightforward as it used to be. The idea of a services or tertiary sector as the last stage of development is no longer realistic. In fact, the idea that there should even be distinct industry and services sectors is now probably a step too far. What has happened in the world of business, which economics should attempt to describe, is that manufacturing and services at an advanced level are linked together as a dynamic complex that is the focus of activity of the fastest growing, wealthiest, most innovative, and most entrepreneurial businesses. This sector includes a huge range of activity, from electronics, software, telecommunications, new materials such as carbon fibre, nanotechnology, bio pharma, genetic engineering, with closely linked services such as venture capital, data analytics, and so on. The different technologies use aspects of the others. Many companies cover many of the above fields. Others specialise, but work in close partnership relationships with other companies that have different specialisms. Most of them have their cooperation enhanced, and the complexity of their activities intensified, by the enabling technologies of social media, cloud computing, sensors and the like. The loose term “high tech” is often applied to all of this activity.

The concept of high tech does not sit well with traditional classifications of economic activity. Formal classification systems such as the International System of Industrial Classification of All Economic Activity (ISIC) developed by the United Nations, or the Nomenclature générale des Activités économiques dans les Communautés européennes (NACE) codes used in the European Union. It is not only that a high-tech company in practice will be working across several of the sectors contained in the classification. It is also that the sectors are seen as separate activities, while the high-tech company may in fact, through innovation in products or processes be overcoming that separation. Moreover the company may in fact, through its own activities and its interactions with others (and perhaps with research institutions also) be engaged in an iterative complex of activity that is far removed from the somewhat linear idea embodied in the activity of a traditional business, where the company buys raw materials, processes them, and sells the resulting product.

The idea of high-tech is widespread and important in policy terms. Universities want to become centers for high-tech, as do cities and countries. The financial sector is anxious to fund it. Politicians stress its importance: it is seen as the source not only of export earnings, creating products that everyone will want, but also as a source of highly paid jobs, jobs that can somehow replace the jobs lost in traditional manufacturing that appear to have moved to countries where the wages are lower. The economic effects of high tech trade are evident also in international trade:

“We expect trade in high-tech goods to outpace growth in total merchandise exports, resulting in the value of high-tech exports increasing more than three-fold by 2030” ¹¹

Can we be more precise about what we mean by high tech? Given the difficulties of existing sectoral classifications, there is a tendency to focus on the products, to define high tech by the kinds of things that come out of it. This is understandable because the products are easier to characterise than the processes that produce them. But it is less than ideal, firstly because the products themselves may often have short lives in the marketplace and also because a focus on the processes brings us closer to the heart of what high tech means, in the almost biological way in which companies, finance, consumers, governments and research institutions interact to generate new products and services and new combinations of products and services.

One definition comes from the bank HSBC, and is given in terms of trade commodities, using the Standard International Trade Classification (SITC):

- Office machines and automatic data-processing machines (SITC code 75)
- Telecommunications equipment (SITC code 76).
- Electrical machinery and appliances (SITC code 77)
- Photographic apparatus and optical goods (SITC code 88)

The European Union statistical office (Eurostat) uses the following definition:

“High technology products are defined according to SITC Rev.4 as the sum of the following products: Aerospace, Computers-office machines, Electronics-telecommunications, Pharmacy, Scientific instruments, Electrical machinery, Chemistry, Non-electrical machinery, Armament.”¹²

Notably absent from both of these definitions is the automobile sector, although arguably its current focus on materials science, automation and flexible manufacturing systems means that it is as much or more high-tech than some of those included above. Another problem is that a lot of the products listed have been commoditised, in that the products or their key components have become widely available from a wide range of producers. An obvious example is the computer, whose components can be bought easily by a new manufacturer in a country where computers have up to now not been produced. But the biggest difficulty is that services are increasingly high-tech in character, and cloud-

¹¹ HSBC Global Connections Report March 2014

¹² <http://ec.europa.eu/eurostat/tgm/web/table/description.jsp>.

based businesses, advanced financial services, and the like will not be found in the current categories.

However, since we are using the standardised input-output tables for analysis, the definition of high tech is based on the sectoral breakdown in those tables. Based on the above considerations, we take the following sectors as high-tech:

Machinery not elsewhere classified
Electrical and optical equipment
Transport equipment

This unfortunately excludes pharmaceuticals, but these are not separated out from chemicals in the tables.

Exports and high-tech are two subjects that are often linked. The policy and business interest in high tech is really driven by two concerns. The first is growth. Activities that use innovative means to develop and produce new products will often see spectacular growth if they are successful, and particularly if they are starting small or from zero. The second consideration is the global market. High tech development is usually with the world market in mind from the beginning, and thus it is intrinsically export-oriented. And exports appeal to policy makers as necessarily good things, something to be encouraged and applauded. From a business point of view exporting high-tech goods is a way to achieve the necessary scale, and even if the product or service is not very successful internationally it may still achieve a significant volume of sales, many times greater than it would have achieved had it been confined to the domestic market.

It's already been remarked that high-tech exports are expected to grow much faster than total exports. This implies that the high-tech share of the total will be increasing. How big a share of total exports is formed by high-tech exports at the moment? And how has it evolved? Calculating the ratio between the two from the data in the input-output tables allows us to answer this question. The graph below gives a summary.

In 2011, only two countries had the distinction of having more than half of their exports in the high-tech category, Taiwan and Korea, and both of those had shown an upward trend over the period from 1995. Japan had the highest share in 1995 at almost 60 per cent, but this declined in more recent years to below the 50 per cent line, yielding first place to Korea and Taiwan.

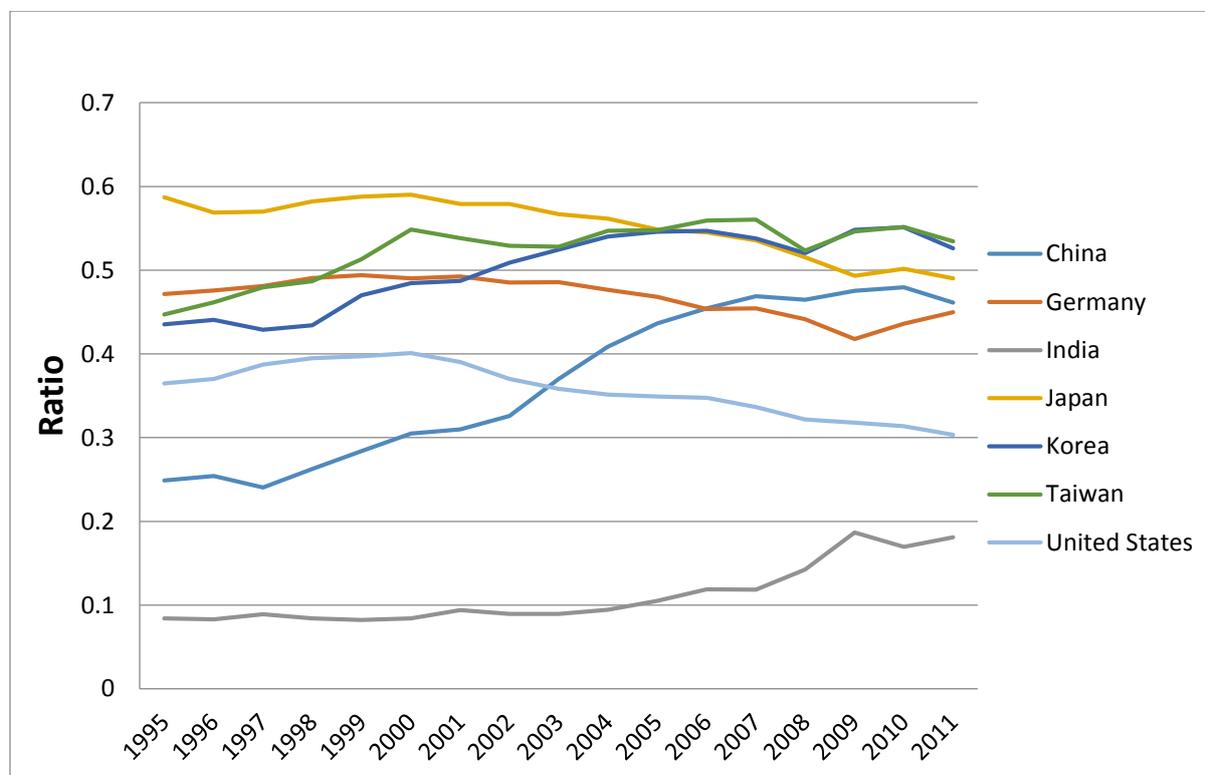
China is one of two countries that appear to be making steady progress in increasing the share of high-tech exports in total exports: its share was about one quarter in 1995 but by 2011 was approaching one half. It overtook the United States in 2003 and Germany in 2006. The other country showing a steady upward trend is India, although it started from a much lower base than China did. Nevertheless it has also almost doubled the share, from under 10 per cent to approach 20 per cent.

Germany appeared at the outset to have a declining share but the last few years have seen an upturn. Its advanced automobile and energy equipment have clearly contributed to this result. The two indisputable declines have been in Japan and the United States.

In general the problem with most ratios being used as indicators is that they change even if only one of the values used has changed. Thus the decline in the ration of high tech to total exports of China

in 2011 might be due to a fall in the high-tech exports or a fall in both, or a rise in high tech exports but an even greater rise in total exports. (In fact, China's high-tech exports grew by 15 per cent in 2011 but its total exports grew even more, at 20 per cent).

Figure 5: Ratio of High-tech exports to total exports, 1995-2011

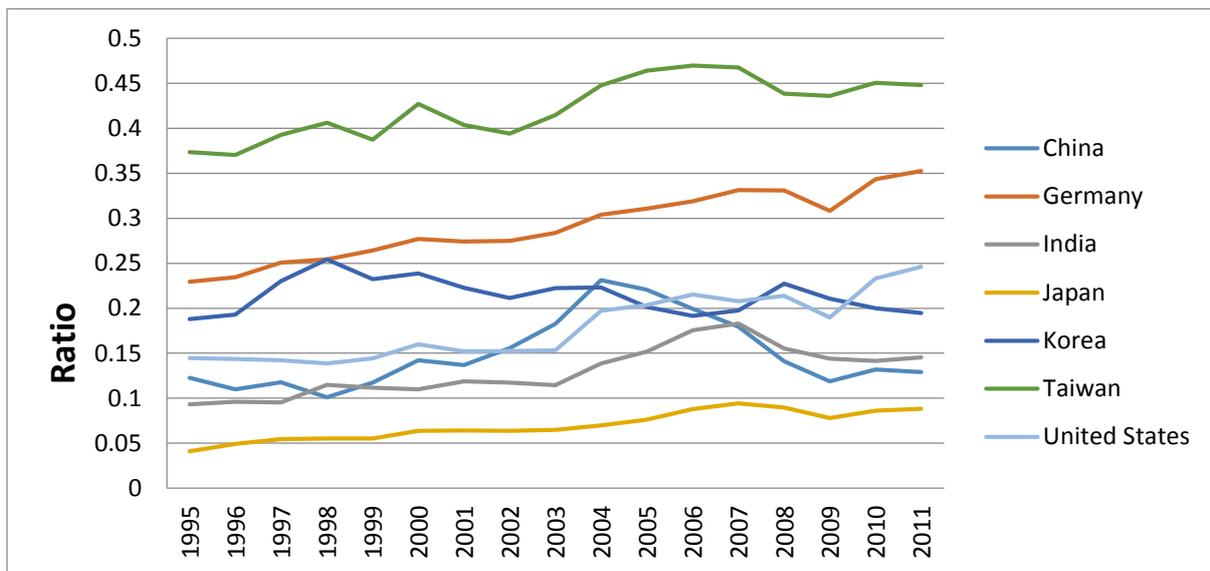


Another way of looking at the high-tech sector in a country is to see how much it is using imported inputs in its production. This proportion has perhaps more significance for high-tech in particular, since the combination of R&D, innovation, finance and entrepreneurship is more difficult to exploit successfully if essential elements are not available domestically. Taking the same indicator of international linkage used above, how does the high-tech sector perform? For simplicity we plot a selection of the countries over time in the graph below. The graph shows that there is an upward trend everywhere except in China. Again the point must be made: this does not mean that China's high-tech sector is becoming disconnected, since it will continue to be driven by world demand. But it does mean that it is becoming less dependent on imported inputs, in contrast to the rest of the world whose high-tech sector appears to be becoming more so. This can mean that China's high-tech sector is finding more of what it needs within China, but there are also grounds for thinking that concerns over intellectual property rights¹³ may make it more difficult for China to source internationally.

¹³ The IP Commission Report: The Report of the Commission on the Theft of American Intellectual Property. http://www.ipcommission.org/report/IP_Commission_Report_052213.pdf

The dependence is highest for Taiwan, where the ratio is around four times the value seen for Japan, which has the lowest value. Strikingly Germany is the second highest share after Taiwan. China is different because of the sheer size and rapid development of the internal market. For better or worse the other countries have more mature and developed internal markets (Germany, Japan, USA) or are at an earlier stage than China (India), or have very high trade openness (Korea, Taiwan) where exports and imports are bigger than GDP.

Figure 6: Ratio of imported intermediate inputs to total intermediate inputs, High-tech, 1995-2011

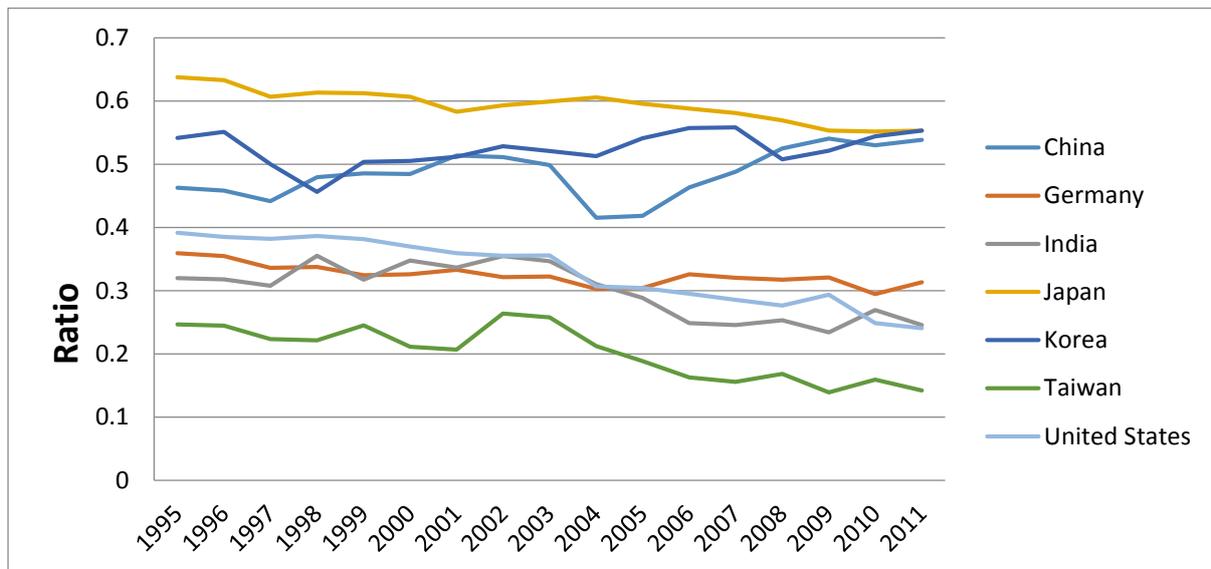


Next let's look at the "inside" of the high tech sector. Input-output tables allow us to examine how the different parts of high tech, as we have defined it, relate to one another: how much the individual sectors use one another for production requirements. We can construct another ratio, which we will call high-tech intensity, and this will look at the ratio of transfers within high tech to all the intermediate inputs to high tech. This ratio also tells us how much the high tech sector as a whole is integrated, and how much all its components are interdependent.

The graph clearly shows two distinct groups. The first is China, Japan and Korea, where the ratios were different in 1995 although higher than in the second group. Over time, the ratios converged in this group to a noticeable degree and are almost identical for the three countries. Although now at a lower value this is nevertheless above all of the second group. The behaviour of China is slightly different to that of the other two because it seems to indicate a dip in the ratio for a number of years beginning in 2003 followed by a rise from 2006 onward. This could be an indication that the domestic high-tech sector in China was increasing its own internal linkages, with individually exporting firms, perhaps regardless of ownership, finding that the presence of other high-tech firms in the country was giving them increased possibilities on the domestic market. While it is perhaps surprising to find these three countries in the same clearly defined group in 2011, it may well indicate a similar degree of integration in their high-tech sectors, even if the detailed substantive composition of the high-tech sector differs from country to country.

The second group is of the remaining countries, all of which show a decline over the period. The causes of this decline are probably various. For most of them, however, it may reflect increased specialisation for export (within manufacturing). Taiwan has the lowest value of all, and this has further declined over the period. This is consistent with Taiwan's role as a sub-supplier to the much larger markets of China, Korea, and many other countries: it does not have a multivalent and self-sustaining high-tech sector to the same degree as most of the other countries in the group.

Figure 7: Ratio of intra-industry to its total intermediate inputs, High-tech, 1995-2011



Services with high-tech significance

Looking at high-tech back in the last section, we noted that the definition, using certain manufacturing sectors than had a high-tech content, was not ideal. For one thing, pharmaceuticals was not included, because the classification system didn't allow it. For the same reason, high-tech services are not covered either. But more importantly, perhaps, by looking only at purely manufacturing activity we are missing some of the essential characteristics of high-tech activity in that it is associated with significant intermediation. This can include supports, of course. So venture capitalists, government agencies, local authority bodies, funds of various kinds, university incubators, patents attorneys, and a wide variety of others services tend to cluster around high-tech activity, certainly in order to assist it but also of course to make a living and look to bigger gains in the future: for most of them, the motivation is also to be associated with the potential IPO in the future. For this reason it's interesting to look at services in connection with high-tech manufacturing in particular. These are not to be confused with high-tech services, although some of the services used may indeed be high-tech.

Again we are constrained by the sectoral classification system of the input output tables so again the selection of services sectors that we are going to adopt is not ideal. However we will be able to distinguish at least between the financial services, IT and telecommunication services, and other inputs into the sector or indeed users of outputs of the sector. For that reason we will look again at

high-tech but this time from the point of view of what use is making of dynamic sectors in the services field.

We look at business services, which is a group made up of three sectors in the input output tables which are as follows:

- Financial services
- Posts and telecommunications
- Renting of machinery and equipment and other business activities

Posts and telecommunications unfortunately cannot be separated but it likely that they are dominated by telecommunications. The last category includes services such as accounting, IT, advertising, and other services.

Before looking at their linkage with high-tech, the first question to ask is how important are these sectors in export terms, and is that importance increasing? Services exports are in general more difficult to achieve than merchandise exports, and also to succeed internationally they will have to have a degree of sophistication that approaches international best practice. There are very few commodity-type internationally traded services, after all.

The graph shows USA stands out as having a much larger share than the other countries and this share has been steadily increasing. Even so it is less than 10 per cent of total exports. The share of the other countries is very small, usually less than 2 per cent, but this is not surprising as none of them is noted for international financial services institutions. The only other notable point is the peak seen in Germany in 2002, where the share briefly rose above 2 per cent.

Figure 8: Ratio of financial intermediation exports to total exports

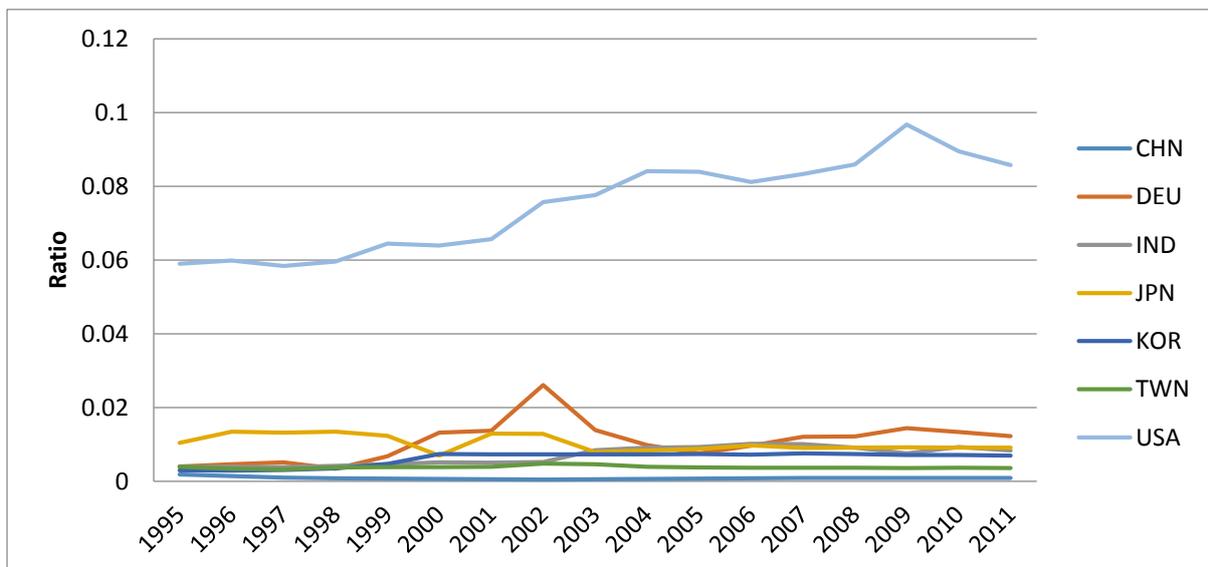
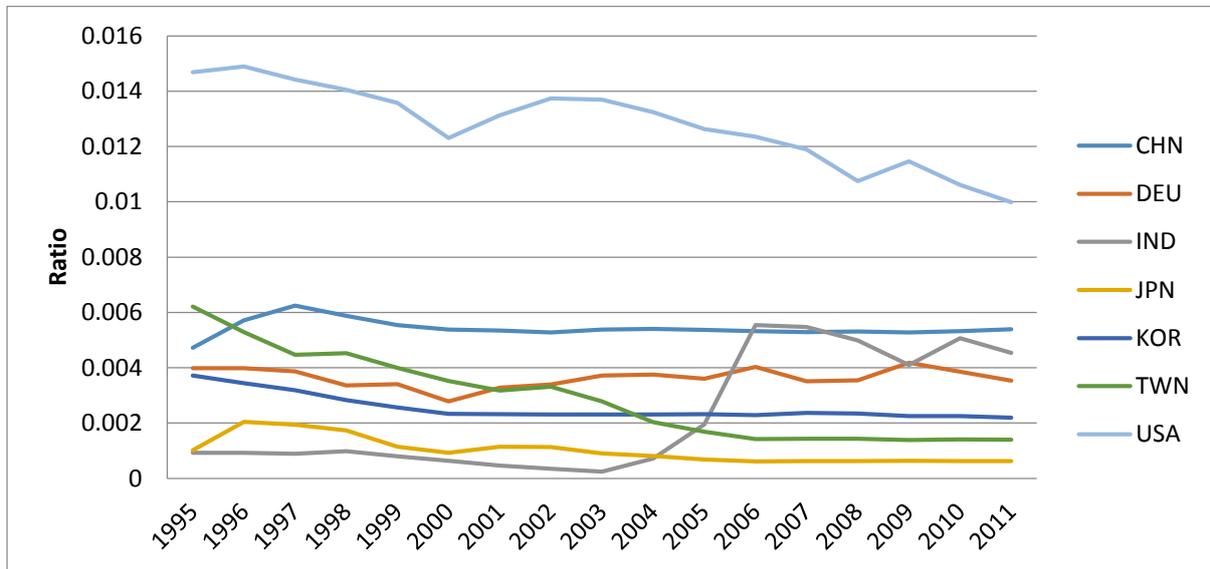
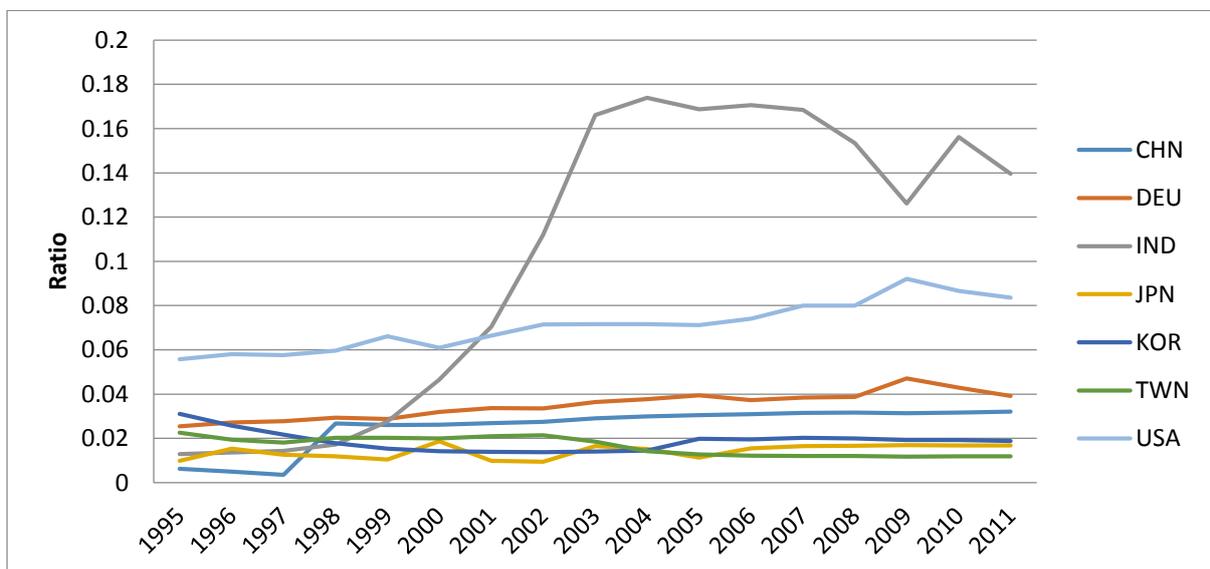


Figure 9: Ratio of posts and telecommunications exports to total exports



The decline in the US ratio may be partly explained by the increasing overseas investment by US companies in telecommunications, in particular. Think of US investment in cable companies in Europe, or US investment in data centres worldwide. This means that the services they provide are not treated as exports of the United States, but rather as domestic provision of telecommunications in the countries in which the investment takes place. The rise of India in this case may also reflect this general pattern, as well as the growth of Indian companies in this sector. But at the same time, the actual shares of total exports for this sector are very small.

Figure 10: Ratio of exports of renting of machinery and equipment and other business activities to total exports

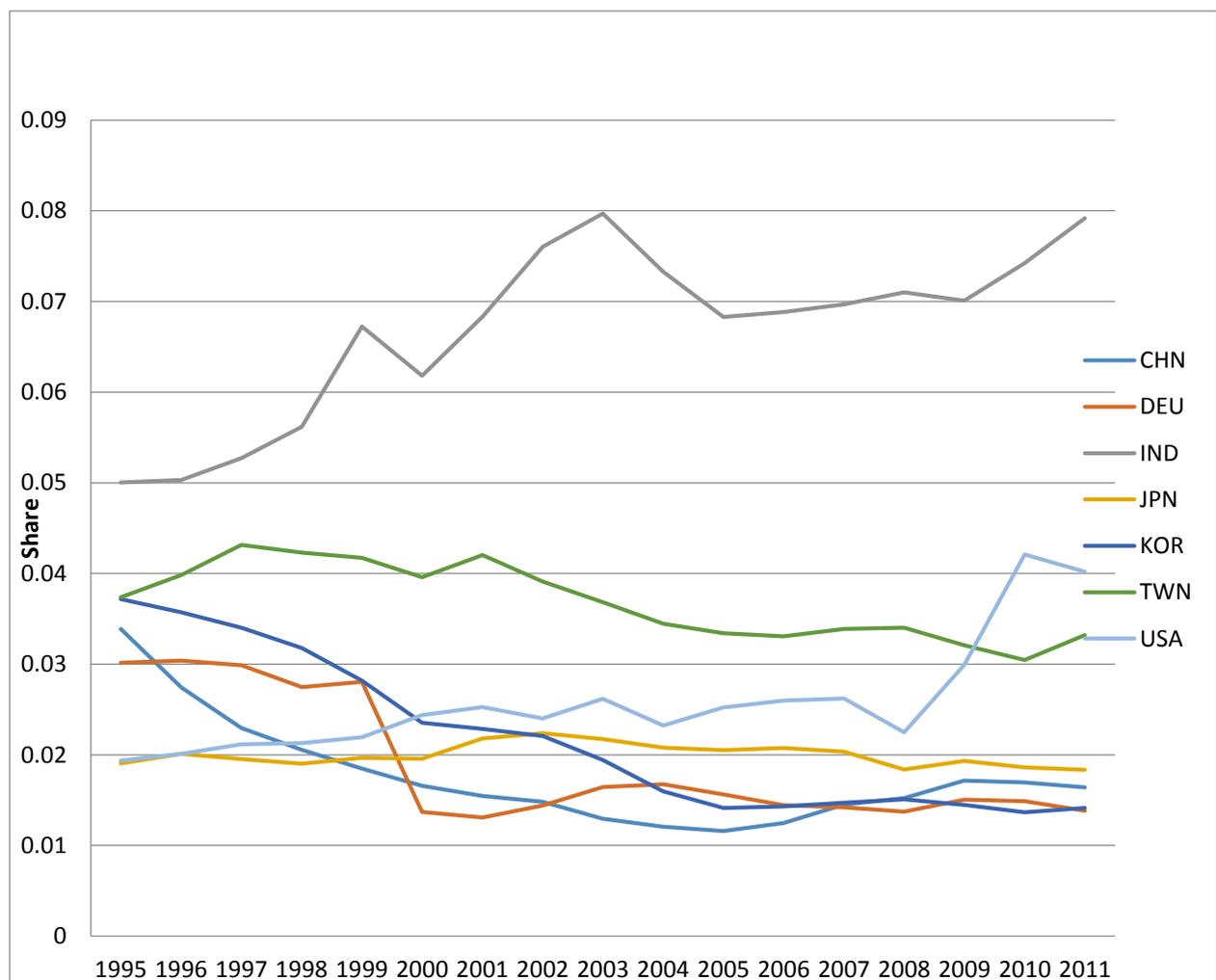


Here the really striking feature is the remarkable increase in the share of this sector in India's total exports. It was negligible in 1995 and has risen to around 15 per cent by 2011, overtaking the US share in 2001 and now almost double that of the US. This probably reflects mainly the "other business activities" part of the sector's title, with a huge range of business services including IT and CRM being outsourced to India, either through FDI or successful Indian companies. But the sector includes a range of activities such as software and computer services. Although well behind India and the United States, Germany is clearly in third position, and China has moved from bottom of the list in 1995 to fourth position in 2011.

This sector dominates the business services group, so much so that a graph of total business services as a share of total exports looks very similar to the above, with India's rise to overtake the United States decisively and Germany in third position above the remaining countries.

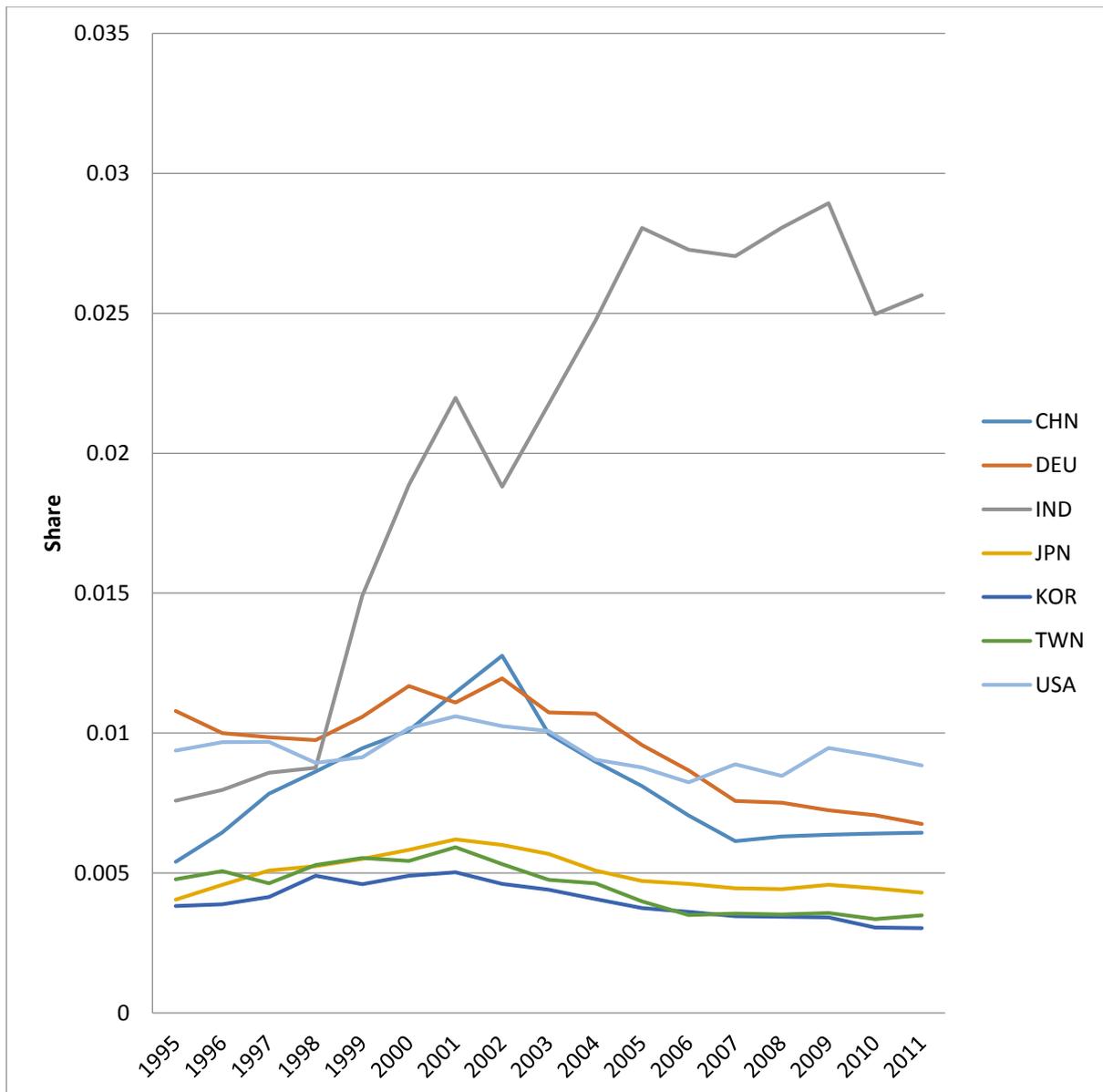
Now let's look at the extent to which these business services are used by the high-tech sector in the different countries. Firstly, financial intermediation:

Figure 11. Share of financial intermediation in intermediate inputs: High-tech



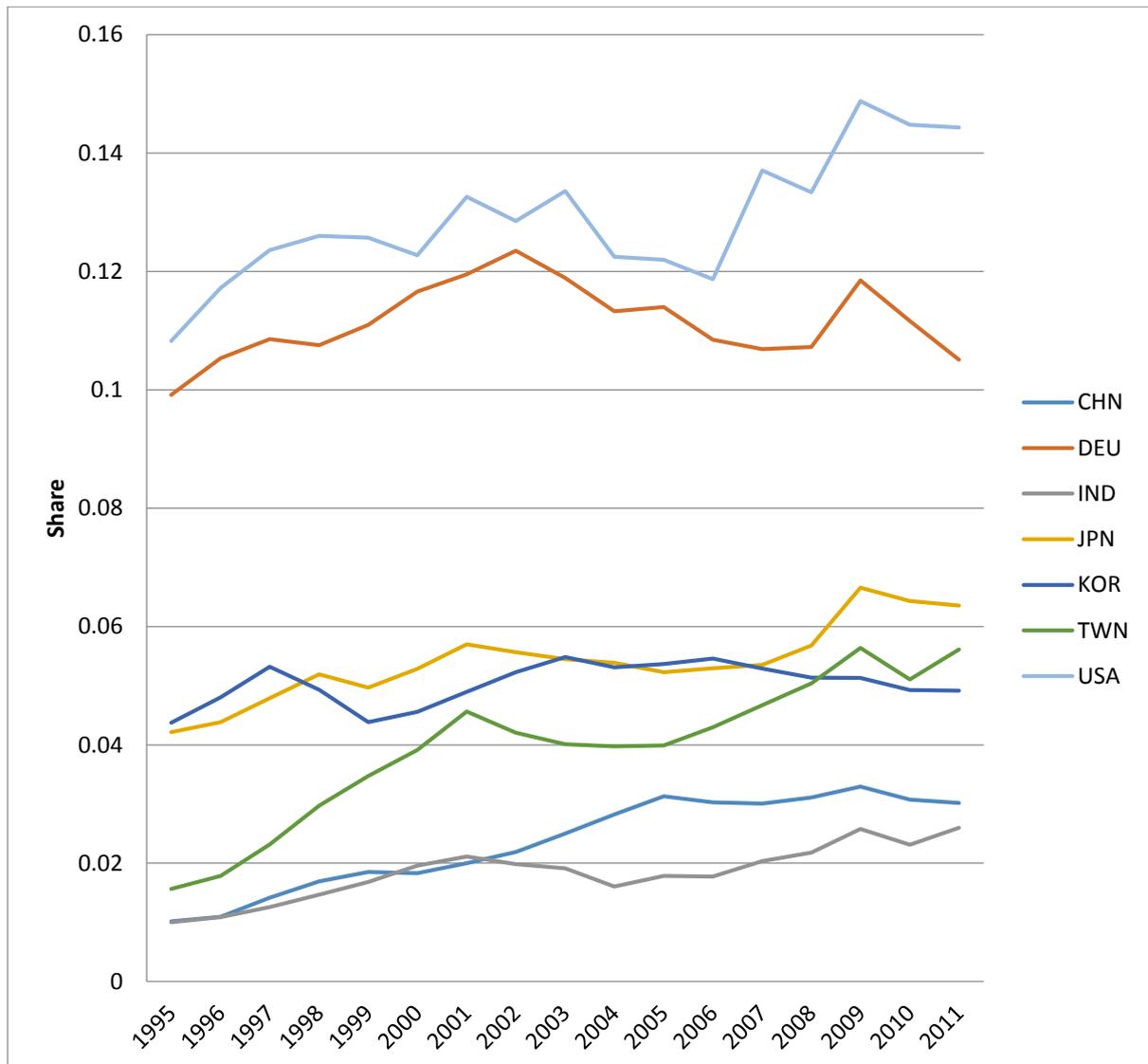
To start with in 1995, India already had higher values than any other country, at 5 per cent of intermediate inputs, and this share has risen markedly over the period, now approaching 8 per cent. The share of financial intermediation in the United States was around the same as most other countries, at 2 per cent, in 1995: since then there has been first a slow rise and then a much sharper one from 2008 onward. Paradoxically, the financial crisis in the United States and western countries seems to have increased the importance of this input in the United States: access to credit and increased risk may be behind this. In the other countries there is generally a decline in the relative importance of this input, with Germany and China being particularly noticeable in this regard. Given the successful growth of the sectors in these countries, the business model followed may differ from either India or the United States, with in-company resources playing a bigger role.

Figure 12: Share of posts and telecommunications in intermediate inputs: High-tech



Once again India stands out with regard to this input: the value of the share more than triples over the period, while the other countries show little major movement. Germany and China both show a peak around 2002 with a decline thereafter.

Figure 13: Share of renting of machinery and equipment and other business activities in intermediate inputs: High-tech



This input relates to the majority of business service (i.e. apart from telecommunications and financial services). Thus it includes services such as accounting and IT., advertising, and other services. High-tech companies if they grow will grow rapidly and will usually need to buy in such services on an increasing scale. The graph shows that high-tech in all countries has increased the share of these services in its purchases. There is variation across countries as to how steep the increase has been but it is clear that the ratio was higher in 2011 than in 1995 in every case considered. There is perhaps no clear pattern with respect to Germany's share but the final value is higher than in 1995. Moreover, it is much higher than in all the other countries except the USA. The USA has clearly the highest share, and it has been increasing sharply, as has that in Taiwan, where

the growing sophistication and outreach of its companies may be reflected. The lack of significant change in the share in Korea, on the other hand, may reflect the large scale of the companies and their conglomerate nature, meaning that many business services are supplied internally. Japan's share is rising, reflecting perhaps some restructuring in the high-tech sector. China and India started from the same point in 1995 and appear to be increasing at a similar rate.

Conclusions

The ratios examined here should be taken only as a first indication of what changes are under way in the world economy. The database, while very rich in its global coverage and its time series nature nevertheless has drawbacks in terms of its sectoral coverage. Moreover, estimation techniques have been used in preparing the tables: each individual data item in an input-output table does not necessarily derive from a survey.

Some initial conclusions can be drawn from the analyses above:

- The importance of high-tech exports to the United States shows a long-term downward trend. This may be offset to some degree by its outward foreign direct investment. There is also a decline in the share of business services and telecommunications in total exports, with a rise in the share of financial intermediation, still the highest among the countries, even with a decline after the financial crisis
- The relatively low level of telecommunications inputs in the high-tech sector in the United States may again be offset by the internalisation of some of these service within large high-tech companies. The role of financial services as inputs to the high-tech sector is however increasing in importance in the United States, as is the role of business services, of which the United States high-tech sector is already the highest user.
- Germany emerges as an advanced country that is one of only two countries that is increasing the share of high-tech in its exports in recent years, the other being India. Its high-tech sector has (apart from China's) the highest dependency on imported inputs to its high-tech sector, but this may reflect specialisation, with an ability to engineer and package components into more complex systems. This is confirmed by the high level of business services inputs to high-tech in Germany.
- Perhaps in keeping with the relative stagnation of the Japanese economy over the years, there are few changes in the indicators for Japan. There is however a long-term decline in the high-tech share of total exports, again, as in the US case, perhaps reflecting some degree of outward FDI, especially in the automotive industries.
- While the rise of China has been the most notable (and noted) feature of changes in the world economy in recent years, the ratios examined here show that India has also been making progress in a number of areas, and that this progress began well before the current policies and new government focus were put in place.
- The financial crisis in 2007-2008 seems to have had the effect of interrupting some of the trends, reversing them in a few cases, but it does not seem to have a permanent effect on the majority of the trends examined.

APPENDIX 1: Similarity of consumption structures

Table A.1 Pairwise comparisons of consumption structures using cosine measure, 1995 and 2011

	1995	AUS	BRA	CAN	CHN	DEU	FRA	GBR	IDN	IND	ITA	JPN	KOR	MEX	RUS	TWN	USA	Average	
AUS		1	0.901679	0.908015	0.595868	0.978234	0.974286	0.971494	0.700159	0.572605	0.964848	0.970064	0.881173	0.897676	0.822805	0.742812	0.863746	0.859092	
BRA		0.901679	1	0.962402	0.653576	0.913079	0.877582	0.937126	0.738284	0.601138	0.936536	0.898957	0.890663	0.837675	0.850165	0.853378	0.901701	0.859621	
CAN		0.908015	0.962402	1	0.567964	0.923099	0.891664	0.93871	0.680091	0.528235	0.922692	0.923439	0.868381	0.828522	0.763499	0.826868	0.923993	0.841098	
CHN		0.595868	0.653576	0.567964	1	0.58257	0.581026	0.594408	0.848906	0.960416	0.65153	0.572243	0.71421	0.686899	0.880044	0.640951	0.47343	0.687753	
DEU		0.978234	0.913079	0.923099	0.58257	1	0.978702	0.976422	0.664865	0.553468	0.965363	0.966228	0.853831	0.884685	0.800066	0.752255	0.888205	0.855067	
FRA		0.974286	0.877582	0.891664	0.581026	0.978702	1	0.96624	0.637839	0.563886	0.944309	0.944956	0.833174	0.864725	0.7883	0.695443	0.8337	0.835989	
GBR		0.971494	0.937126	0.93871	0.594408	0.976422	0.96624	1	0.702713	0.568075	0.979911	0.959079	0.905854	0.849782	0.811792	0.806167	0.907059	0.867177	
IDN		0.700159	0.738284	0.680091	0.848906	0.664865	0.637839	0.702713	1	0.793905	0.761961	0.684657	0.837886	0.796478	0.878687	0.771828	0.582609	0.755054	
IND		0.572605	0.601138	0.528235	0.960416	0.553468	0.563886	0.568075	0.793905	1	0.63038	0.557303	0.708508	0.661114	0.839499	0.598835	0.459031	0.662275	
ITA		0.964848	0.936536	0.922692	0.65153	0.965363	0.944309	0.979911	0.761961	0.63038	1	0.957201	0.926618	0.902258	0.848687	0.79527	0.878696	0.879141	
JPN		0.970064	0.898957	0.923439	0.572243	0.966228	0.944956	0.959079	0.684657	0.557303	0.957201	1	0.904207	0.902396	0.791225	0.760502	0.902757	0.855951	
KOR		0.881173	0.890663	0.868381	0.71421	0.853831	0.833174	0.905854	0.837886	0.708508	0.926618	0.904207	1	0.860561	0.85873	0.831565	0.81172	0.855443	
MEX		0.897676	0.837675	0.828522	0.686899	0.884685	0.864725	0.849782	0.796478	0.661114	0.902258	0.902396	0.860561	1	0.850784	0.660657	0.719898	0.825257	
RUS		0.822805	0.850165	0.763499	0.880044	0.800066	0.7883	0.811792	0.878687	0.839499	0.848687	0.791225	0.85873	0.850784	1	0.795996	0.679505	0.867373	
TWN		0.742812	0.853378	0.826868	0.640951	0.752255	0.695443	0.806167	0.771828	0.598835	0.79527	0.760502	0.831565	0.660657	0.795996	1	0.835635	0.77301	
USA		0.863746	0.901701	0.923993	0.47343	0.888205	0.8337	0.907059	0.582609	0.459031	0.878696	0.902757	0.81172	0.719898	0.679505	0.835635	1	0.791355	
	2011	AUS	BRA	CAN	CHN	DEU	FRA	GBR	IDN	IND	ITA	JPN	KOR	MEX	RUS	TWN	USA	Average	Av.'11-Av.'95
AUS		1	0.883439	0.911697	0.837673	0.977943	0.978088	0.981022	0.622103	0.666866	0.96485	0.945398	0.919179	0.834763	0.844524	0.796811	0.872937	0.877331	0.018239339
BRA		0.883439	1	0.956016	0.899352	0.895519	0.904027	0.872555	0.722304	0.734747	0.918879	0.917303	0.916751	0.846701	0.883535	0.85453	0.919903	0.882848	0.023226281
CAN		0.911697	0.956016	1	0.842387	0.922828	0.921058	0.900932	0.661004	0.676444	0.920888	0.937655	0.919515	0.810763	0.839854	0.856088	0.923303	0.875027	0.033928751
CHN		0.837673	0.899352	0.842387	1	0.826547	0.836512	0.805602	0.8768	0.843225	0.855648	0.839378	0.862311	0.868802	0.92922	0.808933	0.760982	0.855836	0.168083158
DEU		0.977943	0.895519	0.922828	0.826547	1	0.989274	0.97806	0.591783	0.651259	0.962846	0.950186	0.916532	0.816791	0.83241	0.767955	0.890335	0.873142	0.018074627
FRA		0.978088	0.904027	0.921058	0.836512	0.989274	1	0.966045	0.592719	0.685987	0.976326	0.972672	0.90819	0.84297	0.826642	0.754307	0.897194	0.878251	0.042261215
GBR		0.981022	0.872555	0.900932	0.805602	0.97806	0.966045	1	0.5747	0.633795	0.963743	0.930591	0.934985	0.787008	0.811226	0.780827	0.885837	0.862933	-0.00424391
IDN		0.622103	0.722304	0.661004	0.8768	0.591783	0.592719	0.5747	1	0.799948	0.645104	0.621447	0.6841	0.82135	0.854545	0.762056	0.539283	0.710578	-0.0444764
IND		0.666866	0.734747	0.676444	0.843225	0.651259	0.685987	0.633795	0.799948	1	0.719615	0.684508	0.688334	0.796516	0.829021	0.596095	0.588433	0.724675	0.062399735
ITA		0.96485	0.918879	0.920888	0.855648	0.962846	0.976326	0.963743	0.645104	0.719615	1	0.962526	0.922006	0.86141	0.843601	0.776223	0.894824	0.886781	0.007639495
JPN		0.945398	0.917303	0.937655	0.839378	0.950186	0.972672	0.930591	0.621447	0.684508	0.962526	1	0.904501	0.854561	0.81266	0.778795	0.931924	0.877757	0.021805869
KOR		0.919179	0.916751	0.919515	0.862311	0.916532	0.90819	0.934985	0.6841	0.688334	0.922006	0.904501	1	0.815108	0.823531	0.85131	0.867463	0.870864	0.015420921
MEX		0.834763	0.846701	0.810763	0.868802	0.816791	0.84297	0.787008	0.82135	0.796516	0.86141	0.854561	0.815108	1	0.870829	0.708506	0.715786	0.828241	0.002984514
RUS		0.844524	0.883535	0.839854	0.92922	0.83241	0.826642	0.811226	0.854545	0.829021	0.843601	0.81266	0.823531	0.870829	1	0.805293	0.775542	0.848902	0.020165595
TWN		0.796811	0.85453	0.856088	0.808933	0.767955	0.754307	0.780827	0.762056	0.596095	0.776223	0.778795	0.85131	0.708506	0.805293	1	0.836699	0.795902	0.022891764
USA		0.872937	0.919903	0.923303	0.760982	0.890335	0.897194	0.885837	0.539283	0.588433	0.894824	0.931924	0.867463	0.715786	0.775542	0.836699	1	0.831278	0.039922449

Table A.2: Ratio of 2011 structural similarity of consumption to 1995 similarity

For each pair of countries, the similarity of their structures of total consumption was assessed by a cosine measure, which has the value 0 when the structures are completely dissimilar and 1 when they are identical. The table gives the ratio between the 2011 value and the 1995 value. The greatest change is seen in the relationship between the consumption structures of China and the United States: the value of 1.607381 is the largest in the table and means that the structures were 61 per cent more similar in 2011 than they were in 1995.

	AUS	BRA	CAN	CHN	DEU	FRA	GBR	IDN	IND	ITA	JPN	KOR	MEX	RUS	TWN	USA	<i>Average</i>
AUS	1	0.979772	1.004056	1.405804	0.999702	1.003902	1.009807	0.888517	1.164618	1.000002	0.974573	1.043132	0.929916	1.026396	1.072696	1.01064	1.032096
BRA	0.979772	1	0.993365	1.376048	0.980768	1.030134	0.931097	0.978354	1.222259	0.981147	1.020408	1.029291	1.010776	1.039251	1.001351	1.020186	1.037138
CAN	1.004056	0.993365	1	1.483168	0.999706	1.032966	0.959756	0.971935	1.280574	0.998045	1.015395	1.058885	0.978565	1.100007	1.035339	0.999254	1.056938
CHN	1.405804	1.376048	1.483168	1	1.418793	1.439715	1.355302	1.032858	0.877979	1.31329	1.466822	1.207364	1.264817	1.055879	1.262082	1.607381	1.285456
DEU	0.999702	0.980768	0.999706	1.418793	1	1.010802	1.001677	0.89008	1.176689	0.997392	0.983397	1.073435	0.923256	1.040427	1.020871	1.002397	1.032462
FRA	1.003902	1.030134	1.032966	1.439715	1.010802	1	0.999798	0.929261	1.216537	1.033906	1.029331	1.090035	0.974842	1.048639	1.084642	1.076159	1.062542
GBR	1.009807	0.931097	0.959756	1.355302	1.001677	0.999798	1	0.81783	1.115689	0.983501	0.970297	1.032158	0.926129	0.999303	0.968568	0.976604	1.00297
IDN	0.888517	0.978354	0.971935	1.032858	0.89008	0.929261	0.81783	1	1.007612	0.846637	0.907677	0.816459	1.031228	0.972525	0.987339	0.925635	0.937747
IND	1.164618	1.222259	1.280574	0.877979	1.176689	1.216537	1.115689	1.007612	1	1.141558	1.228251	0.971526	1.20481	0.987519	0.995424	1.281901	1.117059
ITA	1.000002	0.981147	0.998045	1.31329	0.997392	1.033906	0.983501	0.846637	1.141558	1	1.005563	0.995023	0.954727	0.994008	0.976051	1.018354	1.01495
JPN	0.974573	1.020408	1.015395	1.466822	0.983397	1.029331	0.970297	0.907677	1.228251	1.005563	1	1.000325	0.946991	1.027092	1.024054	1.032309	1.03953
KOR	1.043132	1.029291	1.058885	1.207364	1.073435	1.090035	1.032158	0.816459	0.971526	0.995023	1.000325	1	0.947182	0.95901	1.023744	1.068673	1.019765
MEX	0.929916	1.010776	0.978565	1.264817	0.923256	0.974842	0.926129	1.031228	1.20481	0.954727	0.946991	0.947182	1	1.02356	1.072426	0.994288	1.011469
RUS	1.026396	1.039251	1.100007	1.055879	1.040427	1.048639	0.999303	0.972525	0.987519	0.994008	1.027092	0.95901	1.02356	1	1.01168	1.141333	1.026664
TWN	1.072696	1.001351	1.035339	1.262082	1.020871	1.084642	0.968568	0.987339	0.995424	0.976051	1.024054	1.023744	1.072426	1.01168	1	1.001273	1.033596
USA	1.01064	1.020186	0.999254	1.607381	1.002397	1.076159	0.976604	0.925635	1.281901	1.018354	1.032309	1.068673	0.994288	1.141333	1.001273	1	1.072274
<i>Average</i>	1.032096	1.037138	1.056938	1.285456	1.032462	1.062542	1.00297	0.937747	1.117059	1.01495	1.03953	1.019765	1.011469	1.026664	1.033596	1.072274	1.048916

APPENDIX 2: Sectoral classification of the WIOD input-output tables

- 1 Agriculture, Hunting, Forestry and Fishing
- 2 Mining and Quarrying
- 3 Food, Beverages and Tobacco
- 4 Textiles and Textile Products
- 5 Leather, Leather and Footwear
- 6 Wood and Products of Wood and Cork
- 7 Pulp, Paper, Paper , Printing and Publishing
- 8 Coke, Refined Petroleum and Nuclear Fuel
- 9 Chemicals and Chemical Products
- 10 Rubber and Plastics
- 11 Other Non-Metallic Mineral
- 12 Basic Metals and Fabricated Metal
- 13 Machinery, Nec
- 14 Electrical and Optical Equipment
- 15 Transport Equipment
- 16 Manufacturing, Nec; Recycling
- 17 Electricity, Gas and Water Supply
- 18 Construction
- 19 Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel
- 20 Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles
- 21 Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods
- 22 Hotels and Restaurants
- 23 Inland Transport
- 24 Water Transport
- 25 Air Transport
- 26 Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies
- 27 Post and Telecommunications
- 28 Financial Intermediation
- 29 Real Estate Activities
- 30 Renting of M&Eq and Other Business Activities
- 31 Public Admin and Defence; Compulsory Social Security
- 32 Education
- 33 Health and Social Work
- 34 Other Community, Social and Personal Services
- 35 Private Households with Employed Persons

