Shifts in International Trade and Value Added: Insights into the Drivers of Growth[1]

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Abstract:

In this paper we adopt a structuralist approach to analyse the long-run growth of real world exports. We construct a unique dataset combining export, import, output, employment and wage data for 196 countries and 22 manufacturing industries over the period 1995-2009. Decomposing global export growth into its structural components, we find the rise in world export volumes seen over this period to have been largely driven by regional and sectoral shifts of emerging economies into more trade-intensive activities. Once we move the analysis to the level of individual industries, we moreover find evidence against the "over-reaction" of trade (i.e. exports in our case) to output growth. In other words, the often cited high elasticity of global trade to income can in fact be mapped into changes of the country and sector composition of global trade, with the faster growing economies moving rapidly into more trade-intensive activities, whereby the elasticity of trade to income at the sectoral level remains well below one.

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1. Introduction

For many years, the global trade volume expanded considerably faster than global output. Real annual export growth was at 6 per cent on average over the past 15 years, at the same time global GDP and production grew only half as fast in real terms, by approximately 3 per cent per annum (WTO 2010). Similarly, trade has fallen dis-proportionally strongly in the recent crisis, calling again for explanations of the "over-shooting" in the trade response to the economic crisis. The question thus arises, what are the factors that have caused trade to grow faster than world output over the past decades? And are these factors going to shape world trade growth in the future? In this paper we attempt to identify the drivers of export growth by decomposing real world export growth into its regional and sectoral components. We will put special emphasis on Central, Eastern and South Eastern European economies (CESEE). Their export orientation has played an important role in their successful catching-up performance shown over the past two decades. Hence, the recovery of the global trading system will continue to be of importance for their future development.

Several explanations have been put forward to explain the continuously strong global trade growth prior to the recent collapse. One prominent strand of the literature focuses on the role of institutional factors, such as the dismantling of trade barriers within the GATT / WTO negotiations, the European economic integration process or similar developments in other regions (see Baldwin et al. 2001,). Strong trade growth is often attributed to falling trading costs occurring through lower or abolished tariff and non-tariff barriers, improved business conditions, falling transportation costs, technological progress, etc. (see for example Hummels 2007 on transportation costs, Jacks et al. 2008 on trade costs more generally). Another explanation refers to the increasing fragmentation of production, also called international outsourcing, and the rising importance of global value chains (Feenstra 1998). Although vertical specialisation is more frequently studied within the context of foreign direct investment, it clearly has strong implications on traditional trade flows. Finally, another strand of the literature analyses the income elasticity of trade (Baier and Bergstrand 2001, Irwin 2002). The explanations put forward to explain the recent "trade collapse" are strikingly similar to those referred to as long-run determinants of global trade. The very recent, but nevertheless abundant literature in essence proposes the following reasons for the strong negative trade reaction in the crisis: sharply rising trade costs including problems with trade financing (Auboin 2009, Chauffour and Farole 2009), the increased importance of vertical specialisation manifested in increasing global supply chains (Escaith 2009, Yi 2009) and falling demand (Bems et al. 2010, Eaton et al. 2010, Freund 2009). In addition, structural differences between domestic and external economic structures have lately been put forward as another explanation for the recent trade collapse in connection with an asymmetric crisis impact on different types of goods. Capital and investment goods have clearly been affected more strongly in the crisis than non-durables and consumption goods, these goods also account for a large fraction of international trade (Francois and Wörz 2009, McKibbin and Stoeckel 2009).

In this paper we take a long-term view on global trade and follow a structuralist approach to analyse the long-run growth of real world exports. Decomposing global export growth into its structural components, we find that the recent rise in world export volumes largely reflects regional and sectoral shifts of emerging economies into more trade-intensive activities. Once we move the analysis to the level of individual industries, we moreover find evidence against the "over-reaction" of trade (i.e. exports in our case) to output growth. Hence, the often cited rising elasticity of global trade to income can in fact be traced to changes in the country and industry composition of global trade, with the faster growing economies moving rapidly into more trade-intensive activities, whereby the elasticity of trade to income at the sectoral level remains well below one.[2]

[2] In other words, the apparent "puzzle" of extraordinary trade growth can be deconstructed in analogy to the de-mystification of the East Asian growth miracle by Young (1995), who showed that the extraordinary growth performance of the four East Asian "tigers" can be explained in a satisfactory way by rapid factor accumulation

A novel aspect of our analysis is the use of sector-specific price indices which are used in deflating export and domestic production data. This seems to be important since radically different price developments were observed in different industries. While for instance prices for office and accounting machinery, including computers, have fallen drastically in the last two decades, prices for chemicals and food and beverages have increased considerably.
The paper proceeds as follows: In the following section, we describe our database and provide some descriptive statistics of world export growth in a regional and sectoral perspective. In Section 3 we develop a decomposition of export growth into a pure growth effect (abstracting from structural change) and two structural effects (the effect of initial specialisation and the effect of changes in specialisation patterns). In Section 4 we use simple growth accounting relationships to argue why the traditional measure of the elasticity of trade to output may be misleading and propose a new elasticity measure at the industry level. Section 5 concludes with special emphasis on the CESEE region.

2. Constructing a New Data Set of World Trade

Our focus is on analysing regional and sectoral patterns of trade and the trade response to output growth. We are working here at the detailed industry level, which implies that we have to combine data from different sources. For trade data, we are using the UN COMTRADE database. Using WITS[3] we aggregate 6-digit HS export and import data directly into 2-digit ISIC, revision 3 industries. Data on domestic production (value added, output, wage and employment) are taken again at the ISIC (revision 3) 2-digit level from UNIDO Industrial Statistics Database 2010. All data are in USD, converted at year-average exchange rates from the IMF's International Financial Statistics database. In total we arrive at a sample consisting of a maximum of 196 countries over the period 1988 to 2009, covering 25 manufacturing industries, ranging from ISIC (revision 3) codes 1 – agriculture and fishing – to 40 – electricity, gas and water supply. Country coverage before 1995 (when we reach a solid average of 150 exporters reporting trade data every year) is rather patchy. For this reason and in order to exclude the crisis-related trade and output decline from our long-term analysis, we restrict the sample to the years 1995 to 2007 and we further exclude agriculture, mining and utilities, gas and water supply. This leaves us with more than 40,000 observations spanning roughly 150 countries, 13 years and 22 industries.

We classify countries broadly into seven geographic regions: EU-15 comprises all EU member states prior to the 2004 enlargement. NAFTA includes the US, Canada and Mexico. CESEEs are divided into 2 regions: We refer to the ten EU members which acceded the EU in 2004 and 2007 as CEE-10, while the remaining ten Eastern and South Eastern European countries are grouped as CIS & Balkans, including Russia. South East Asia (S-E-Asia) contains ten ASEAN members plus China, India, Japan and South Korea. Latin America (LatAm) consists of 14 mainland Latin American countries. All remaining countries are classified as rest of the world (ROW). A list of all countries and their grouping is given in Table A1 in the appendix.

A major concern was to deflate all data in order to reflect different price developments within individual industries. Since industry-specific price deflators were not available for all countries in the sample, we use US prices as a shortcut. This implies the rather crude assumption that price developments do not vary across countries, however it does take account of the fact that certain

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and structural shifts of labour out from relatively unproductive (agricultural) activities into highly productive manufacturing sectors.

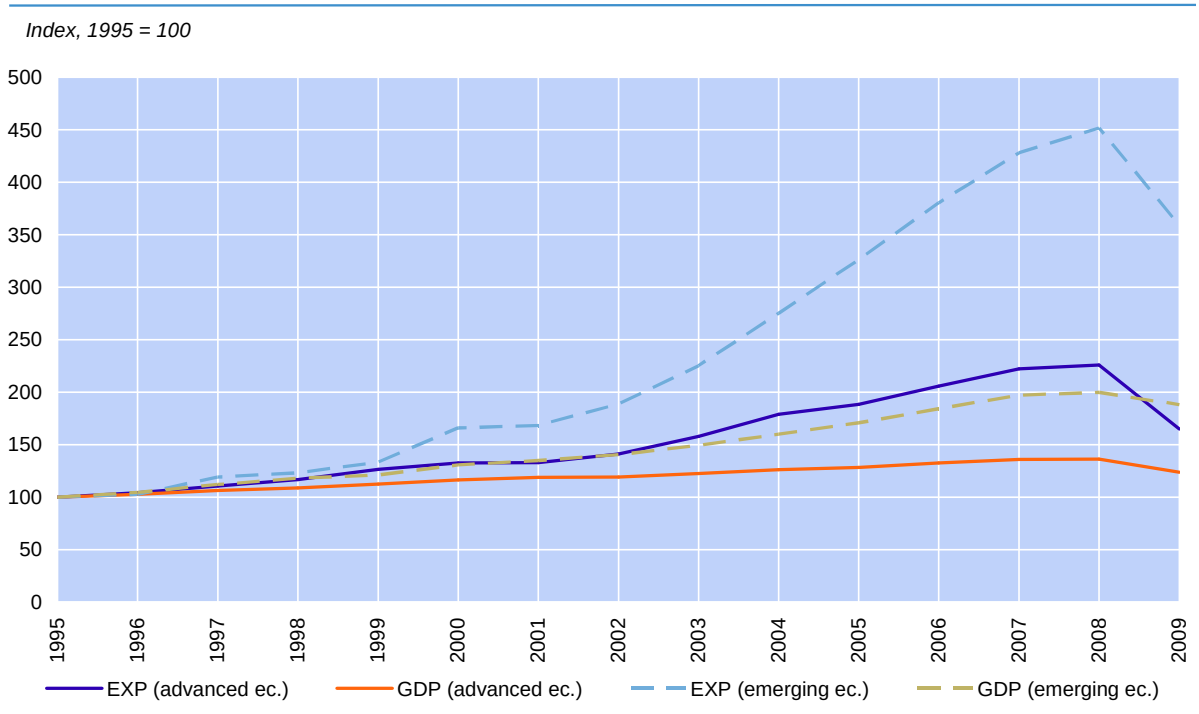
[3] The access software "World Integrated Trade Solutions" was developed jointly by the World Bank and UNCTAD and allows to aggregate countries and goods prior to downloading the data. It further includes tools for the analysis of tariffs and non-tariff barriers, a feature which we did not use in this context.

goods were becoming constantly cheaper over the observation period (for example computers lost dramatically in value) while others were subject to continuous price increases (such as chemical products and food and beverages). We use industry-specific US import price indices to deflate export data. Since the US imports goods from almost all countries in the world, we are confident that these price indices reflect average world price developments for traded goods. For domestic production data (value added, output and wages) we use the US producer price index.

2.1 Regional Trends in World Exports since 1995

Figure 1 reveals a global shift of world output and trade towards emerging economies. Although the majority of global production (73% of global GDP in 2007, down from 79% in 1995) remains inside the advanced economies, dynamics are much stronger in emerging economies. Over the same period, average annual GDP growth was 2.6% in advanced economies compared to 5.8% in emerging countries. This regional re-allocation is more pronounced with respect to world exports. In 1995 70.6% of the world export volume originated from advanced markets, by 2007 their share had fallen to 55.5% (and further to 52.4% in the crisis year 2009). This loss in global export market share was a consequence of the large growth differential between the two groups of countries. Average real export growth amounted to 6.9% in advanced countries over the 1995-2007 period, only about half the 13.3% per annum growth performance recorded for emerging markets' exports.

Figure 1: Global Exports and GDP, 1995-2009.



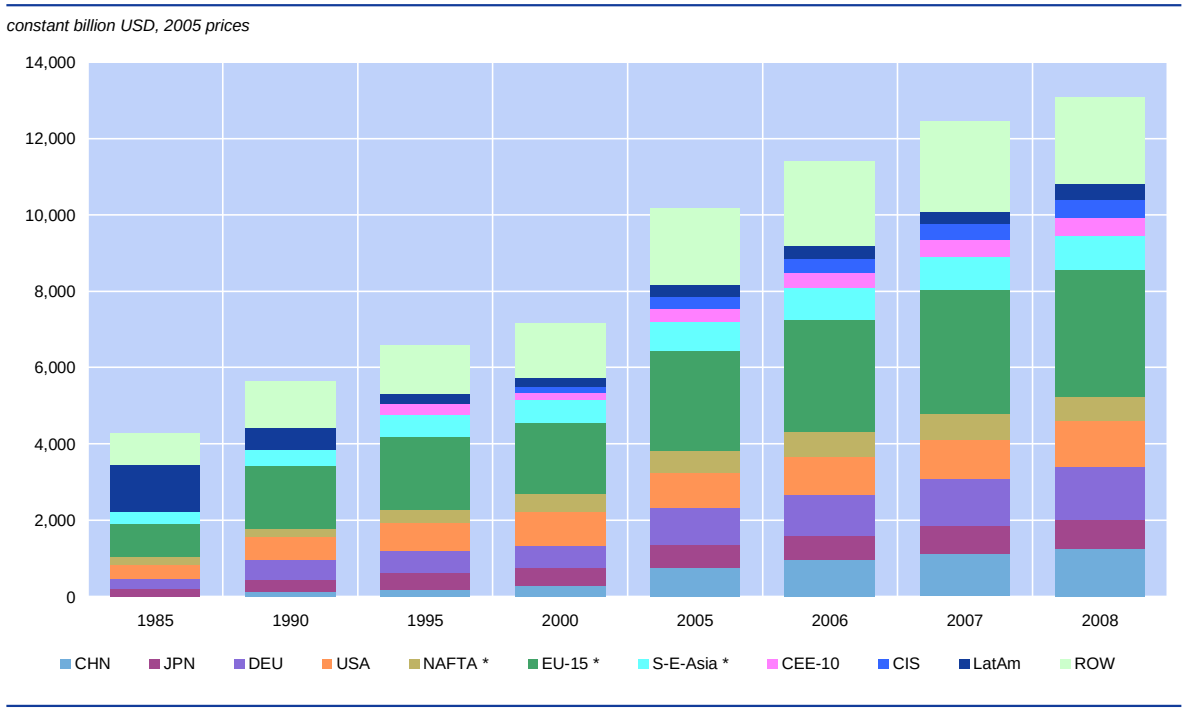
Source: own calculations based on UN COMTRADE and Worldbank WDI database.
Note: Advanced economies are OECD members excluding Czech Republic, South Korea, Mexico, Poland, Slovakia, and Turkey. Exports are deflated by sector specific US import prices, GDP by the GDP deflator.

Figure 1 also illustrates the huge growth gap between exports and GDP, a point which we will discuss in more detail below. Several factors can explain this growth differential. One of them is related to structural differences between domestic output and the external sector: GDP largely consists of non-tradables, the share of services in GDP is often around 70% and services continue to be considerably less suitable to trade than goods. The relatively constant goods share in total exports of around 80%

suggests that the tradability of services is growing proportional to the expansion of world trade, but not more.[4] Another explanation of this growth differential may be found in conceptual differences between GDP (which is a value-added concept) and exports (which are measured on a gross basis). Finally, the increasing importance of outsourcing and fragmentation is also cited often in this context.

The global regional shift in world exports is depicted in more detail in Figure 2 below. It demonstrates in particular the impressive growth of China's share in world exports. Other rapidly expanding regions are South East Asia, the new EU member states (CEE-10) and CIS and the Balkans (CIS). Their gains in world market shares came mainly at the expense of Western Europe, NAFTA, Japan, but also Latin America. On the other hand, Germany could maintain its world market share remarkably well, which may be related to a growing importance of intra-EU trade.

Figure 2: Regional Composition of World Exports, 1985-2008.



Source: own calculations based on UN COMTRADE.
Note: Total merchandise exports are deflated using the country specific consumer price index; * denotes the region without the respective country displayed separately.

Another salient feature of global trade is the growing share of intra-regional trade (see Table 1). For almost all regions, intra-regional exports are gaining importance, especially so in South East Asia, Latin America and EU-15. CESEEs exhibit a different behaviour with a stable or declining share of intra-regional exports in the strict sense (i.e. within the CEE-10 or the CIS/Balkans area respectively). This is related to their transition, which implied also a re-orientation of their trade flows away from previous COMECON partners towards new trading partners in the West. Hence, their ongoing integration into global trade networks implied a decline of intra-regional trade contrary to the general world-wide trend.[5] Also China shows the same pattern, exports to other South East Asian

[4] Figure 1 above only includes merchandise exports, thus excluding service exports altogether.
[5] Certainly, if the relevant market for "intra-regional" trade would be defined as intra-EU-trade for the EU-10, then the respective figures rise to roughly 68% in 2005 and around 65% in 2008 and 2009 thus showing an enormous importance of intra-regional trade for the region. However, since we focus on long-term structural

partners are declining in relative terms since the opening up to international trade in the 1980s. China's intra-regional trade share seems to stabilize lately at roughly 25% of total exports. In contrast, intra-regional trade is rapidly growing in importance for Japan, which reflects the greater dynamism in South East Asia, making the region a more attractive destination for Japanese exports.

Table 1: Share of intra-regional exports, 1985-2009.

in % of total exports to world

	1985	1995	2005	2008	2009
DEU - EU-15	50.0	50.6	53.4	50.8	51.7
USA - NAFTA	28.1	29.7	36.8	32.0	31.8
CHN - S-E-Asia	32.8	30.7	24.1	24.5	25.2
JPN - S-E-Asia	18.3	28.5	33.6	37.2	33.6
EU-15	53.0	56.3	58.8	56.4	54.9
CEE-10	-	10.8	7.0	9.0	7.9
CIS & Balkan	-	39.2	24.7	26.4	18.7
NAFTA	44.3	46.2	55.9	49.9	48.3
Latin America	10.2	25.6	19.3	21.6	23.7
South East Asia	27.4	34.2	34.8	35.4	34.9

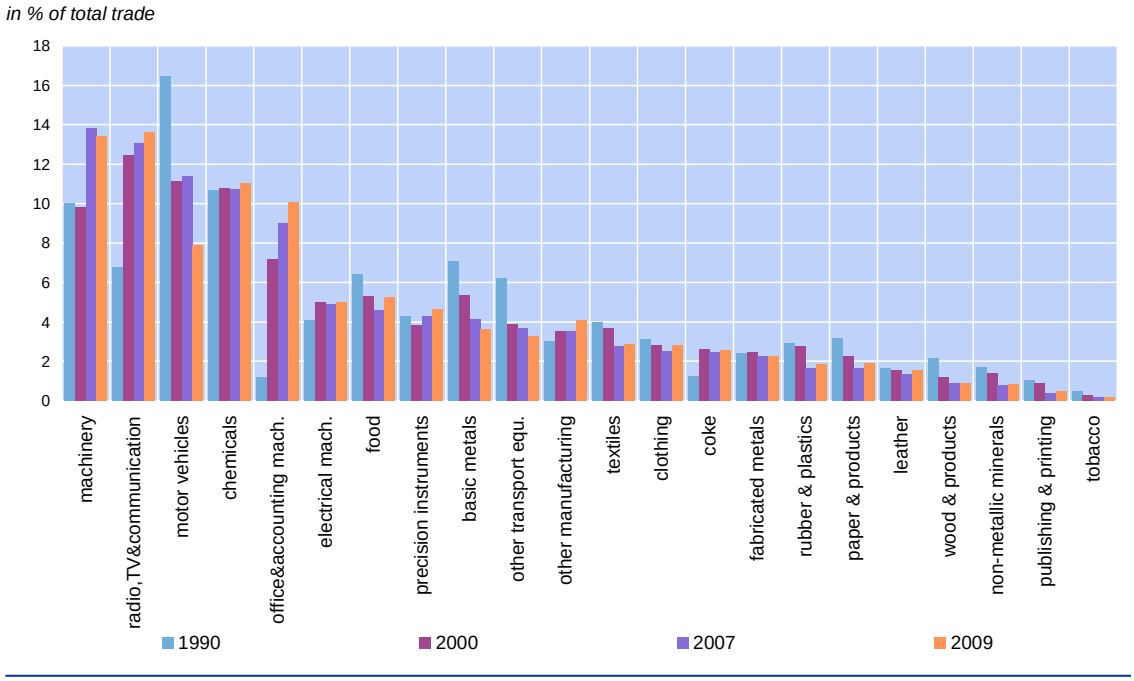
Source: own calculations based on UN COMTRADE.
Note: Intra-regional trading partners for individual countries are defined as follows: EU-15 for Germany, NAFTA for USA and South and East Asia (S-E-Asia) for Japan and China.

2.2 Sectoral Trends in World Exports over the Past Two Decades

The rising importance of individual players in global exports is intrinsically related to structural change within these countries. As shown in Figure 3, global exports are rather concentrated in a handful of economic activities. At the same time there has been a great deal of restructuring over the past two decades. The five most important industrial activities (machinery and equipment; radio, TV & communication equipment; motor vehicles; chemicals and related products; accounting & office machinery) accounted for 58% of world manufacturing exports in 2007, whereas in 1990 their cumulative share was 45%. Rather diverse developments are observed for each of these industries: The share of motor vehicle exports has fallen from 16% in 1990 to slightly more than 10% in real terms in 2007. The sector-specific deflation which we employ in this analysis plays an important role for this result. Also the share of other transport equipment has been on a continuous decline since 1990, from more than 6% to less than 4% of real manufacturing exports. The 2008/09 crisis reinforced these developments. On the other hand, real exports of office and accounting machinery have shown a tremendous increase, the share of computers and related products in global export volume has risen from a mere 1.2% in 1990 to 9% in 2007. Real export shares of machinery and equipment as well as radio, TV and communication equipment had also increased to more than 13% by 2007, while the share of chemicals and chemical products remained roughly stable at 11% since 1990. Thus, this global overview already reveals substantial structural changes in world trade flows, however a more detailed look reveals – rather unsurprisingly – that the countries reporting a shift in export patterns to their fastest growing industries were those to report the highest real export growth figures.

change in trade flows in this paper, we define intra-regional markets as those at the beginning of our observation period.

Figure 3: Real Trade Shares of Individual Industries, 1990-2009.



Source: own calculations.
Note: Export shares are ranked by their importance in 2007.

Table 2 shows that South East Asia is moving most strongly into the five most important categories in world manufacturing trade. Trade patterns between the region and the world average are highly congruent in 2007. Of course, average world patterns are dominated by NAFTA and the EU-15, which are still the largest exporters in 2007 as shown in Figure 2 above. In this sense, and representing also the largest fraction of worldwide demand for manufactures, sectoral specialisation patterns in NAFTA and the EU-15 meet international demand and can thus be considered as "successful" (Buitelaar and van Kerkhoff 2010). However, the dynamics towards globally strongly growing export categories are more pronounced in emerging regions, such as South East Asia or CEE-10. The new EU members show a distinct pattern of exports with an increasing share of motor vehicles. In 2007 this category represented more than 18% of CEE-10 exports, more than the 11% share of this category in global exports. Further, the importance of motor vehicles is still on the rise in the region, in contrast to global developments. It should be noted that the CEE-10 region has probably undergone the most dramatic structural change in this period out of all regions in our sample. This is not surprising for transition countries. The point we want to make here is that the impressive real export growth of the region goes hand in hand with substantial structural changes at the industry level, which are mirrored by developments in domestic value added, as we will show below.

Table 2: Top-5 Export Activities by Region in 2007.

	1995	2007
	share of region's exports in %	
CEE-10, cumulative real export growth: 445%		
motor vehicles	6.5	18.2
machinery	6.8	13.5
radio, TV & comm. equ.	2.1	11.4
electrical mach.	4.8	7.7
office & acc. mach.	0.2	7.1
S-E-Asia, cumulative real export growth: 260%		
radio, TV & communication equ.	17.6	21.0
office & acc. mach.	3.6	15.7
machinery & equip.	8.5	12.2
motor vehicles	11.5	8.2
chemicals & products	8.0	6.6
EU-15, cumulative real export growth: 125%		
machinery & equip.	11.1	17.5
chemicals & products	13.3	14.9
motor vehicles	14.2	14.7
radio, TV & communication equ.	4.4	6.2
food & beverages	8.3	5.7
NAFTA, cumulative real export growth: 117%		
motor vehicles	17.7	15.0
machinery & equip.	9.4	14.1
radio, TV & communication equ.	9.5	11.9
chemicals & products	11.2	10.5
office & acc. mach.	2.7	8.0
Latin America, cumulative real export growth: 115%		
food & beverages	23.8	26.0
basic metals	20.1	14.3
motor vehicles	6.5	10.9
chemicals & products	7.8	8.0
machinery & equip.	3.3	7.1

Source: own calculations.

Note: CIS & Balkans are not reported here. Due to the dominance of Russia, basic metals and coke and petroleum products are dominating the export structure of this region resulting in a rather unique export pattern.

3. Decomposing World Exports

When describing our database, we have repeatedly pointed out the importance of structural change for the developments of world trade. We are thus interested in a decomposition of the real trade growth along several dimensions, including the national and regional component of changes in trade, the sector composition of changes in trade, and finally also changes in the sector composition of regional trade. To do this in a more systematic way than in the previous section, we start by defining exports X_{is} very generally as exports X in sector i by country s. Total exports of country s are then given by $X_s = \sum_i X_{i,s}$. We define export shares by country for each sector as:

$$\phi_{i,s} = \frac{X_{i,s}}{\sum_i X_{i,s}} \quad (1)$$

Globally, we can also define global shares by industry, i.e. further summing over all exporters:

(2) $$\Phi_i = \frac{\sum_s X_{i,s}}{\sum_s \sum_i X_{i,s}}$$

Our first decomposition is then related to national deviations from the global composition of trade. The change in a country's exports can be written as:

(3)
$$\begin{aligned} \%\Delta X_s &= \frac{X_s^1 - X_s^o}{X_s^o} \\ &= \sum_i \Phi_i^0 \left[\frac{X_{i,s}^1 - X_{i,s}^o}{X_i^o} \right] \\ &+ \sum_i \left(\phi_{i,s}^0 - \Phi_i^0 \right) \left[\frac{X_{i,s}^1 - X_{i,s}^o}{X_{i,s}^o} \right] \end{aligned}$$

This gives national exports, decomposed into a global effect, and an exporter effect (deviation) based on changes relative to the global average over sectors and destinations. We can also specify a decomposition of changes in national exports based on deviations from global changes in trade. To do this, we define global exports as follows.

(4) $$\Psi_i = \sum_s X_{i,s}$$

Our second decomposition is then related to national deviations from the global change in trade. The change in a country's exports can be written as:

(5)
$$\begin{aligned} \%\Delta X_s &= \frac{X_s^1 - X_s^o}{X_s^o} \\ &= \sum_i \phi_{i,s}^0 \left[\frac{\Psi_i^1 - \Psi_i^o}{\Psi_i^o} \right] \\ &+ \sum_i \phi_{i,s}^0 \left[\frac{X_{i,s}^1 - X_{i,s}^o}{X_{i,s}^o} - \frac{\Psi_i^1 - \Psi_i^o}{\Psi_i^o} \right] \end{aligned}$$

Finally, we can also define a combined or total decomposition as follows:

(6)
$$\begin{aligned} \%\Delta X_s &= \frac{X_s^1 - X_s^o}{X_s^o} = A + B + C \\ A &: \text{global change in total trade} = \sum_i \Phi_i^0 \left[\frac{\Psi_i^1 - \Psi_i^o}{\Psi_i^o} \right] \\ B &: \text{deviation from global share structure} = \sum_i \left(\phi_{i,s}^0 - \Phi_i^0 \right) \left[\frac{X_{i,s}^1 - X_{i,s}^o}{X_{i,s}^o} \right] \\ C &: \text{shift in composition} = \sum_i \Phi_i^0 \left[\frac{X_{i,s}^1 - X_{i,s}^o}{X_{i,s}^o} - \frac{\Psi_i^1 - \Psi_i^o}{\Psi_i^o} \right] \end{aligned}$$

In equation (6), the first term A captures changes in the global volume of trade. In the case where country *s* is identical in trade structure and changes in trade to the global average, this also represents the change in trade volume for country *s*. Put differently, the term A captures the pure growth effect in the absence of changes in underlying sector structure. The terms B and C capture

reasons why country s may have a trade growth that is different from the global average. Both of these terms refer to a different impact of the sector structure of trade. In other words, a large contribution of these two effects to the country's overall trade growth reflects a high importance of industrial structure or structural change for the country. The second term, B, captures differences in the importance of various sectors i for country s – for example if steel exports are more important for country i than they are for the world as a whole. This reflects the contribution of the initial trade structure to subsequent trade growth. A positve effect implies that the country's initial trade structure is beneficial for future export growth. In contrast, a negative value would reveal that the initial industry structure has been a drag on growth. The final term C captures differences in the change in trade at the sector level for country s relative to the world – for example if steel exports fall or rise more for country i than they do for the world as a whole. This effect quantifies the importance of structural change for trade growth. A positive value would again reveal a growing share of fast growing industries with a rising export intensity, thus improving the country's trade performance.

Table 3: Structural Decomposition of World Export Growth, 1995-2007.

	$\%\Delta X_s$	A	B	C
	cum. export growth	global importance of industry	initial export structure	industry-specific growth rate differential
	in %		in ppt	
EU-15	125	175	-7	-42
CEE-10	445	175	-678	948
CIS	283	175	-142	250
NAFTA	117	175	7	-64
LatAm	115	175	-166	106
S-E-Asia	260	175	36	50
ROW	242	175	-90	158

Source: own calculations.

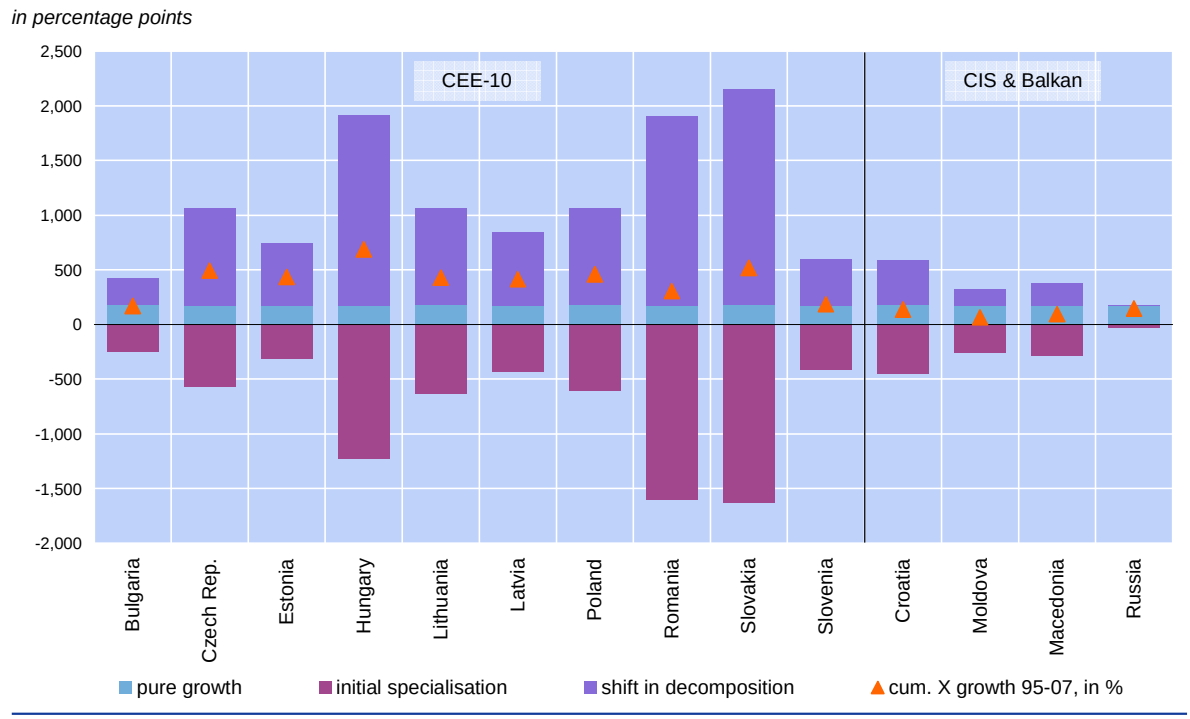
Table 3 reports the results of this decomposition analysis applied to exports. While the EU-15, NAFTA and also Latin America have recorded a cumulative growth performance over the 1995-2007 period which remained below the global export growth rate of 175% in the absence of structural change (i.e. they were relatively underperforming), CESEE and South and East Asian countries have shown export growth beyond the "pure growth" effect. Structural change played only a minor role for the two most advanced regions in our sample, NAFTA and EU-15. In both regions the contribution of structural change to overall export growth was negative, i.e. they were growing more slowly than the world average in those economic activities whose importance in global trade was increasing.

When looking into the two effects of industrial structure on the successful emerging regions' export growth, we find an interesting distinction between CESEE and South East Asia. The initial export structure of the CESEE countries was not conducive to future rapid export growth. However, the new EU member states in particular exhibited substantial structural change, showing particularly strong export growth in industries with rising global importance. Thus, they have managed to change their initially unfavourable export structure. In contrast, South East Asia shows considerably less evidence of structural change over the period 1995-2007. The beneficial initial export structure was compounded by favourable structural change, both effects were positive for this region and added about one third to the above-average export performance over the period.

Latin America also showed some restructuring towards strongly growing industries, however this effect was not strong enough to offset the region's unfavourable initial export structure.

To summarize the global decomposition of real export growth over the recent past, the CEE-10 clearly was the region characterised by the most substantial shift of export shares at the industry level. It was also the region exhibiting the strongest export growth performance in real terms – despite the region's particularly strong specialisation on motor vehicles, whose share in global trade flows has actually been declining gradually (although export growth is still high in this category in absolute terms).

Figure 4: Structural Decomposition of CESEE Export Growth, 1995-2007.



Source: own calculations.

Given the uniqueness of the CEE-10 region, Figure 4 shows the contribution of all three effects on total cumulative real export growth in more detail. Hungary, Romania and Slovakia are the three countries for which the structural change towards rapidly growing export sectors was most pronounced. This went hand in hand with substantial restructuring over the period, moving away from the initial disadvantageous specialisation patterns prevalent in those countries in the mid-1990s. Also, Poland and the Czech Republic show significant structural change, while CIS and Balkan countries (including Bulgaria) do not exhibit a great deal of structural change, resulting in generally lower export growth in those countries. In particular for Russia total export growth corresponds to the pure growth effect only.

4. Estimating the Output Elasticity of Exports

So far we have concentrated on export flows and structural change therein. In this section we attempt to relate exports to output developments. An often cited phenomenon in the literature is the increasing elasticity of export to output growth. The recent trade collapse during the financial and economic crisis is often explained by the large output elasticity of exports in today's globalized world.

To quantify the relationship between exports and GDP, we will define a number of indicators. We will also integrate these with standard growth decompositions. We start by defining GDP in growth terms as the weighted growth in value added in goods and in services:

(7) $$g_{GDP} = \theta_{goods} g_{VA,\ goods} + \theta_{services} g_{VA,\ services}$$

In equation (1), the term g denotes growth in GDP or the total economy's value added, while θ is the respective share of goods and services in GDP.

We will also specify a second growth rate, for exports X:

(8) $$g_X = \phi_{goods} g_{X,\ goods} + \phi_{services} g_{X,\ services}$$

In equation (2), the term g denotes growth in exports, while ϕ is the share of goods and services in total exports.

Starting from (1) and (2), we will now define a set of export elasticities:

(9)
$$Z_1 = g_X - g_{GDP}$$
$$Z_2 = g_{X,\ goods} - g_{GDP}$$
$$Z_3 = g_{X,\ goods} - g_{VA,\ goods}$$
$$Z_4 = g_{X,\ services} - g_{VA,\ services}$$

Much of the literature has focused exclusively on Z_2, and indeed the repeated emphasis on trade growth by the WTO (and earlier by the GATT) has also been focused on Z_2. With some manipulation, we can link Z_2 to Z_3 as follows:

(10) $$Z_2 = Z_3 + \theta_{services}\left[g_{VA,\ goods} - g_{VA,\ services}\right]$$

Essentially, to the extent that the real growth rate of the service sector lags growth in manufactured goods, Z_2 will point to trade growth that seems to exceed growth in GDP. The magnitude of this growth differential one the one hand and the share of services in GDP on the other hand determines to extent to which exports "over-react" to GDP growth. It becomes clear from equation 4 above that with a services share of roughly 70% and a realistic growth differential between the service and goods sector this elasticity can easily be around 2-3, as commonly reported in the literature (Irwin 2002, Freund 2009).

We use the following simple regression model to estimate the output elasticity of exports:

(11) $$d\ln X_{sit} = \alpha + \beta * d\ln(output)_{sit} + \mu_{si} + \varepsilon_{sit}$$

The coefficient β gives us an estimate of Z_3 in equation (10) above. We estimate equation (11) in a panel of 70 – 80 countries over the period 1995-2007. We include country-specific fixed effects and further control for changes in unit labour costs as a potentially important determinant of a country's export performance in a certain industry.[6]

When we use GDP instead of manufacturing value added, we obtain an estimate of Z_2 at around 2, which is roughly in line with the existing literature. The discrepancy between our coefficient and the often higher estimates found in the recent literature (Irwin 2002, Freund 2009) can be explained by the sector-specific deflation procedure that we employ. There are important differences in price developments of motor vehicles, electrical machinery, precision instruments and office and

[6] We also tried with more control variables, such as productivity growth and a time trend, however these variables were often insignificant without having an effect on the other coefficients in the model. The Bayesian information criterion (BIC) was clearly in favour of the specification with unit labour cost changes as the only control variable.

accounting equipment compared to the economy wide export deflator. Together these categories accounted for roughly 30% of global trade in 2007 in our dataset. However, when we turn to the elasticity referred to as Z_3 above, the output elasticity of exports drops considerably. On average, manufacturing exports respond only very moderately to growth in value added within the same sector. The elasticity of manufacturing exports to manufacturing value added is far below one and found to be around 0.2 (see Table 4). Thus, within the same sector, we do not find an overshooting in the trade response to output changes.[7] Rather, this result corroborates the view that the impressive real trade growth rates which we witnessed in the past couple of years represent in fact structural change at the country and industry level.

Table 4: Elasticity of Manufacturing Exports to Manufacturing Output, 1995-2007.

	full sample	**1995-2001**	**2001-2007**
%Δ(value added)	0.1945 ***	0.1428 ***	0.2045 ***
	4.78	*2.36*	*4.67*
%Δ(unit labour costs)	-0.0706 **	-0.1285	-0.0701 **
	-2.17	*-1.35*	*-1.78*
constant	-0.0823	-0.2242	-0.0735
	-1.1	*-1.08*	*-0.79*
Obs.	622	281	402
No. of countries	81	69	78
R_2-within	0.0977	0.0603	0.1021
R_2-overall	0.1009	0.0408	0.0966
R_2-between	0.0520	0.0013	0.0949
F-value	13.76	3.55	13.04

Source: own calculations.

Note: The dependent variable is the growth of real manufacturing output, calculated as the first difference of ln(exports). *, **, *** indicate that the coefficient estimate is statistically significant at the 10-, 5-, 1-significance level. T-values are given below coefficients.

In line with the existing literature, we can also confirm a rising elasticity of exports to value added. The coefficient increased from 0.14 in the first half of our observation period to 0.2 in the second half. Another interesting observation relates to the significance of changes in unit labour costs: While this was not systematically related to export growth in the beginning of the observation period, falling unit labour costs were associated with more export growth in the latter half of the period.

[7] We have also run the regressions using manufacturing output instead of value added, in order to eliminate the conceptual difference between the net concept of value added and the gross measure of exports. The results are broadly similar, suggesting that this conceptual difference does not induce a bias in the results. According to this reasoning, the conceptual difference between exports and GDP would be ruled out as a reason for the "puzzling" large trade response during the global recession.

Table 5: Elasticity of Manufacturing Exports to Manufacturing Output by Regions.

	full sample	1995-2001	2001-2007
%Δ(value added) interacted with regional dummy for:			
CIS+Balkan	0.5593 ***	-1.6929 *	0.6561 ***
	4.29	*-1.88*	*4.82*
CEE-10	0.2964 ***	0.376 ***	0.0851
	4.48	*5.02*	*1.31*
EU-15	0.2635 ***	0.227 ***	0.2037 ***
	4.46	*3.59*	*2.74*
LatAm	0.0522	-0.033	0.2422 ***
	1.05	*-0.91*	*3.44*
NAFTA	0.1001	0.5381 ***	0.7409 ***
	0.35	*2.93*	*4.49*
S-E-Asia	0.383 ***	0.3675 ***	0.4869 ***
	5.8	*4.12*	*4.87*
ROW	0.1811 ***	0.2088	0.1694 **
	2.35	*1.64*	*2.12*
%Δ(unit labour costs)	-0.066 **	-0.1751 **	-0.0623
	-2.12	*-2.16*	*-1.64*
constant	-0.0755	-0.3272 *	-0.0585
	-1.05	*-1.85*	*-0.65*
Obs.	622	281	402
No. of countries	81	69	78
R_2-within	0.1243	0.1233	0.1293
R_2-overall	0.1296	0.0570	0.0959
R_2-between	0.0683	0.0000	0.0529
F-value	14.00	9.71	12.92

Source: own calculations.

Note: The dependent variable is the growth of real manufacturing output, calculated as the first difference of ln(exports). *, **, *** indicate that the coefficient estimate is statistically significant at the 10-, 5-, 1-significance level. T-values are given below coefficients.

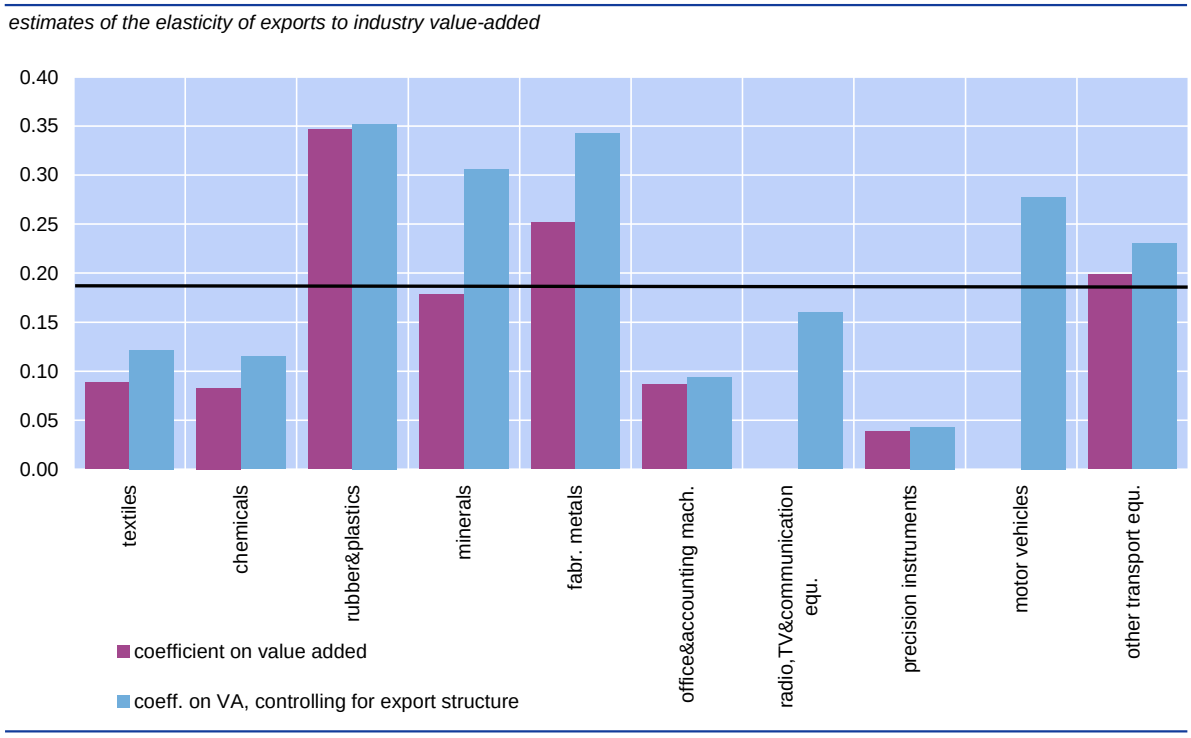
In Table 5 we report the results from estimating the same model, however now we interact manufacturing value added with a dummy for each region in our sample. Again in line with the literature, we find a significantly stronger export reaction in South East Asia compared to all other regions. We also find a very strong elasticity in the CIS, however the result for the first sub-period is rather puzzling. For the new EU members we observe again a result which stands in contrast to the global picture: The output-elasticity of exports has declined for the region. The EU-15 show a relatively constant output elasticity of exports slightly greater than 0.2, while the results for NAFTA are again difficult to interpret.

Results for individual industries are given in Tables A2 and A3 in the appendix. Figure 5 displays the elasticity estimates for those industries which yield a statistically significant coefficient. Contrary to our expectations, the most important industries in global exports are not those which are at the same time characterised by a strong export response to growth in value added. It is rather activities such as rubber & plastics, metals, but also motor vehicles and other transport equipment which are characterized by highly elastic exports. These industries also represent a sizeable amount of world trade, however only motor vehicles is among the top-5 categories in 2007 shares. The coefficient for motor vehicles only becomes significant when controlling in addition for the country's world export share within motor vehicles as well as for the export-to-value added ratio within the industry in each country.

In general, the coefficient on the output elasticity of exports is higher and becomes more significant when we control for these two structural indicators at the industry-country level which are themselves highly significant: the importance of exports in the respective industry in terms of domestic value added (i.e. the ratio of exports to value added or the export intensity of the sector) and the country's share in world exports within each industry. This result further underlines the

importance of the industry structure for export growth. Thus, a structural decomposition of export growth does not leave much room for a great "trade puzzle" in terms of exports "over-reacting" to changes in domestic value added.

Figure 5: Elasticities of Exports to Value Added by Industries



Source: own calculations.
Note: Includes only industries with a statistically significant (at the 5% level) elasticity of exports to value added. The black bar indicates the weighted average elasticity for all industries of 0.19.

5. Implications for Central and Eastern Europe and General Conclusions

In this paper we construct a new set of trade and output data at the ISIC 2-digit industry level over the period 1995-2007, using sector-specific price deflators for exports and domestic value added to account for dramatically different price developments in individual industries over the sample period.

Decomposing export growth into a pure growth component and two structural effects – the growth contribution of initial industry specialisation and the effect of structural change at the industry level – we find that CESEEs have been subject to considerable structural change with an overall positive effect on their export growth performance. In particular the new EU members (CEE-10) showed a successful restructuring towards fast growing sectors. This has implied an increasing specialisation of the region on motor vehicles besides machinery and electronic goods. However, in a longer-term global perspective, trade in motor vehicles is becoming less important in relative terms. Further, trade in machinery and cars was severly hit in the recent crisis, corroborating the negative impact on Eastern Europe. As a consequence, continued domestic restructuring will remain important for the region, as global trade patterns partly move away from CESEE's current specialisation.

It is an often cited stylized fact that global exports grow faster than GDP. This often cited high "elasticity of exports to output" drops to far below one when we look at the elasticity of an industry's

exports to value added in the respective industry. This result is important, as it offers us an alternative explanation of the rise (and crisis-related contraction) of exports changes in the regional and industrial composition of exports itself (i.e. countries moving into trade-intensive sectors), rather than a change in the nature of trade and production (i.e. global supply chains). This may also imply that we overestimate the effect of falling trading costs and global supply chains on export growth.

References

Auboin M. (2009), "Boosting the availability of trade finance in the current crisis: Background analysis for a substantial G20 package", Policy Insight No. 35, June 2009, Centre for Economic Policy Research

Baldwin, R., P. Martin, G. Ottaviano (2001), "Global Income Divergence, Trade, and Industrialization: The Geography of Growth Take-Offs", Journal of Economic Growth 6(1), pp. 5-37.

Baier S., J. Bergstrand (2001), "The growth of world trade: tariffs, transport costs, and income similarity", Journal of International Economics 53(1), pp. 1-27.

Bems, R., R. Johnson, K-M. Yi (2010), "Demand Spillovers and the Collapse of Trade in the Global Recession", IMF Working Paper No. 10/142.

Chauffour J-P., T. Farole (2009), "Trade Finance in Crisis Market Adjustment or Market Failure?", Policy Research Working Paper 5003, July 2009, The World Bank.

Buitelaar, P., H.A.M. van Kerhoff (2010), "The performance of EU foreign trade: a sectoral analysis", De Nederlandsche Bank Occasional Studies 8(1).

Eaton, J., S. Kortum, B. Neiman, J. Romalis (2010), "Trade and the Global Recession", mimeo.

Escaith H. (2009), "Trade Collapse, Trade Relapse and Global Production Networks: Supply Chains in the Great Recession", MPRA Paper No. 18433.

Feenstra, R.C. (1998), "Integration of Trade and Disintegration of Production in the Global Economy, The Journal of Economic Perspectives 12(4), pp 31-50

Francois J., J. Woerz (2009), "Follow the Bouncing Ball – Trade and the Great Recession Redux" in Baldwin R. (ed.): The Great Trade Collapse: Causes, Consequences and Prospects. VoxEU.org Ebook, published 27 November 2009, http://www.voxeu.org/index.php?q=node/4269 .

Freund, C. (2009), "The Trade Response to Global Downturns. Historical Evidence," World Bank Working Papers 5015, August 2009.

Hummels, D. (2007), "Transportation Costs and International Trade in the Second Era of Globalization", The Journal of Economic Perspectives 21(3), pp. 131-154.

Jacks, D., Ch. Meissner, D. Novy (2008), "Trade Costs, 1870-2000", American Economic Review: Papers & Proceedings 2008, 98 (2), pp. 529–534.

Irwin, D. (2002), "Long-Run Trends in World Trade and Income" World Trade Review, 1, pp 89-100.

McKibbin, W.J., A. Stoeckel (2009), "Modelling the Global Financial Crisis. Centre for Applied Macroeconomic Analysis," The Australian National University, Working Paper 25/2009.

Yi, K-M. (2009), "The Collapse of Global Trade: The Role of Vertical Specialization" in The Collapse of Global Trade, Murky Protectionism, and the Crisis: Recommendations for the G20, edited by R. Baldwin and S. Evenett, a VoxEU.org publication.

Young, A. (1995), "The Tyranny of Numbers: Confronting the Statistical Realities of the East Asian Growth Experience." *Quarterly Journal of Economics* 110 (August), pp 641-680.

WTO (2010), "International Trade Statistics 2010".

Appendix

Appendix Table A1: List of countries and regional grouping

EU-15:

AUT	Austria
BEL	Belgium
DEU	Germany
DNK	Denmark
ESP	Spain
FIN	Finland
FRA	France
GBR	United Kingdom
GRC	Greece
IRL	Ireland
ITA	Italy
LUX	Luxembourg
NLD	Netherlands
PRT	Portugal
SWE	Sweden

CEE-10:

BGR	Bulgaria
CZE	Czech Republic
EST	Estonia
HUN	Hungary
LTU	Lithuania
LVA	Latvia
POL	Poland
ROM	Romania
SVK	Slovakia
SVN	Slovenia

CIS & Balkan:

ALB	Albania
BIH	Bosnia and Herzegovina
BLR	Belarus
HRV	Croatia
MDA	Moldova
MKD	Macedonia, FYR
MNE	Montenegro
RUS	Russian Federation
SER	Serbia
UKR	Ukraine

NAFTA:

CAN	Canada
MEX	Mexico
USA	United States

Latin America (LatAm):

ARG	Argentina
BOL	Bolivia
BRA	Brazil
CHL	Chile
COL	Colombia
CRI	Costa Rica
ECU	Ecuador
NIC	Nicaragua
PAN	Panama
PER	Peru
PRY	Paraguay
SLV	El Salvador
URY	Uruguay
VEN	Venezuela

South and East Asia (S-E-Asia):

BRN	Brunei
CHN	China
IDN	Indonesia
IND	India
JPN	Japan
KHM	Cambodia
KOR	Korea, Rep.
LAO	Lao PDR
MMR	Myanmar
MYS	Malaysia
PHL	Philippines
SGP	Singapore
THA	Thailand
VNM	Vietnam

Appendix Table A2: Output Elasticity of Exports by Industry, Fixed Effect Panel Estimation Results

	Food	Textiles	Clothing	Wood & Products	Paper & Products	Chemicals	Rubber & Plastics	Non-metallic Minerals
%Δ(value added)	-0.0346	0.0887	-0.0567	-0.0395	0.031	0.0829	0.3468	0.1783
	-0.35	1.97	-0.68	-0.46	0.33	2.14	3.12	1.85
%Δ(unit labour costs)	-0.0788	0.0736	-0.0006	-0.1492	-0.0645	-0.012	-0.2596	-0.0798
	-1.03	0.95	-0.01	-1.43	-0.31	-0.18	-2.09	-0.52
constant	-0.1266	0.192	0.0333	-0.2253	-0.0675	0.0518	-0.4952	-0.1609
	-0.68	1.32	0.23	-1.09	-0.14	0.32	-1.91	-0.52
Obs.	616	593	537	585	577	573	587	571
No. of countries	79	77	76	78	75	73	76	74
R_2-within	0.0026	0.0133	0.0019	0.0046	0.0013	0.0097	0.0533	0.0215
R_2-overall	0.0077	0.0000	0.0060	0.0101	0.0089	0.0103	0.0367	0.0288
R_2-between	0.0664	0.0413	0.5500	0.1941	0.1060	0.0003	0.0011	0.1127
F-value	0.5281	2.3034	0.2333	1.075	0.0816	2.2968	6.1298	2.5069

	Basic Metals	Fabricated Metals	Machinery & Equ.	Office & Acc. Mach.	Electrical Mach.	Radio, TV & Communication Equ.	Precision Instruments	Motor Vehicles	Other Transport Equ.
%Δ(value added)	0.0264	0.2515	-0.0553	0.0864	0.0166	0.0617	0.0384	0.2142	0.1987
	0.62	2.51	-0.49	1.93	0.23	0.64	1.68	1.47	2.69
%Δ(unit labour costs)	-0.1012	0.0243	-0.2571	-0.1988	-0.3953	-0.2575	-0.1213	-0.0617	0.2443
	-1.08	0.12	-1.01	-2.65	-3.94	-1.78	-1.14	-0.38	1.18
constant	-0.2047	0.1354	-0.2945	-0.1909	-0.6709	-0.3858	-0.0718	-0.0435	0.4827
	-0.89	0.34	-0.63	-1.07	-3.32	-1.28	-0.39	-0.12	1.34
Obs.	564	543	579	439	552	448	494	538	501
No. of countries	75	74	74	59	74	58	63	69	67
R_2-within	0.0039	0.0202	0.0071	0.0583	0.0846	0.0442	0.0107	0.0143	0.0226
R_2-overall	0.0050	0.0137	0.0142	0.0512	0.0560	0.0297	0.0191	0.0124	0.0072
R_2-between	0.0072	0.1343	0.1009	0.1558	0.0035	0.1047	0.0497	0.0202	0.0024
F-value	0.9474	3.394	0.5249	5.1766	9.0175	1.8357	2.6286	1.2589	3.6285

Source: own calculations.

Note: The dependent variable is the growth of real manufacturing output, calculated as the first difference of ln(exports). *, **, *** indicate that the coefficient estimate is statistically significant at the 10-, 5-, 1-significance level. T-values are given below coefficients.

Appendix Table A3: Output Elasticity of Exports by Industry Controlling for Industry Structure, Fixed Effect Panel Estimation Results

	food	textiles	cloth	wood	paper	chem	rubber	minerals
	Food	Textiles	Clothing	Wood & Products	Paper & Products	Chemicals	Rubber & Plastics	Non-metallic Minerals
%Δ(value added)	0.0696	0.1215	-0.0306	0.0356	0.0776	0.115	0.3519	0.3058
	1.26	2.61	-0.34	0.37	0.86	2.54	3.16	2.83
export intensity	0.247	0.0141	0.0125	0.0461	0.1453	0.013	0.126	0.2901
	4.18	2.28	1.42	2.42	4.33	1.83	1.21	3.07
world export share	0.0327	0.0225	0.049	0.0433	0.0504	0.0051	0.0278	0.0223
	1.97	2.25	1.49	1.42	3.03	0.39	1.91	1.5
%Δ(unit labour costs)	-0.0786	0.0696	-0.017	-0.0915	-0.0352	-0.0673	-0.3434	-0.2905
	-1.12	0.91	-0.19	-0.89	-0.17	-1.13	-2.75	-1.97
constant	-0.4412	0.1105	-0.087	-0.2377	-0.2683	-0.1278	-0.8636	-0.813
	-2.26	0.78	-0.55	-1.16	-0.58	-0.91	-2.98	-2.48
Obs.	616	593	537	585	577	573	587	571
No. of countries	79	77	76	78	75	73	76	74
R_2-within	0.1627	0.0322	0.0164	0.0322	0.0465	0.022	0.0766	0.0915
R_2-overall	0.0215	0.0002	0.0056	0.0015	0.0012	0.0232	0.0245	0.0352
R_2-between	0.0105	0.0129	0.0132	0.0011	0.0215	0.1103	0.0078	0.0672
F-value	7.3924	3.2948	1.104	2.5576	7.4738	2.4366	5.9729	6.1766

	Basic Metals	Fabricated Metals	Machinery & Equ.	Office & Acc. Mach.	Electrical Mach.	Radio, TV & Communication Equ.	Precision Instruments	Motor Vehicles	Other Transport Equ.
%Δ(value added)	0.0687	0.3422	0.0586	0.0937	0.0513	0.16	0.0432	0.2779	0.2303
	1.45	3.79	0.56	2.04	0.66	1.82	1.69	1.94	2.93
export intensity	0.0123	0.336	0.0175	0.0002	0.005	0.0091	0.0001	0.0018	0.0046
	3.64	4.84	1.73	1.84	2.25	3.65	0.89	1.72	1.81
world export share	0.0983	-0.0042	0.0317	0.0256	0.0274	0.0185	0.0367	0.0143	0.056
	2.94	-0.37	2.03	1.55	2.1	1.49	2.22	0.62	3.05
%Δ(unit labour costs)	-0.118	0.0765	-0.3026	-0.2027	-0.4138	-0.2479	-0.1242	-0.0678	0.263
	-1.24	0.38	-1.18	-2.66	-4.14	-2.08	-1.18	-0.37	1.27
constant	-0.4451	-0.019	-0.5213	-0.2551	-0.7676	-0.4953	-0.138	-0.145	0.3592
	-1.83	-0.05	-1.07	-1.39	-3.8	-1.99	-0.74	-0.36	1
Obs.	564	543	579	439	552	448	494	538	501
No. of countries	75	74	74	59	74	58	63	69	67
R_2-within	0.016	0.0774	0.077	0.0649	0.0994	0.1752	0.014	0.0693	0.0487
R_2-overall	0.0013	0.0131	0.0418	0.025	0.0746	0.0651	0.0004	0.015	0.0066
R_2-between	0.0211	0.0253	0.1044	0.0498	0.1146	0.0045	0.0007	0.0004	0.0017
F-value	5.2119	9.3349	2.5202	3.6068	7.5352	5.7636	2.6736	3.4868	4.8098

Source: own calculations.

Note: The dependent variable is the growth of real manufacturing output, calculated as the first difference of ln(exports). *, **, *** indicate that the coefficient estimate is statistically significant at the 10-, 5-, 1-significance level. T-values are given below coefficients.