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Abstract

With the availability of international value added trade data it has become evident that gross export data and value added data do not provide the same information. Although gross exports crosses national borders and is the target of trade policy, value added data tell us what fragment in the production chain is internationally competitive in a particular country. With respect to comparative advantage the differences between the two types of data are often illustrated by means of examples using a single sector. In the Ricardian theory of comparative advantage, however, the position of a commodity versus all other commodities in a country determines whether or not a sector has a comparative (dis)-advantage. This implies that distributions of comparative advantage of all sectors should be compared and not just individual sectors. In this paper we determine the distributions of Revealed Comparative Advantage (RCA) in terms of gross exports and value added for 40 countries. A Systematic comparison of these distributions shows that the distributions of RCA calculated with gross exports and value added data are indeed significantly different from each other. After establishing these significant differences we use the Great Recession as an example to determine which RCA measure has the largest information content regarding the real economy. We find that RCA calculated with value added data is the most telling.

JEL-Code: F100, F140, F600.

Keywords: revealed comparative advantage, gross exports, value added exports.

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1 Introduction

Traditionally international trade is analyzed by using data on gross exports. This is the export that crosses national borders and is registered by custom officials. The assumption is that gross export flows provide sufficient information to analyze the structure of international trade and, for example, comparative advantage. As long as international fragmentation is limited gross exports indeed provide this information.[1] This, however, is no longer the case. International fragmentation of the production process has become a salient characteristic of the world economy and international trade flows no longer, or to a lesser extent than it used to be, reflect what a country is producing and exporting (see Brakman, Van Marrewijk, and Partridge, 2015 for some recent references). The export of a computer, for example, is in a fragmented world no longer reflecting the production of that computer from start to finish. The country involved might only contribute a (small) fragment of the production process, or in other words, add only a part of total value added of the final product (Johnson, 2014). The analyses of the characteristics of international trade flows thus becomes more challenging. Furthermore, because the available data on fragmentation, in detail and coverage, are lagging behind gross export data we still have to develop a complete understanding of the issues involved.

This paper tries to contribute in this respect, and compares differences between Revealed Comparative Advantage (RCA) based on gross export data and value added data. This difference is important because an analysis concerning the strength of a sector on the international market based on gross export data could lead to very different conclusions than an analysis in value added terms. In gross export terms China has, for example, a comparative advantage in computers, whereas in value added terms this is no longer the case and value added data indicate that China instead has a comparative advantage in assembly (Johnson, 2013). Koopman et al. (2014) give examples how comparative

[1] The process of fragmentation is known under different names. Richard Baldwin (2006), f.i. has coined the term 'second unbundling'; 'second', as opposed to the 'first' unbundling that started in the 19th century. The transport revolution of the 19th century made is possible to spatially separate production from consumption with international trade as a result. The 'second unbundling' indicates that the production process itself is becoming spatially unbundled. Other terms are: vertical specialization, international fragmentation, or slicing-up-the-value chain.

advantage can turn into comparative disadvantage using RCA based on gross versus value added data. Furthermore, because these value-added chains cover many countries, trade frictions or business cycles that involve only a limited number of countries can have global consequences along the supply chain. It goes almost without saying that these difference are important from a policy perspective. The calculated welfare effects (in terms of real consumption) of a 40% worldwide tariff differ markedly in models with, or without intermediates. With intermediates the losses tend to be larger, this is because with intermediates single tariffs can affect the demand at all stages of production (all border crossings of intermediates are affected) rather than without intermediates, and so the global welfare effects are magnified (Costinot, and Rodriquez-Clare, 2014)

Recent analyses of value added trade indicate that (Johnson, 2014; Johnson and Noguera, 2012): the difference between value added exports and gross exports is increasing; gross exports of manufactures is larger than value added exports of manufactures; that these findings are different across countries and time, and that fragmentation is strong between nearby trading partners. Especially the fact that the difference between value added exports and gross exports is becoming larger over time increases the likelihood that RCA based on gross exports and value added exports lead to different conclusions (see also Timmer et al., 2013). Although Timmer et al. (2013) calculate RCA based on value added data, but they do not analyze patterns of RCA in a systematic way, or compare RCA measures based on gross export data to those based on value added data. Koopman et al. (2014, p.491, Figure 2) inspect the differences between the two measures visually for two ISIC sectors in their sample, and show the potential differences. They, however, do not perform a statistical analysis for all commodities to determine the differences between the two measures over the complete RCA distribution of sectors. This paper tries to contribute in this respect, and shows that the measures differ significantly. Using examples, it is compelling to conclude that the two measures and the information they contain are different, this, however, still has to be decided on the basis of a systematic and statistical comparison of RCA distributions.

The set-up of this paper is as follows. In section 2 RCA is defined. Section 3 discusses the data-set which is based on the WIOD data. Section 4 analyses the distributions of RCA based on gross export data and value added data. Section 5 takes a closer look at strong and weak sectors as identified by the two measures of RCA. Although, most sectors are identified by both measures to be strong or weak, noticeable differences exist. Section 6 shows that these differences might be very important. Using the example of the Great Recession, we show that unemployment changes after 2008 are best explained by RCAs based on value added data. Section 7 concludes

2. Revealed Comparative Advantage

The notion of Revealed Comparative Advantage (RCA) was first introduced by Liesner (1958) and operationalized by Balassa (1965). It is widely used to identify a country's weak and strong export sectors. The RCA index is essentially a normalized export share (a country's exports in some sector as a fraction of national exports, divided by a group of reference countries's exports in that sector as a fraction of their total exports). When the RCA index exceeds unity, a comparative advantage is 'revealed' for the country in that particular sector. On average, about one third – in terms of gross exports – of all sectors have an RCA index above one, although this percentage varies considerably across countries (Hinloopen and van Marrewijk, 2001). Hillman (1980) discusses the sufficient conditions that make RCA consistent with the textbook case of comparative advantage. He concludes that RCA is consistent with comparative advantage 'if a country's exports of a particular good are simultaneously neither prominent in its total exports nor overly prominent in total world trade in that good (p. 321).' Interestingly, Hillman's (1980) discussion assumes that all value added is domestic (p.318), implying that his condition is more suitable for RCA in value added terms than in gross export terms. This is also the reason why Vollrath (1991) – after a survey of 10 RCA measures – prefers measures that correct for 'double counting', although his discussion is related to intra-industry analyses that dominated the trade literature in the 1980s and 1990s.

Formally, one can proceed as follows. Let $X_{i,t}^{j}$ be the value of exports from country $i \in I$ for sector $j \in J$ in period $t \in T$. Then $X_{i,t} = \sum_j X_{i,t}^{j}$ is the value of exports from country i in period t, $X_t^j = \sum_i X_{i,t}^{j}$ is the total value of exports for sector j in period t, $X_t = \sum_i \sum_j X_{i,t}^{j}$ is the total value of exports for all countries and sectors in that period and Revealed Comparative Advantage (RCA) as measured by Balassa (1965) for country i and sector j in period t equals:

$$(1) \qquad RCA_{i,t}^{j} = \frac{X_{i,t}^{j} / X_{i,t}}{X_t^j / X_t}, \quad i \in I,\ j \in J, t \in T.$$

If $RCA_{i,t}^{j} > 1$, country i is said to have a revealed (or observed) comparative advantage in the production of commodity j in time period t as its export share for product j is larger than the concomitant export share in the group of reference countries I.

Equation (1) will be used throughout the paper to indicate RCA, however it will be applied to two different data-sets; gross exports, and value added exports.

3 Data: Gross Trade Flows and Value-added Trade Flows

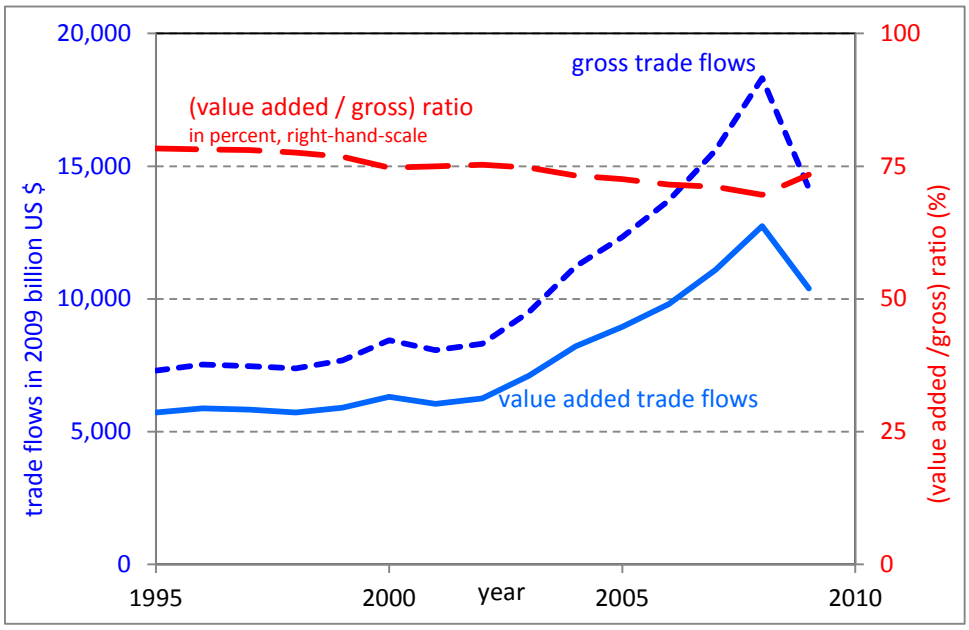
The WIOD trade data identify 40 individual countries and a 'Rest of the World' (RoW) group of countries to characterize global trade flows in the period 1995–2009 (see Table A1 in the Appendix).[2] The countries are the 27 countries of the EU (January 1, 2007), and: Australia, Brazil, Canada, China, India, Indonesia, Japan, Mexico, Russia, Taiwan, Turkey, and the USA. Together these countries represent about 85% of world GDP. Furthermore, the data cover 35 sectors, and are constructed by combining national Input-Output tables with international trade data.

Expressed in constant 2009 US dollars, global gross trade flows increased by about 94 percent in this period (see Figure 1), from $7,305 billion in 1995 to $14,160 billion in 2009.[3] Global gross trade flows peaked, however, in 2008 at $18,315 billion (and the

[2] See: www.WIOD.org
[3] We converted current dollars to constant dollars using the US GDP deflator.

drop in 2009 was almost 23 percent). Measured in value-added terms, global trade flows increased in the same period by about 82 percent, from $5,722 billion in 1995 to $10,397 billion in 2009. As illustrated in Figure 1, value-added trade and gross trade move up and down quite closely, although the gap between these flows is gradually increasing since value added trade rises more slowly. As a consequence, the *ratio* of value-added trade to gross trade is gradually declining over time, from 78 percent in 1995 to 73 percent in 2009 (see Figure 1, where this ratio is depicted on the right-hand-scale of the figure).[4]

Figure 1 Global trade flows, 1995–2009



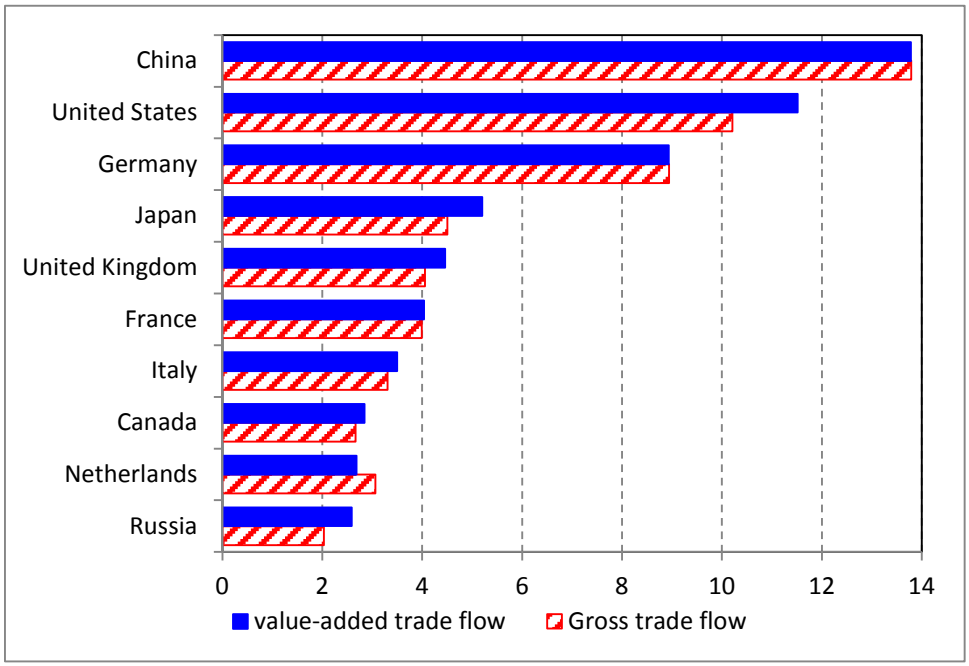
Source: authors' calculations based on WIOD data compiled by Zhi Wang.

In general, there is only a limited difference if we look a the Top 10 trading countries from a value-added point of view compared to a gross flow point of view, see Figure 2. In fact, the order of the first seven countries is identical (with the UK, Japan, and the USA having somewhat higher shares in value-added terms). The Russian Federation is the only country in the Top 10 in value-added terms that does not also make it to the Top 10 in gross terms (which can to some extent be explained by the fact that they export

[4] The exception is the rise in the ratio of value-added to gross trade flows in 2009 as a consequence of the Great Recession. This rise appears to be temporary only, see Brakman, van Marrewijk, and Partridge (2015) and Los, Timmer, and de Vries (2015).

mainly raw materials and mineral fuels both extracted in Russia itself). The reverse holds for South Korea, which drops from 9th to 11th place.

Figure 2 Top 10 value-added trading countries; 2009, percent of total trade



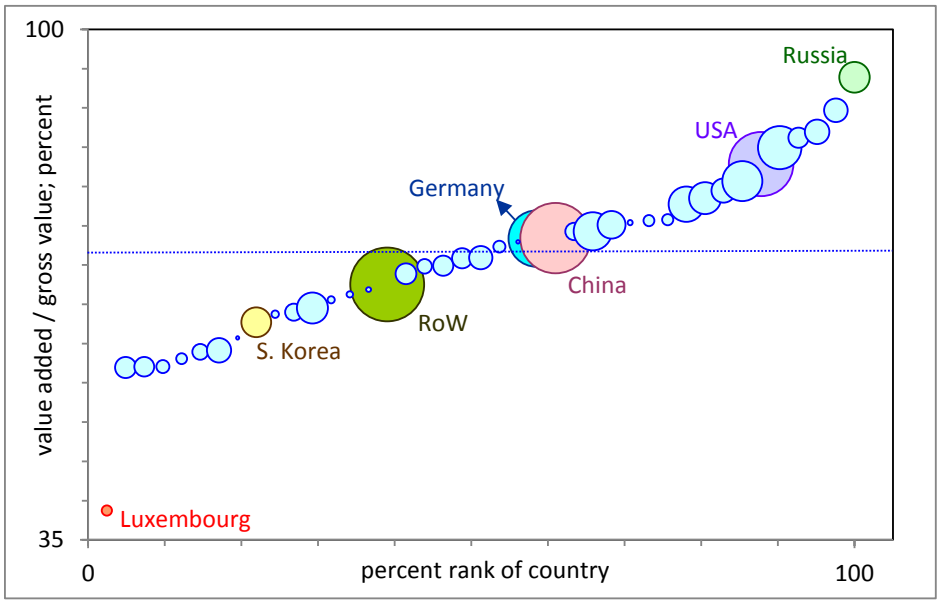
Source: authors' calculations based on WIOD data compiled by Zhi Wang.

The above observations on the Top 10 countries notwithstanding, there are substantial differences between countries regarding the ratio of value-added versus gross trade flows. This is illustrated in Figure 3, where the countries are ranked from low-to-high value added / gross trade flows (in percentage terms). The size of the bubbles is proportional to the size of value-added trade flows, while the horizontal line depicts the median value for value-added / gross trade flows (equal to 71 percent).[5] The minimum value of 38.7 percent is reached for Luxembourg, a small open economy which depends heavily on intermediate inputs from other countries for its exports. The maximum value of 93.9 percent is reached for the Russian Federation, which makes only limited use of intermediate inputs from other countries.

[5] The un-weighted average is 70.8 percent and the weighted average is 73.4 percent.

A closer look at Figure 3 reveals that Luxembourg is rather exceptional in this group of countries since its value-added / gross trade ratio is more than 18 percentage points smaller than the second ranked country (Taiwan). This is probably related to the WIOD selection of countries, which only includes Luxembourg because it is a member of the European Union (which paid for the construction of the WIOD database) and not because of the size of its economy, population, or trade flows. The ratio of value-added / gross trade flows are close to the median country value for Germany and China, while the ratio is fairly high, for example, for the USA and fairly low for South Korea and the Rest of the World. In the analysis on revealed comparative advantage below we only focus on individual countries, and thus exclude the artificial 'Rest of World' group of countries. Moreover, we only focus on relatively well-defined and tradable sector aggregates; thus exclude the sectors c29 (real estate activity), c31 (public admin and defense; compulsory social security), and c35 (private households with employed persons).[6]

Figure 3 Country trade; ratio of value-added over gross value in percent, 2009



Source: authors' calculations based on WIOD data compiled by Zhi Wang; size of bubbles proportional to the size of value-added trade flows; the horizontal line depicts the median country value (71 percent).

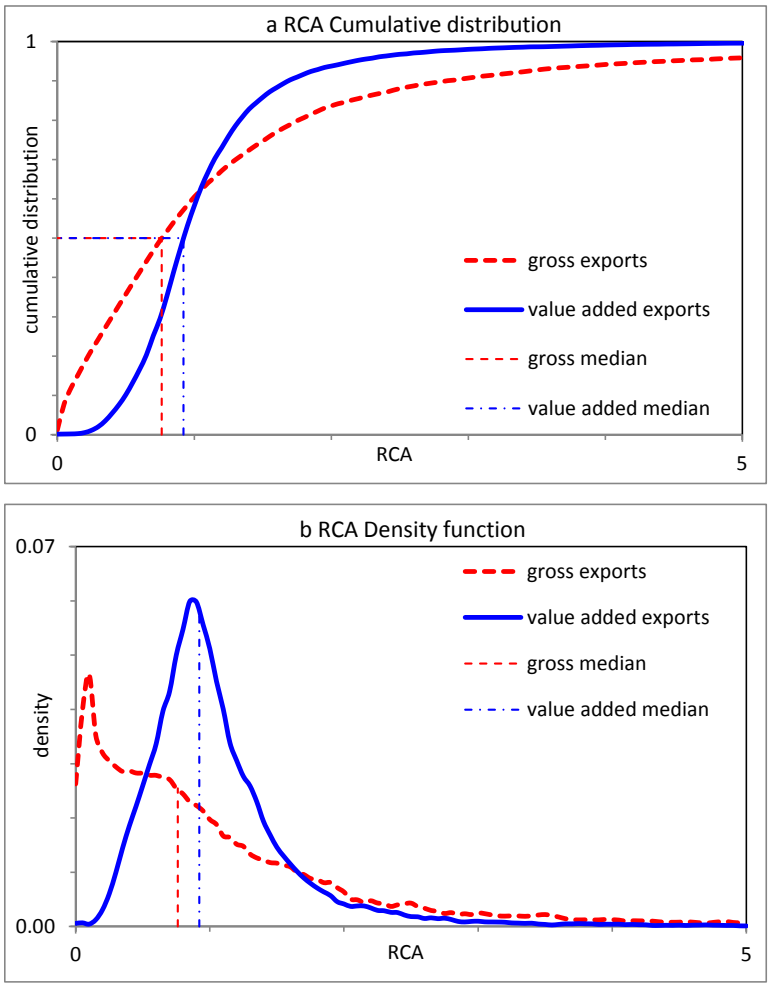
[6] We would like to thank Marcel Timmer for advice on which sectors to exclude.

4.Revealed Comparative Advantage: analysis

Equation (1), defining RCA, is used throughout the paper. The analysis in this section focuses on two types of export flows, namely the regularly observed gross exports in a sector from a country to the rest of the world and an estimate of the actual value added export flows for that sector and country using the WIOD data. We thus discuss two sets of RCA measures, which we will refer to as RCA based on gross exports and value-added exports, respectively. In both cases the reference group is the world as a whole. The discussion in this section focuses on the distribution properties of the two sets of RCA measures for individual countries (excluding RoW and 3 sectors).

Here we are interested in comparing the entire distribution, instead of just a pairwise comparison of a single element in two distributions, say, the RCA of Textiles in gross export terms to that in value added terms. The reason that analyses based on pairwise comparisons between RCA values of a sector in different countries are not satisfactory is that comparative advantage changes are not about a change of the trade (export/import) status –RCA value- of a single commodity, but of that commodity versus all other commodities. More specifically, one is interested in the trade status of that commodity versus all other commodities in the first distribution versus the position of that commodity versus all other commodities in the second distribution. Whether a pairwise comparison of RCA calculated in gross export terms is (somewhat) different in gross export terms or value added terms is less relevant. This is a major lesson from the Ricardian theory of comparative advantage. Changes in the relative (comparative) position of commodities versus one another imply that changes of the whole distribution must be analysed. Before testing differences we provide some descriptive statistics of the distributions.

Figure 4 Global Revealed Comparative Advantage distributions, 1995–2009



Source: authors' calculations based on WIOD data compiled by Zhi Wang; distributions are based on combining observations for 32 sectors in 40 countries, during 15 years; see main text for details.

For both RCA measures we have observations for 32 sectors and 40 countries over a 15 year period (19,200 observations in total). Figure 4 contrasts the distribution properties of RCA for gross exports with value-added exports for all these observations taken together.[7] Panel 4a depicts the cumulative distribution, which is S-shaped for value-added export RCA and concave for gross export RCA. Panel 4b shows the density functions of the two distributions, which is more or less regularly hump-shaped for value-added export RCA and almost monotonically declining (except for very small values) for gross export RCA. For reference purposes, the median value is also depicted in Figure 4. Note that the median is higher for value-added RCA (0.92) than for gross exports (0.76),

[7] We realize that the observations for a sector and country in one year are not independent of those in another year, see also the discussion below. Figure 4 looks very similar in any individual year.

in contrast to the mean, which is higher for gross export RCA (1.38) than for value-added RCA (1.06), see also Table 1.

Table 1 RCA distribution summary statistics, 1995–2009

	Mean	Median	Maximum	St. deviation	RCA > 1
1a Distribution as a whole (32 sectors, 40 countries, 15 years)					
Gross exports	1.38	0.76	46.7	2.43	39.5
Value added	1.06	0.92	21.1	0.85	41.7
1b Average individual country distribution per year; average of Table A3 and A4					
Gross exports	1.38	0.74	12.4	1.93	39.5
Value added	1.06	0.92	4.3	0.66	41.7
1c Individual country comparison					
Is gross export statistic in Table A3 bigger than value-added statistic in Table A4?					
# of times	29	8	38	40	18
Percent	73	20	95	100	45

See Tables A3 and A4 in the Appendix and the main text for construction details.

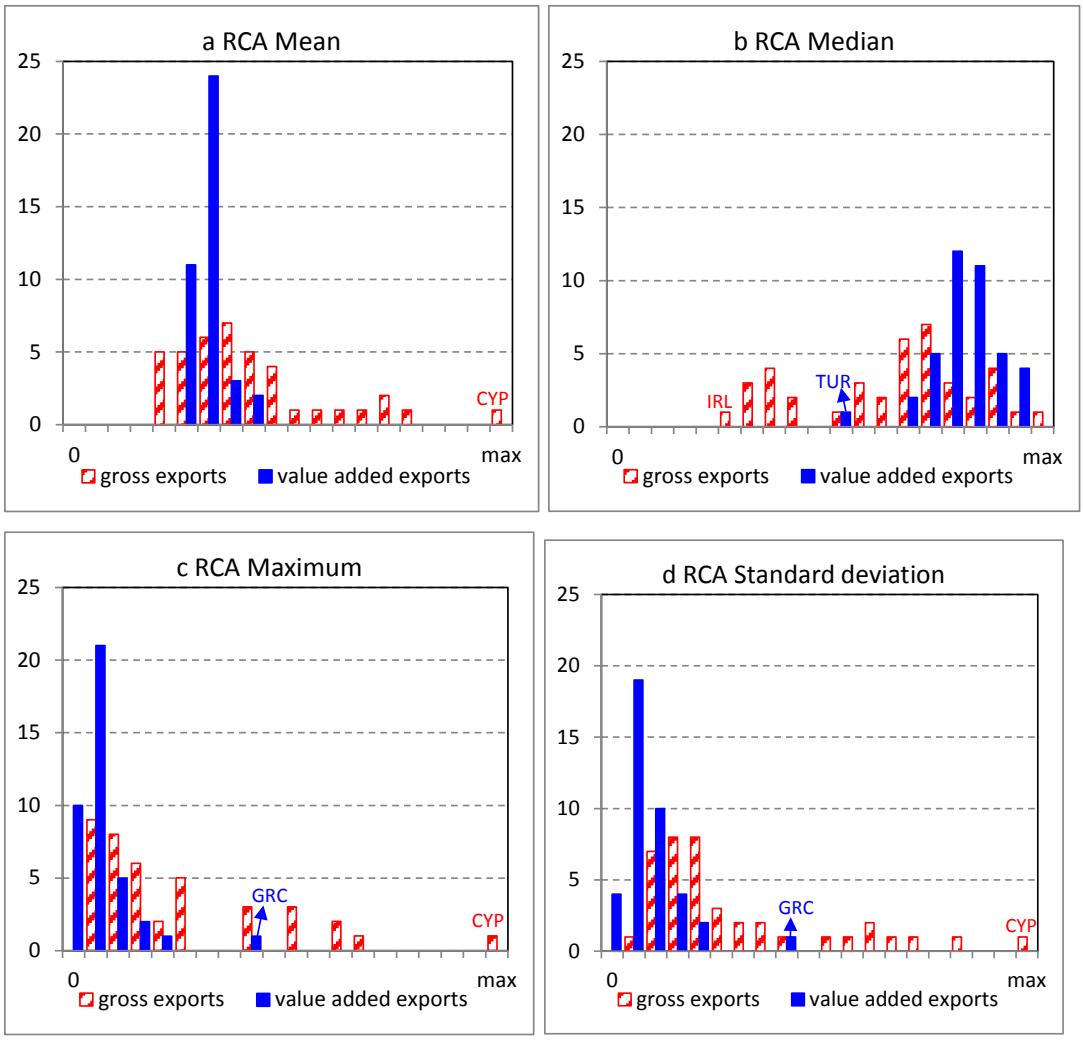
Table 1 provides summary statistics for gross export RCA and value added RCA in three parts. Table 1a compares the two distributions as a whole. As illustrated by Figure 4, the distribution of value added RCA is more concentrated than for gross exports since both its standard deviation and its maximum are much lower; as a consequence the mean and the median are much closer together for value added RCA than for gross export RCA. Note that there is virtually no difference, however, regarding the share of sectors with a revealed comparative advantage ($RCA > 1$), which is about 40 percent in both cases.

Table 1b reports the averages of the summary statistics per country, details of which are provided in Tables A3 and A4 in the Appendix.[8] The statistic is (of course) identical for

[8] The statistics are calculated for each country in every individual year; the values reported in Tables A3 and A4 for a country are the averages for the 15 years, except for median (which is the median) and maximum (which is the maximum); the values reported in Table 1b are the averages for the countries.

the mean and virtually the same for the median. Note that the average maximum per country is substantially lower for gross export RCA than in Table 1a, but the same holds (even more so) for value added RCA, such that the relative difference is even bigger. Again, the standard deviation is substantially lower for value added RCA.

Figure 5 Distribution of RCA summary statistics for individual countries, 1995–2009



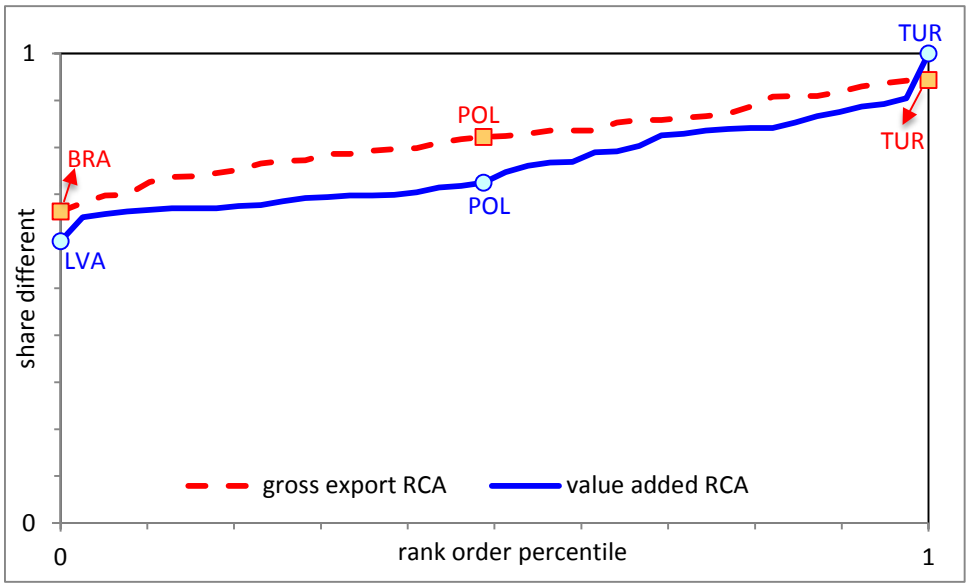
Source: authors' calculations based on WIOD data compiled by Zhi Wang; distributions are based on data from Tables A3 and A4, see there and the main text for details; range is in 20 equal intervals from zero to 1.05 times the maximum value of a summary statistic (for both gross exports and value added exports).

Table 1c indicates to what extent our observations for the distributions as a whole or the averages per country also hold for individual countries. More specifically, it answers the question if a gross export RCA statistic in Table A3 in the Appendix is bigger than the equivalent value-added RCA statistic in Table A4 of the Appendix. We then see that all

countries have a smaller standard deviation for value added RCA and almost all countries have a lower maximum for value added RCA (the two exceptions are Taiwan and Spain). However, not all countries have a lower mean for value added RCA (there are 11 exceptions) and not all countries have a higher median for value added RCA (there are 8 exceptions). Since the share of sectors with a revealed comparative advantage ($RCA > 1$) is about the same in the two distributions, it comes as no surprise that this share is higher for gross export RCA in about half the cases (for 18 countries, or 45 percent). In general, Table one indicates that RCAs in terms of value added show a less extreme distribution of relevant statistics for value added based RCAs than for gross export based RCAs. One interpretation is that in value added terms globalization is more intricate than in gross export terms; the supply chain involves many countries to some extent and many countries have a – relative modest – comparative advantage in a fragment of the chain. The gross export statistics indicate a more extreme distribution of RCAs where some countries seem to dominate a specific sector. This observation is consistent with the first of five facts described by Johnson (2014); "World value added exports are equal to about 70-75 percent of gross exports today…" Gross exports are larger than value added exports and have the tendency to magnify differences resulting in a more spread out distribution of RCA values.

Figure 5 visualizes this. Each panel of the figure is subdivided into 20 intervals of equal length from zero to $1.05 \times$ the maximum of the relevant statistic. Figure 5a shows that the value added RCA means of the countries are much closer together than of gross export RCA (where Cyprus is a clear outlier). Figure 5b shows the same for the median (although Turkey remains somewhat of an outlier for value added RCA), Figure 5c for the maximum and Figure 5d for the standard deviation (although in both cases Greece remains somewhat of an outlier for value added RCA). In short, it appears that the country distributions of value added RCA are much more similar than of gross export RCA.

Figure 6 Share of significantly different RCA country distributions, 1995–2009



Source: authors' calculations based on WIOD data compiled by Zhi Wang; a country's RCA distribution in any given year is compared to the distribution of each of the 39 other countries in that year; the null hypothesis is that the two distributions are the same; the HWM index is used for the comparison; countries are ranked from low to high in terms of number of rejections of null hypothesis averaged over all years.

The above observations might tempt one to conclude that value added RCA observations are more readily comparable between countries, unlike gross export RCA observations (see Hinloopen and van Marrewijk, 2001, for evidence on the latter). However, 'have a good look at' is not testing, and a formal test is necessary. The null hypothesis is that the two sample distributions are drawn from the same underlying distribution. We tested the null hypothesis at the 10 percent significance level using the Harmonic Weighted Mass (HWM) index, see Hinloopen, Wagenvoort, and van Marrewijk (2012).[9] The essence of this method is that the comparison of entire distributions is evaluated using Probability–Probability (PP) Plots. The surface area between the diagonal in this graph – which corresponds to the two distributions being drawn from the same distribution – and the actual distribution gives the required number; the larger the number, the larger the surface

[9] As discussed by the authors, the HWM index coincides with the L_1 version of the Fisz-Cramèr-von Mises statistic for bilateral testing of continuous distributions with a symmetric number of observations. One could also analyse distributions with non-parametric methods, such as kernel estimates. Kernel estimates, however, are hard to interpret and more importantly hard to evaluate statistically, as one has to make ad hoc grid cell assumptions (see Dinardo and Tobias, 2001).

are between the diagonal and the actual distribution and the larger the likelihood that the two distributions are drawn from different distributions.

We proceed in two steps. First we calculate the share of rejections for each country over the whole period 1995–2009 for which value added data are available. This rejection rate indicates that a country is different from other countries over the whole sample period. From a comparative advantage perspective one expects this to be the case as countries are different and specialize according to country specific comparative advantage. Figure 6 summarizes the results by ordering the countries in terms of the number of rejections (rank order percentile). For gross export RCA the average share of rejections is 82 percent, as represented by Poland, ranging from a low of 66 percent for Brazil to a high of 96 percent for Turkey. It is true that the average share of rejections is *lower* for value added RCA, namely 76 percent, ranging from a low of 60 percent for Latvia to a high of 100 percent for Turkey.[10] It is, however, evident from Figure 6 that even for value added RCA the hypothesis of samples being drawn from the same distribution, such that observations on RCA values can in fact be readily compared between countries, is rejected for at least 60 percent of the observations. We therefore conclude:

Conclusion 1. Different countries specialize differently. Consistent with the theory of comparative advantage, distributions of RCA between different countries are different. This holds for gross export RCA as well as for value added RCA.

Second, the gross export RCA distribution is quite different from the value added RCA distribution. We also formally tested this hypothesis using the HWM index at the 10 percent level by comparing for each country in any given year the gross export RCA distribution with the value added RCA distribution for that country in the same year. In all 600 cases except one (Slovakia in 2009) the two distributions are statistically significantly different. Therefore:

[10] The share of rejections for value added RCA is in fact lower than for gross export RCA for 25 of the 40 countries (62.5 percent).

Conclusion 2. The distributions of cross export RCA and value added RCA are almost always significantly different for a country. These measures thus do not convey the same information.[11]

Although we now know that the distributions of the two RCA measures are significantly different we do not know how the information they contain on strong and weak sectors is different. In the next section we address this topic.

4 Revealed strong and weak sectors

The ultimate purpose of calculating RCA indices is to determine which sectors are relatively 'strong' for some country (RCA > 1), and which sectors are relatively weak (RCA<1), whatever the underlying reason for this strength or weakness may be (hence the term 'revealed'). For many decades economists have calculated RCA indices and determined a country's strong and weak sectors based on gross export flows. Now that new and detailed trade data are available, we can also determine a country's weak and strong sectors based on value added trade flows. The question arises, of course, to what extent these exercises give rise to different conclusions.

To identify the differences we have four possible sector classifications, as illustrated in Figure 7. First, a sector may reveal to have a comparative advantage for both gross export RCA *and* value added RCA; we label this region *strong – strong* in Figure 7. Second, and similarly, a sector may reveal to have a comparative *dis*advantage for both gross export RCA *and* value added RCA; we label this region *weak – weak* in Figure 7.[12] If these were the only two outcomes observed empirically, it would not be important to distinguish between gross exports and value added trade flows for determining a country's strong and weak sectors. The two remaining possibilities thus arise if distinguishing between gross exports and value added flows actually *is* important. We will see below that this is actually the case for all 40 countries we analyze. Third, therefore, a sector may reveal to have a comparative *dis*advantage for gross exports and simultaneously a comparative advantage for value added trade; we label this region *weak – strong* in Figure 7.

[11] So the visualization of Koopman et al. (2014, p.491, Figure 2) to indicate that gross export RCA and value added RCA are different for two ISIC sectors in their sample holds in general.

[12] For the strong – strong and weak – weak regions in Figure 7 we will say that RCA as identified by gross export flows is 'confirmed' by value added export flows.

Apparently the strength and importance of these sectors for a particular country are *under*estimated when using gross export flows. Fourth, and finally, a sector may reveal to have a comparative advantage for gross exports and simultaneously a comparative disadvantage for value added trade; we label this region *strong – weak* in Figure 7. Apparently the strength and importance of these sectors for a particular country are *over*estimated when using gross export flows.

Figure 7 Four possible sector classifications

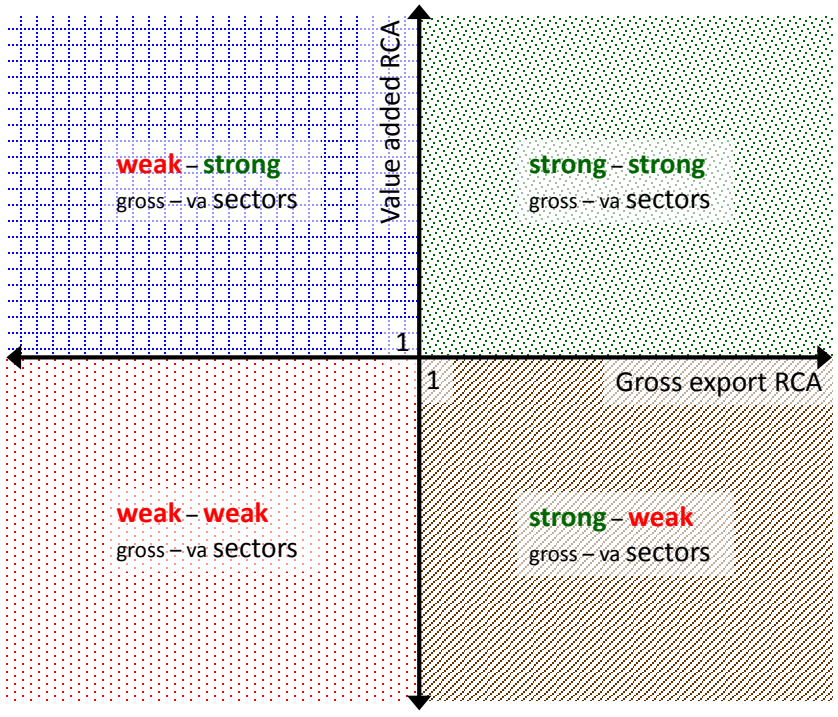


Table 2 provides an overview of the sector classification for all countries in 2009. Column (a) lists the number of strong – strong sectors out of a total of 32 sectors; the average is 10 sectors (31 percent), ranging from a minimum of 4 for South Korea to a maximum of 15 for Austria and Bulgaria. When we compare this information to the number of strong sectors using gross export RCA, which is provided in column (h) of Table 2, we notice that the average number of strong sectors is 13 and that most of these sectors are confirmed to be strong sectors using value added RCA (namely on average 10 sectors, or 75 percent). The share of strong – strong sectors varies substantially between countries. For Ireland and Luxembourg all strong sectors identified by gross export RCA

are confirmed strong sectors using value added RCA. For Brazil, on the other hand, only 6 of the 12 strong sectors identified by gross export RCA are confirmed strong sectors using value added RCA.

Column (b) in Table 2 lists the number of weak – weak sectors; the average is 15 sectors (47 percent), ranging from a minimum of 11 for Austria, Estonia, and the Netherlands to a maximum of 22 for India. When we compare this information to the number of weak sectors using gross export RCA, which is provided by the complement of column (h), we notice that the average number of weak sectors is 19 and that most of these sectors are confirmed to be weak sectors using value added RCA (namely on average 15 sectors, or 81 percent). The share of confirmed weak sectors varies between countries. For China 17 of the 18 weak sectors identified by gross export RCA are confirmed weak sectors using value added RCA. For Indonesia, on the other hand, only 12 of the 19 weak sectors identified by gross export RCA are confirmed weak sectors using value added RCA.

The complement of the confirmed weak sectors are the weak – strong sectors, which are listed in column (c) of Table 2; the average number is 4 sectors (13 percent), ranging from a minimum of 1 for China, Spain, and Lithuania to a maximum of 8 for Finland. Similarly, the complement of the confirmed strong sectors are the strong – weak sectors, which are listed in column (d) of Table 2; the average number is 3 sectors (9 percent), ranging from a minimum of 0 for Ireland and Luxembourg to a maximum of 8 for Romania.

Table 2 Overview of sector classification per country; # of sectors (out of 32), 2009

gross va	strong strong	weak weak	weak strong	strong weak	Total confirmed	Total va strong	Total gross strong	Strong change
Country	(a)	(b)	(c)	(d)	(e)	(g)	(h)	(i)
AUS	6	17	4	5	23	10	11	-1
AUT	15	11	2	4	26	17	19	-2
BEL	13	12	3	4	25	16	17	-1
BGR	15	12	4	1	27	19	16	3
BRA	6	17	3	6	23	9	12	-3
CAN	11	12	5	4	23	16	15	1
CHN	11	17	1	3	28	12	14	-2
CYP	11	17	3	1	28	14	12	2
CZE	11	12	3	6	23	14	17	-3
DEU	9	17	2	4	26	11	13	-2
DNK	9	15	3	5	24	12	14	-2
ESP	13	14	1	4	27	14	17	-3
EST	14	11	5	2	25	19	16	3
FIN	8	14	8	2	22	16	10	6
FRA	11	15	2	4	26	13	15	-2
GBR	10	14	6	2	24	16	12	4
GRC	11	15	4	2	26	15	13	2
HUN	10	14	5	3	24	15	13	2
IDN	10	12	7	3	22	17	13	4
IND	6	22	2	2	28	8	8	0
IRL	9	17	6	0	26	15	9	6
ITA	11	18	2	1	29	13	12	1
JPN	6	21	3	2	27	9	8	1
KOR	4	21	4	3	25	8	7	1
LTU	9	16	1	6	25	10	15	-5
LUX	7	19	6	0	26	13	7	6
LVA	10	16	2	4	26	12	14	-2
MEX	6	17	5	4	23	11	10	1
MLT	11	14	5	2	25	16	13	3
NLD	12	11	6	3	23	18	15	3
POL	11	15	2	4	26	13	15	-2
PRT	12	14	4	2	26	16	14	2
ROM	10	12	2	8	22	12	18	-6
RUS	7	15	7	3	22	14	10	4
SVK	10	13	4	5	23	14	15	-1
SVN	11	15	2	4	26	13	15	-2
SWE	11	16	3	2	27	14	13	1
TUR	8	18	3	3	26	11	11	0
TWN	6	16	6	4	22	12	10	2
USA	10	18	2	2	28	12	12	0
Mean	10	15	4	3	25	13	13	0
%	31	47	13	9	78	41	41	0

See Table A1 in the Appendix for an overview of country codes; light shaded cells indicate minimum of respective column; dark shaded cells with white text indicate maximum; see the main text for details.

From the above we learn that Finland has no less than 8 sectors for which the strength is *under*estimated by gross export RCA and 2 sectors for which the streng is *over*estimated (see column (d) in Table 2), for a total of 10 'misclassified' sectors from a value added perspective (equal to 31 percent of all sectors).[13] Similarly, Romania has no less than 8 sectors for which the strength is overestimated by gross export RCA and 2 sectors for which the strength is underestimated, also for a total of 10 'misclassified' sectors from a value added perspective. The total number of misclassified sectors from a value added perspective is also 10 for Indonesia and Russia. The identification of strong and weak sectors based on gross export RCA is thus particularly difficult for those four countries (Finland, Romania, Indonesia, and Russia). It is somewhat less problematic for China, Cyprus, India, and the USA, which each have only 4 misclassified sectors from a value added perspective (13 percent of the number of sectors). On average the number of misclassified sectors from a value added perspective is 7 (22 percent of the number of sectors).

The last three columns of Table 2 show the number of strong sectors in a given country identified by value added (column (g), the sum of columns (a) and (c)), the number of strong sectors identified by gross exports (column (h), the sum of columns (a) and (d)), and the difference between the number of strong sectors as we go from RCA based on gross exports to value added trade (column (i), the difference between columns (g) and (h)). Note that there is no difference regarding the total number of identified strong sectors for gross exports and value added exports.

Conclusion 3. On average, about 13 sectors (41 percent) are identified as strong and 19 sectors (59 percent) as weak using either gross or value added RCA. Although most sectors identified as either strong or weak using gross export RCA are confirmed strong or weak using value added RCA (more than 75 percent of the sectors), some sectors are strong in gross export terms, and weak in value added terms, and vice versa.

[13] We use the term 'misclassified deliberately as value added data reveal more directly in what sectors a particular country is strong or weak than gross export data.The number of 'misclassified' sectors from a value added perspective is 32 minus the number of confirmed sectors listed in column (e) of Table 2; column (e) is the sum of (a) and (b).

These differences must of course be identified for each country for policy purposes, not knowing these discrepancies can result in policy errors. Below we give three examples that illustrate conclusion 3.

5 Country specific (mis-) classifications of strong and weak sectors

We want to illustrate the distribution of sectors for a country in a conceptual framework similar to Figure 7 which is also more or less the same for individual countries.[14] At the same time we want to illustrate the relative importance of a sector for the economy as a whole. We can achieve the second objective fairly easily by using a bubble diagram where the size of the bubbles are proportional to the sector's value added export share. Achieving the first objective means we have to impose some country-specific normalization measures since the RCA distributions differ significantly per country for gross export RCA and value added RCA. We do this by transforming all RCA observations to a $[0,2] \times [0,2]$ diagram as follows:[15]

- If $RCA_{i,t}^{j} \leq 1$ we transform to $\overline{RCA}_{i,t}^{j} = 0.1 + 0.9 \cdot RCA_{i,t}^{j}$
- If $RCA_{i,t}^{j} > 1$ we transform to $\overline{RCA}_{i,t}^{j} = 1 + \alpha_t^j \ln(RCA_{i,t}^{j})$, for $\alpha_t^j = 1.2 \max_i RCA_{i,t}^{j}$

The transformation maintains the ordering of observations and does not affect the identification of weak and strong sectors. The "0.1" value for weak sectors avoids cluttering of the diagram at the origin. The transformation for strong sectors scales up to the maximum observation, while the "1.2" value avoids cluttering of the diagram at (2,2). We continue by discussing three specific examples for 2009 in sections 5a-c, and provide an overview for all countries in section 5d.

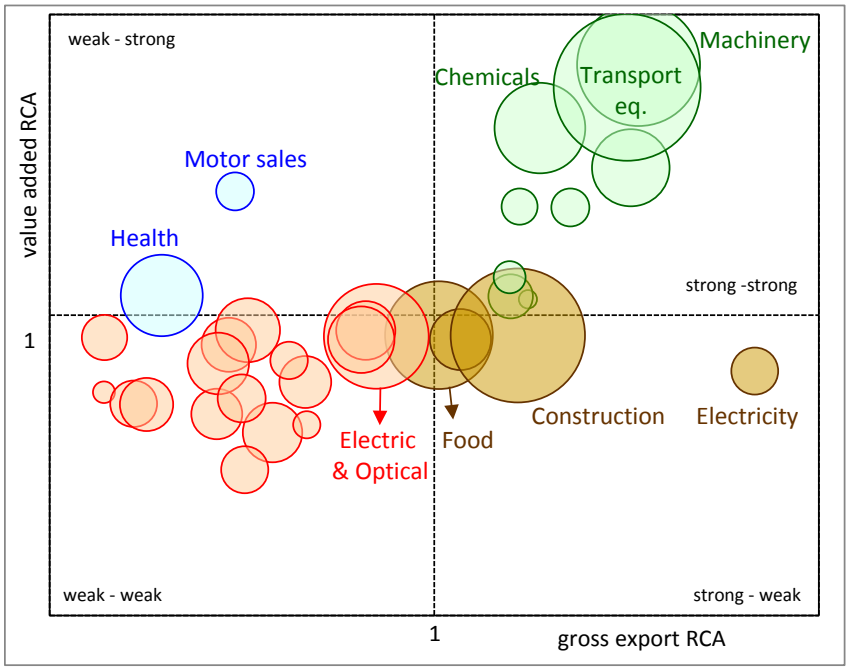
5a A 'standard' country: Germany

Germany represents a fairly 'standard' country, with 17 confirmed weak sectors (such as Electric & Optical) and 9 confirmed strong sectors (such as Chemicals, Machinery, and Transport Equipment), see Figure 8. Two sectors switch from weak in gross export RCA

[14] Note that RCA indices are bounded from below by 0, and unbounded from above, which makes the transformation useful.
[15] Independently for gross export RCA and value added RCA.

to strong in value added RCA, namely Health and Motor Sales. Four sectors make the opposite switch from strong to weak, namely Food, Construction, Wood, and Electricity.

Figure 8 Germany sector classification, 2009

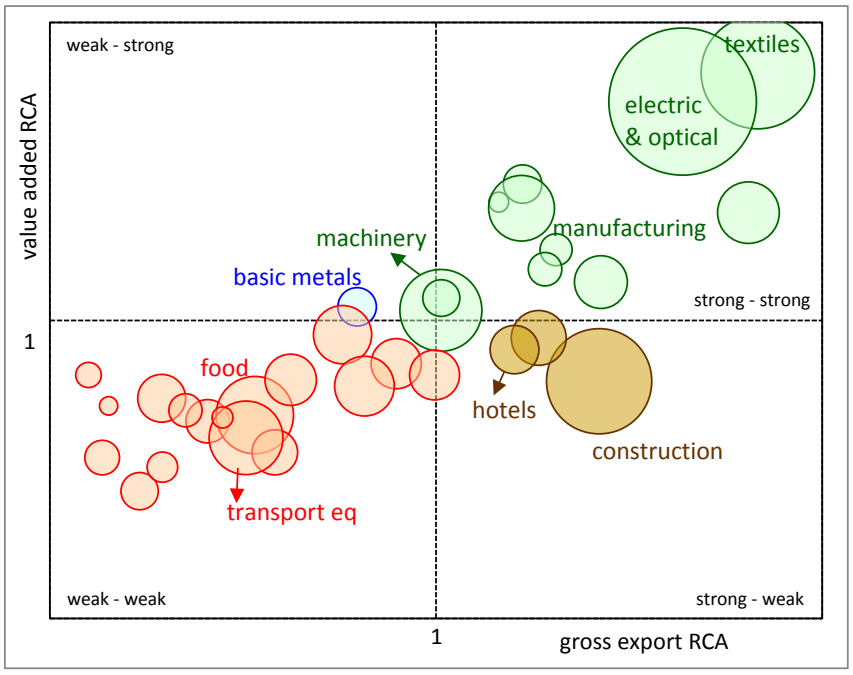


Bubble size proportional to value added exports

5b A country with small differences: China

China represents a country with relatively small differences in identifying RCA using either gross exports or value added, with 17 confirmed weak sectors (such as Food and Transport Equipment) and 11 confirmed strong sectors (such as Textiles, Electric & Optical, Machinery, and Manufacturing), see Figure 9. Only one sector (Basic Metals) switches from weak in gross exports to strong in value added and only three sectors (Hotels, Construction, and Wholesale Trade) make the opposite switch.

Figure 9 China sector classification, 2009

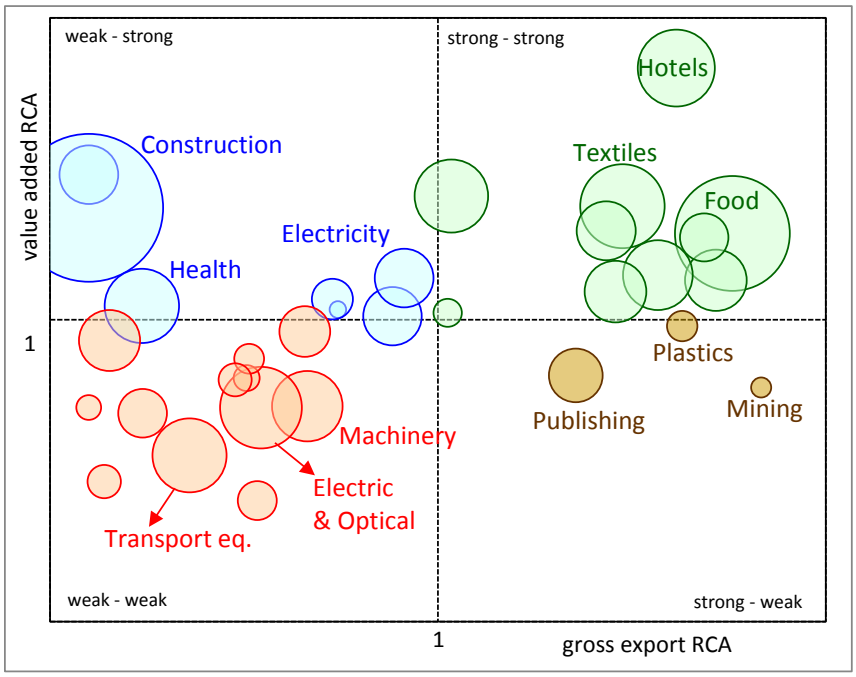


Bubble size proportional to value added exports

5c A country with big differences: Indonesia

Indonesia represents a country with big differences between RCA measured using gross exports and using value added exports. There are only 12 confirmed weak sectors (such as Machinery, Transport Equipment, and Electric & Optical) and 10 confirmed strong sectors (such as Hotels, Textiles, and Food), see Figure 10. No less than 7 sectors switch from weak using gross export RCA to strong using value added RCA, namely Construction, Manufacturing, Electricity, Agriculture, Other Mineral, Basic Metals, and Health. In addition, three sectors make the oppositite switch from strong to weak, namely Publishing, Plastics, and Mining.

Figure 10 Indonesia sector classification, 2009



Bubble size proportional to value added exports

5d Switching sectors from 1995 to 2009

Tables 3 and 4 below provide a more comprehensive overview of the most important switching sectors for all countries from 1995 to 2009.

Table 3 From strong to weak, 1995–2009
Gross export RCA > 1 *and* value added RCA < 1 for at least 12 years (80 percent)

a Ordered per sector

Sector	Countries	Sector	Countries
Wood	Bulgaria, Brazil, Canada, Denmark, Lithuania, Portugal, Romania, Slovenia	Petroleum	Belgium, Bulgaria, Spain, Finland, S. Korea, Slovakia
Electricity	Germany, Denmark, France, Romania, Slovenia	Publishing	Brazil, Indonesia, United States
Plastics	Spain, France, Netherlands	Construction	Germany, Hungary, Netherlands
Hotels	China, Japan, Taiwan	Health	Australia, Greece, Slovakia
Mining	Australia, Indonesia	Basic metals	Japan, Sweden
Agriculture	Denmark	Other mineral	Brazil
Elec. & optical	Malta	Transport eq.	United Kingdom
Manufacturing	Mexico	Wholesale trade	China
Inland transport	India	Telecom	Brazil

Other business	France	Education	Canada
Other services	Brazil		

b Ordered per country

Country	Sectors	Country	Sectors
Brazil	Wood, Publishing, Oth. Mineral, Telecom, Oth. Services	Denmark	Agriculture, Wood, Electricity
France	Plastics, Electricity, Oth. Business	Australia	Mining, Health
Bulgaria	Wood, Petroleum	Canada	Wood, Education
China	Wholesale trade, Hotels	Germany	Electricity, Construction
Spain	Petroleum, Plastics	Indonesia	Mining, Publishing
Japan	Basic metals, Hotels	Netherlands	Plastics, Construction
Romania	Wood, Electricity	Slovakia	Petroleum, Health
Slovenia	Wood, Electricity	Belgium	Petroleum
Finland	Petroleum	UK	Transport equipment
Greece	Health	Hungary	Construction
India	Inland transport	S. Korea	Petroleum
Lithuania	Wood	Mexico	Manufacturing
Malta	Electric & Optical	Portugal	Wood
Sweden	Basic metals	Taiwan	Hotels
USA	Publishing		

Table 3 lists the sectors and countries that go from strong using gross export RCA to weak using value added RCA during at least 12 of the 15 years under consideration (80 percent). No less than 8 countries make the switch from strong towards weak for Wood, followed by 6 for Petroleum, and 5 for Electricity. In some sectors there is a clear geographic component to the switch, such as for Hotels (China, Japan, and Taiwan). For 11 sectors the switch is limited to only one country, while another 11 sectors are not listed at all in Table 3.

Table 4 lists the sectors and countries to go from weak using gross export RCA to strong using value added RCA during at least 12 of the 15 years under consideration. No less than 8 countries make the switch from weak to strong for three different sectors, namely Construction, Wholesale Trade, and Education, followed by 5 countries for Wood. For 7 sectors the switch is limited to only one country, while another 11 sectors are not listed at all in Table 4. Combining the information from Tables 3 and 4 leads to the following:[16]

[16] Tables A5 and A6 in the Appendix provide an overview of confirmed strong and confirmed weak sectors.

Table 4 From weak to strong, 1995–2009
Gross export RCA < 1 *and* value added RCA > 1 for at least 12 years (80 percent)

a Ordered per sector

Sector	Countries	Sector	Countries
Construction	Australia, Canada, Finland, Indonesia, Japan, Luxemb., Russia, USA	Wholesale trade	Estonia, Italy, Luxembourg, Malta, Netherlands, Poland, Slovakia, Sweden
Education	Estonia, Finland, Lithuania, Luxembourg, Latvia, Russia, Sweden, USA	Wood	Hungary, Japan, S. Korea, Malta, Taiwan
Leather	Austria, Czech Rep., France, Hungary	Health	Belgium, Ireland, Netherlands, Russia
Electricity	Australia, Indonesia, Mexico	Motor sales	Canada, Germany, France
Hotels	Bulgaria, Greece, Netherl.	Inland transp.	Belgium, Brazil, Greece
Other business	Indonesia, S. Korea, Taiwan	Mining	Bulgaria, UK
Publishing	Hungary, Italy	Fin. services	Malta, Sweden
Food	USA	Petroleum	Mexico
Machinery	Taiwan	Retail trade	Ireland
Other transport	Luxembourg	Telecom	Taiwan
Oth. services	Russia		

b Ordered per country

Country	Sectors	Country	Sectors
Luxembourg	Construction, Wholesale trade, Oth. Transport, Education	Russia	Construction, Education, Health, Oth. Services
Taiwan	Wood, Machinery, Telecom, Oth. Business	Hungary	Leather, Wood, Publishing
Indonesia	Electricity, Construction, Oth. Business	Malta	Wood, Wholesale trade, Financial services
Netherlands	Wholesale trade, Hotels, Health	Sweden	Wholesale trade, Financial services, Education
USA	Food, Construction, Education	Australia	Electricity, Construction
Belgium	Inland transport, Health	Bulgaria	Mining, Hotels
Canada	Construction, Motor sales	Estonia	Wholesale trade, Education
Finland	Construction, Education	France	Leather, Motor sales
Greece	Hotels, Inland transport	Ireland	Retail trade, Health
Italy	Publishing, Wholesale trade	Japan	Wood, Construction
S. Korea	Wood, Other business	Mexico	Petroleum, Electricity
Austria	Leather	Brazil	Inland transport
Czech Rep.	Leather	Germany	Motor sales
UK	Mining	Lithuania	Education
Latvia	Education	Poland	Wholesale trade
Slovakia	Wholesale trade		

Conclusion 4. Most frequent switching from weak or strong in gross export RCA to strong or weak in value added RCA occurs in the sectors: Wood, Construction, Wholesale Trade, Education, Electricity, Petroleum, and Health. Least switching occurs in the sectors Textiles, Chemicals, Water Transport, and Air Transport.

6 An Application: The Great Recession, RCA and unemployment

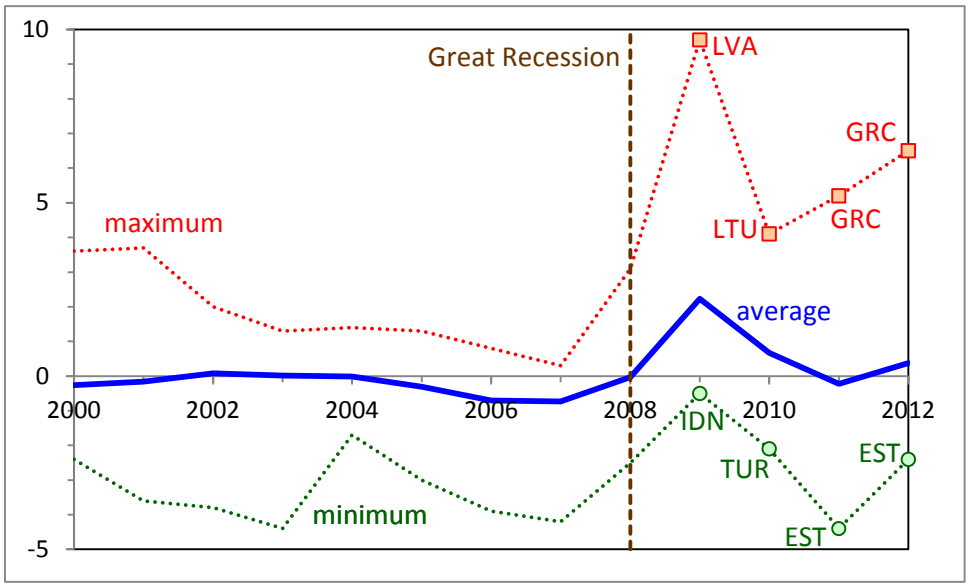
Now that we have discussed the basic similarities and differences between RCA based on gross export flows and value-added flows, which is important by itself, one may wonder if one measure is more informative about what is happening in the real economy than the other. As already indicated RCA on value added information is a more relevant indicator for what a country is specializing in and in what activities it has a comparative (dis)-advantage.

A striking application is the Great Recession. After the start of the crisis in 2008, world trade decreased by an unprecedented rate, especially in 2009. Only the experience in the 1930s comes close. However, world trade bounced back in 2010 (see for a discussion Behrens et al., 2013, and for an illustration of the 'trade collapse', Figure 1, in Brakman et al. 2015).

Interestingly, some countries turned out to be more resilient than others and it is tempting to relate the two measures of RCA to resilience; does one measure provide more relevant information to determine whether some countries are better able to cope with the trade collapse than others. We briefly look into this topic in this section. We will concentrate the discussion on the change in total unemployment, measured in percentage points as a measure of resilience.[17]

[17] We include 39 countries only as data for Taiwan is not available at the World Development Indicators. We also gathered information on GNI PPP and various other unemployment measures. Data availability is less complete for GNI PPP and for primary, secondary, and tertiary unemployment. Data is complete for youth, male, and female unemployment, but these measures are very similar to total unemployment. For these reasons we restrict attention in our discussion only to changes in total unemployment.

Figure 11 Change in unemployment; percentage points, 39 countries, 2000–2012



Data source: World Development Indicators online.

Figure 11 illustrates the average change in unemployment for 39 countries (solid, thick line), ranging from a low of -0.7 percentage points in 2007 to a high of 2.2 percentage points in 2009. As a consequence of the Great Recession, which started in 2008 (see van Marrewijk, 2012, chapter 2 for details), unemployment rose substantially in 2009 and 2010, recovered slightly in 2011, and deteriorated again in 2012. The figure also shows the minimum and maximum range of changes in unemployment. The largest increase in 2009 was +9.7 percentage points in Latvia, followed by +4.1 in Lithuania in 2010, and +5.2 and +6.5 for Greece in 2011 and 2012. The smallest increase in 2009 was -0.5 percentage points in Indonesia, followed by -2.1 for Turkey in 2010, and -4.4 and -2.4 for Estonia in 2011 and 2012. Economic shocks and recoveries may have a local character. The Baltic states Latvia, Lithuania and Estonia were among the hardest hit countries in 2009 and 2010 (an average increase in unemployment of 8.6 and 2.9 percentage points), but they were also among the countries recovering most quickly in 2011 and 2012 (an average decline in unemployment of 3.1 and 1.9 percentage points).

The analysis below focuses on the annual change in unemployment in percentage points in 2009, 2010, 2011, and 2012 as endogenous variable, as well as the cumulative change in unemployment in percentage points since 2008 for the same years. As explanatory variables we focus on the identification of a country's weak and strong sectors in 2008

using revealed comparative advantage. We already established in section 3 of this paper that the RCA values of one country cannot readily be compared to that of another country. The only meaningful information provided is whether a sector has a revealed comparative advantage ($RCA > 1$) or not. Rather than just using a dummy variable in our estimations we also take the information we have on the (value-added) size of a sector into consideration, which we denote $share_i^j$ for sector *i* in country *j*. Hypothesizing that the impact on the economy as measured by the change in unemployment is the opposite if a sector is identified as weak rather than strong and that this effect is proportional to the size of the sector, we define the variable Z_i^j to be +1 if a sector is strong (RCA>1) and -1 otherwise, see equation (2), leading to equation (3).

(2) $$Z_i^j \equiv \begin{cases} 1 & if \quad RCA_i^j > 1 \\ -1 & otherwise \end{cases}$$

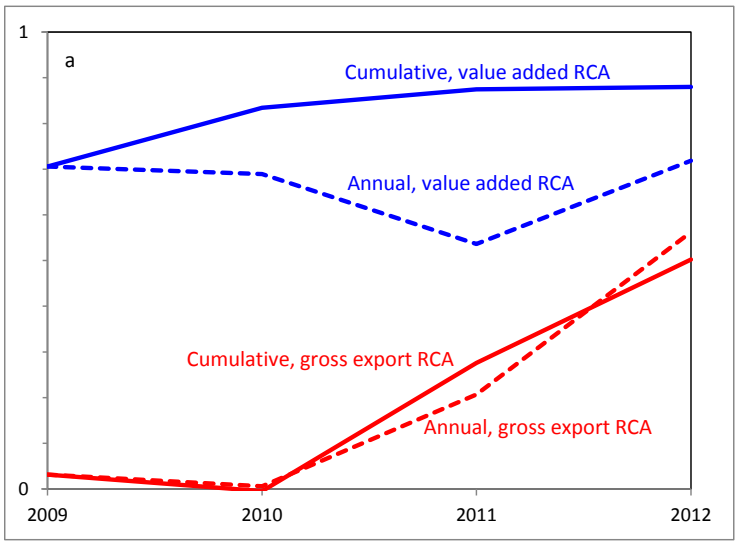
(3) $$\Delta U_{j,t} = \left(\sum_i \beta_i share_i^j Z_i^j\right) + \varepsilon_{j,t}$$

Tables 5 and 6 list the estimated coefficients based on equation (3) using either gross-export based RCA (Table A7) or value-added RCA (Table A8). Figure 12 summarizes the main findings of Tables A7-8. Panel 12a focuses on the explained variance measured as adjusted R^2 for the years 2009 to 2012, both individually and cumulative since 2008. Clearly the share of the variance explained is much larger using value-added based RCA than gross-export RCA, both for the individual year effect and for the cumulative effect. Panel 12b of Figure 12 shows the number of significant coefficients among the 32 sectors. Again, this number is much higher for the value-added based RCA estimates than for the gross-export based RCA estimates. In this sense the value-added RCA is more informative about what is going on in the real economy and shows a closer connection to developments in the real economy, which is unemployment in our example. Recalling from Conclusion 3 that more than 75 percent of the sectors are either confirmed weak or confirmed strong, one realizes that the difference in performance between the value-added and the gross-export based RCA estimates is caused by the less than 25 percent switching sectors, which suggest that the sectors identified by tables 3 and 4 dominate the economy in various countries in employment terms.

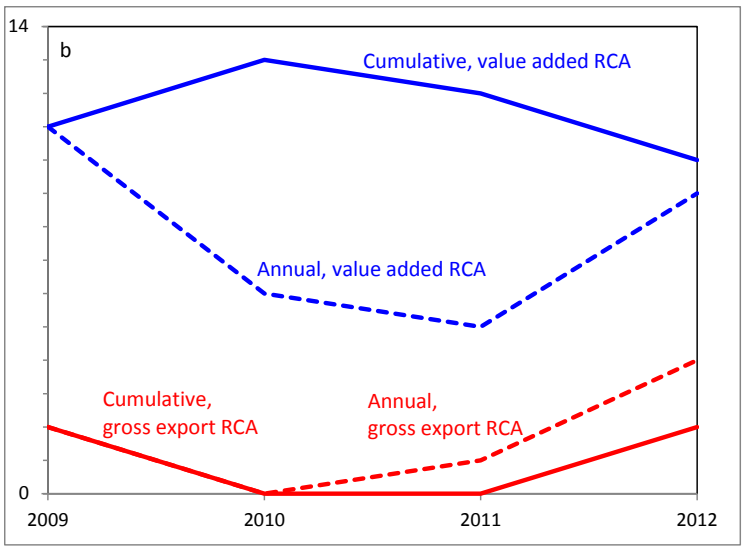
Figure 12 Explanatory power RCA based share estimates

Annual and cumulative change in unemployment percentage points

a. Adjusted R^2



b. Number of significant coefficients at 10 percent level



7. Conclusions

One of the major new developments in the character of international trade over the last 25 years has been the increased fragmentation of the production process. Many traded products are no longer designed, constructed and sold by a single country but are produced in international supply chains. For international trade analyses this is an important development as gross exports are painting an incomplete picture of the nature

of international trade. A country might in gross export terms be a giant in some product, but in value added terms only a marginal exporter. With the availability of international value added trade data it has become possible to analyze supply chains in international trade more in detail.

In this paper we focus on the analysis of comparative advantage using gross export trade data and value added trade data. With respect to comparative advantage the differences between the two types of data are often illustrated by means of examples using a few sectors; usually measures of RCAs calculated with gross export data are compared with RCAs calculated with value added data. In the theory of comparative advantage, however, the position of a commodity versus all other commodities in a country determines whether or not a sector has a comparative (dis)-advantage. This implies that the distributions of comparative advantage of all sectors should be compared and not just pairwise comparisons of RCA values of individual sectors. In this paper we determine the distributions of Revealed Comparative Advantage (RCA), in terms of gross exports and value added, for 40 countries. Systematically comparing these distributions shows that the distributions of RCA calculated with gross exports and value added data are indeed significantly different from each other. After establishing these significant differences we use the Great Recession as an example to determine which RCA measure has the largest information content regarding the real economy. We find that RCA calculated with value added data is the most telling.

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Appendix

Table A1 Overview of included individual countries

Code	Country	Code	Country
AUS	Australia	IRL	Ireland
AUT	Austria	ITA	Italy
BEL	Belgium	JPN	Japan
BGR	Bulgaria	KOR	South Korea
BRA	Brazil	LTU	Lithuania
CAN	Canada	LUX	Luxembourg
CHN	China	LVA	Latvia
CYP	Cyprus	MEX	Mexico
CZE	Czech Republic	MLT	Malta
DEU	Germany	NLD	Netherlands
DNK	Denmark	POL	Poland
ESP	Spain	PRT	Portugal
EST	Estonia	ROM	Romania
FIN	Finland	RUS	Russia
FRA	France	SVK	Slovakia
GBR	United Kingdom	SVN	Slovenia
GRC	Greece	SWE	Sweden
HUN	Hungary	TUR	Turkey
IDN	Indonesia	TWN	Taiwan
IND	India	USA	United States

Table A2 Overview of included sectors

Sector	NACE	Description	Short name
c1	AtB	Agriculture, Hunting, Forestry and Fishing	Agriculture
c2	C	Mining and Quarrying	Mining
c3	15t16	Food, Beverages and Tobacco	Food
c4	17t18	Textiles and Textile Products	Textiles
c5	19	Leather, Leather and Footwear	Leather
c6	20	Wood and Products of Wood and Cork	Wood
c7	21t22	Pulp, Paper, Paper , Printing and Publishing	Publishing
c8	23	Coke, Refined Petroleum and Nuclear Fuel	Petroleum
c9	24	Chemicals and Chemical Products	Chemicals
c10	25	Rubber and Plastics	Plastics
c11	26	Other Non-Metallic Mineral	Other Mineral
c12	27t28	Basic Metals and Fabricated Metal	Basic Metals
c13	29	Machinery, Nec	Machinery
c14	30t33	Electrical and Optical Equipment	Electric & Optical
c15	34t35	Transport Equipment	Transport Eq.
c16	36t37	Manufacturing, Nec; Recycling	Manufacturing
c17	E	Electricity, Gas and Water Supply	Electricity
c18	F	Construction	Construction
c19	50	Sale, Maintenance and Repair of Motor Vehicles and Motorcycles; Retail Sale of Fuel	Motor Sales
c20	51	Wholesale Trade and Commission Trade, Except of Motor Vehicles and Motorcycles	Wholesale Trade
c21	52	Retail Trade, Except of Motor Vehicles and Motorcycles; Repair of Household Goods	Retail Trade
c22	H	Hotels and Restaurants	Hotels
c23	60	Inland Transport	Inland Transport
c24	61	Water Transport	Water Transport
c25	62	Air Transport	Air Transport
c26	63	Other Supporting and Auxiliary Transport Activities; Activities of Travel Agencies	Other Transport
c27	64	Post and Telecommunications	Telecom
c28	J	Financial Intermediation	Financial Services
c29	70	Real Estate Activities	Real Estate
c30	71t74	Renting of M&Eq and Other Business Activities	Other Business
c31	L	Public Admin and Defence; Compulsory Social Security	Public Admin
c32	M	Education	Education
c33	N	Health and Social Work	Health
c34	O	Other Community, Social and Personal Services	Other Services
c35	P	Private Households with Employed Persons	Private Households

Table A3 Gross export RCA; summary statistics for individual countries, 1995–2009

Country	Mean	Median	Maximum	St. deviation	RCA > 1*
AUS	2.10	0.59	33.42	4.59	35.6
AUT	1.38	1.03	9.67	1.33	53.5
BEL	1.30	1.03	6.54	0.99	51.9
BGR	2.25	1.10	30.85	3.60	52.5
BRA	1.19	0.75	6.46	1.21	41.7
CAN	1.09	0.85	5.05	0.94	43.5
CHN	1.07	0.82	5.18	0.96	40.2
CYP	3.16	0.76	46.71	5.97	44.4
CZE	1.61	1.09	20.55	1.89	53.1
DEU	0.80	0.67	2.91	0.55	30.2
DNK	1.18	0.70	12.38	1.76	38.8
ESP	0.99	0.90	2.59	0.65	42.5
EST	1.73	0.78	13.46	2.68	43.5
FIN	0.99	0.49	7.49	1.52	29.6
FRA	0.93	0.85	4.43	0.76	37.9
GBR	1.03	0.77	5.69	0.99	34.4
GRC	2.61	0.75	29.96	5.16	42.3
HUN	1.51	0.84	12.84	2.12	40.8
IDN	1.20	0.65	8.03	1.37	40.0
IND	1.13	0.51	7.23	1.52	33.5
IRL	0.87	0.30	5.64	1.15	29.6
ITA	1.14	0.78	4.57	0.99	35.8
JPN	0.70	0.37	3.16	0.72	26.7
KOR	0.74	0.44	3.61	0.74	24.4
LTU	2.35	0.84	25.75	3.96	46.9
LUX	1.37	0.36	26.03	4.05	26.0
LVA	2.46	0.67	19.80	4.30	42.7
MEX	1.00	0.42	14.58	1.72	28.1
MLT	1.85	0.82	20.56	3.33	39.0
NLD	1.19	0.94	3.85	0.85	49.6
POL	1.57	0.99	24.65	2.22	49.4
PRT	1.37	0.84	5.91	1.22	42.9
ROM	1.55	0.92	9.55	1.84	47.7
RUS	1.40	0.44	11.14	2.43	27.9
SVK	1.35	0.97	10.62	1.31	49.0
SVN	1.33	0.99	13.56	1.47	49.0
SWE	1.26	0.89	8.72	1.38	42.9
TUR	0.82	0.39	8.05	1.39	25.4
TWN	0.72	0.45	3.30	0.74	29.2
USA	0.89	0.79	3.28	0.74	37.9

The statistics are calculated for each country in every individual year; the values reported are the averages for the 15 years, except for median (which is the median) and maximum (which is the maximum); * the RCA>1 value is the average share of sectors with RCA>1 (% of total)

Table A4 Value added export RCA; summary statistics for ind. countries, 1995–2009

Country	Mean	Median	Maximum	St. deviation	RCA > 1*
AUS	1.04	0.94	3.72	0.56	41.5
AUT	1.04	1.08	1.81	0.31	55.8
BEL	1.06	1.02	2.22	0.32	51.9
BGR	1.13	1.07	4.41	1.13	57.1
BRA	0.89	0.80	2.68	0.46	26.7
CAN	0.94	0.86	2.96	0.38	38.8
CHN	1.05	0.83	4.09	0.69	34.8
CYP	1.35	0.92	10.26	1.45	40.8
CZE	1.08	0.98	3.27	0.47	48.8
DEU	0.92	0.87	1.76	0.30	28.3
DNK	1.08	0.93	5.16	0.68	34.4
ESP	0.99	0.89	2.68	0.41	37.1
EST	1.16	0.99	5.92	0.76	50.4
FIN	0.99	0.95	2.17	0.33	42.7
FRA	0.95	0.89	2.32	0.29	35.4
GBR	1.05	0.98	3.33	0.35	47.3
GRC	1.41	0.93	21.07	2.55	45.6
HUN	1.06	0.97	2.88	0.43	47.5
IDN	1.04	0.98	3.01	0.44	50.6
IND	1.02	0.87	4.73	0.77	32.5
IRL	1.01	0.89	4.32	0.70	38.8
ITA	1.01	0.87	2.44	0.46	41.7
JPN	0.89	0.82	2.47	0.44	24.2
KOR	0.92	0.79	2.86	0.47	29.0
LTU	1.07	0.91	4.36	0.95	42.7
LUX	1.29	0.99	8.07	1.28	49.4
LVA	1.16	0.95	5.28	0.85	44.2
MEX	0.90	0.83	2.04	0.38	30.6
MLT	1.27	1.07	6.48	0.90	55.0
NLD	1.07	1.07	2.36	0.37	56.5
POL	1.09	0.93	2.97	0.45	48.5
PRT	1.16	0.94	4.62	0.81	37.7
ROM	1.13	0.89	3.31	0.67	38.5
RUS	1.26	0.92	5.49	1.09	43.5
SVK	1.05	0.92	3.30	0.46	44.0
SVN	1.10	0.89	3.45	0.57	40.4
SWE	0.99	0.99	1.86	0.32	47.7
TUR	0.92	0.58	7.79	1.19	24.0
TWN	1.03	0.86	4.55	0.64	38.1
USA	1.00	0.99	2.01	0.31	47.5

The statistics are calculated for each country in every individual year; the values reported are the averages for the 15 years, except for median (which is the median) and maximum (which is the maximum); * the RCA>1 value is the average share of sectors with RCA>1 (in % of total)

Table A5 Confirmed strong sectors, 1995–2009
Gross export RCA > 1 *and* value added RCA > 1 for every year (100 percent)

Sector	Country codes
Other Transport	AUT BEL BGR CYP EST GRC HUN LTU LVA MLT NLD POL RUS SVN
Food	AUS BEL BRA CYP DNK ESP EST FRA IRL LTU NLD POL
Motor Sales	BEL BGR CYP CZE GRC HUN ITA LTU MEX MLT RUS SWE
Retail Trade	BGR CYP GRC HUN ITA LTU LVA MEX MLT ROM RUS SWE
Other Mineral	AUT CHN CZE ESP FRA ITA POL PRT SVK SVN TUR
Basic Metals	AUS AUT BEL BGR CAN CZE FIN ITA POL SVK SVN
Agriculture	BGR BRA CYP ESP FRA GRC IND LTU NLD TUR
Inland Transport	AUT BGR CZE HUN LTU LVA ROM RUS SVK USA
Air Transport	AUS CYP ESP FRA GBR LUX MLT NLD PRT USA
Leather	BRA CHN ESP IDN ITA PRT ROM SVK SVN
Manufacturing	CHN CZE DNK EST IND ITA POL ROM TWN
Telecom	AUT BEL CYP GRC LUX MLT PRT SWE USA
Textiles	CHN EST IDN IND ITA PRT ROM TUR
Publishing	AUT DEU FIN IRL PRT SVK SVN SWE
Machinery	AUT DEU DNK FIN ITA JPN SVN SWE
Hotels	AUS BRA CAN CZE IDN IND IRL MLT
Water Transport	BGR CYP DNK EST GRC JPN KOR TWN
Chemicals	BEL DEU FRA GBR IRL NLD SVN
Plastics	BEL CAN CHN DEU ITA SVN TWN
Transport Eq.	CAN DEU ESP FRA JPN KOR MEX
Electric & Optical	CHN FIN JPN KOR MEX TWN
Wholesale Trade	CYP GRC JPN LTU LVA USA
Financial Services	AUT GBR IRL LUX USA
Other Business	BEL GBR IRL NLD USA
Construction	BGR BRA EST LVA
Other Services	GBR LUX MLT NLD
Education	AUS GBR MLT
Health	CAN FRA SWE
Wood	EST FIN
Mining	RUS
Petroleum	IDN
Electricity	BGR

See Table A1 in the Appendix for an overview of the country codes

Table A6 Confirmed weak sectors, 1995–2009
Gross export RCA < 1 *and* value added RCA < 1 for every year (100 percent)

Sector	Country codes
Machinery	AUS BEL BGR BRA CAN CYP ESP EST GRC HUN IDN IND IRL LTU LUX LVA MEX MLT NLD PRT ROM RUS SVK
Electric & Optical	AUS AUT BEL BGR BRA CAN CYP DNK ESP FRA GRC IDN ITA LTU LUX LVA NLD POL PRT ROM RUS SVN TUR
Mining	AUT BEL CHN DEU ESP FIN FRA HUN IND IRL ITA JPN KOR LTU MLT PRT ROM SVN SWE TUR TWN USA
Financial Services	BGR BRA CHN CYP CZE DEU DNK ESP EST FIN FRA IND ITA JPN KOR LTU MEX ROM RUS SVN TUR TWN
Transport Eq.	AUS BGR CHN CYP DNK EST FIN GRC IDN IND IRL ITA LTU LUX LVA MLT NLD RUS TWN
Chemicals	AUS AUT BRA CAN CHN CZE EST FIN GRC IDN JPN LUX LVA MEX PRT RUS TUR USA
Water Transport	AUS AUT BEL BRA CAN CZE ESP HUN IDN IND IRL ITA LTU LVA MEX RUS SVK TUR
Textiles	AUS AUT BRA CAN DEU DNK FIN FRA GBR IRL JPN LUX NLD RUS SWE USA
Manufacturing	AUS BRA CYP DEU ESP GBR GRC HUN IRL JPN KOR LUX NLD RUS SWE USA
Food	AUT CHN CZE FIN GBR JPN KOR LUX MEX ROM RUS SVK SVN SWE TWN
Leather	BEL CAN CYP DEU DNK GBR GRC IRL JPN LVA MEX NLD RUS SWE USA
Agriculture	AUT CZE DEU FIN GBR IRL ITA JPN KOR MEX PRT SVN SWE TWN
Other Services	BEL BGR DEU FRA ITA KOR LTU LVA MEX ROM SVN SWE TUR TWN
Hotels	DEU DNK ESP EST FIN FRA HUN ITA RUS SVN SWE TUR USA
Petroleum	AUT CHN DEU EST FRA IRL ITA JPN LUX MLT SVN USA
Plastics	AUS BRA FIN GBR GRC IRL KOR LVA RUS SWE USA
Retail Trade	DEU DNK ESP EST FRA JPN PRT SVN TUR TWN USA
Other Business	BGR BRA CAN CYP DEU JPN MEX POL RUS SVN TUR
Publishing	AUS CHN CYP DNK GRC IND KOR LTU LVA TWN
Electricity	BRA GBR IND IRL ITA JPN KOR MLT TWN USA
Air Transport	BRA DEU IDN IND ITA LTU SVK SVN SWE TUR
Health	DNK ESP IND ITA JPN KOR MEX ROM TUR TWN
Wood	CYP ESP FRA GRC ITA LUX MEX NLD TUR
Wholesale Trade	BRA CAN DEU FRA GBR IDN IND TUR TWN
Motor Sales	AUS CHN DNK IDN IND KOR TWN USA
Inland Transport	CHN DEU FRA IRL ITA KOR TUR TWN
Education	CHN DEU ESP FRA ITA MEX SVN TUR
Telecom	CAN DEU IDN IND JPN RUS TUR
Other Mineral	AUS IRL KOR MLT SWE USA
Basic Metals	FRA GBR IRL LTU MLT USA
Other Transport	BRA CAN IND KOR MEX TUR
Construction	DNK ESP FRA MEX MLT

See Table A1 in the Appendix for an overview of the country codes

Table A7 Gross export RCA based share estimates

	Annual change in unemployment				Cumulative change since 2008		
Time	2009	2010	2011	2012	2008-10	2008-11	2008-12
Agriculture	27.4	-0.2	-28.6	-18.7	27.2	-1.4	-20.1
Mining	283.0	-39.6	-82.0	-71.9	243.4	161.4	89.4
Food	16.4*	3.7	-4.2	-0.1	20.0	15.8	15.8
Textiles	16.0	-0.2	-10.6	-7.3	15.8	5.3	-2.1
Leather	-50.0	9.2	54.1**	54.8***	-40.7	13.4	68.1
Wood	-5.6	-12.1	7.2	-3.2	-17.7	-10.5	-13.6
Publishing	1.3	24.5	9.4	20.3	25.8	35.2	55.5
Petroleum	-59.8	-5.1	36.2	26.0	-64.9	-28.7	-2.7
Chemicals	30.9	2.5	-23.7	-25.9*	33.4	9.7	-16.2
Plastics	27.2	-27.4	-21.9	-16.8	-0.2	-22.1	-38.8
Other Mineral	26.5	-38.2	41.7	136.8	-11.7	30.0	166.8
Basic Metals	32.1	6.2	12.2	17.4	38.2	50.4	67.8
Machinery	12.4	-7.2	-7.9	-8.7	5.2	-2.8	-11.5
Electric & Optical	12.2	3.3	-9.5	-7.7	15.4	5.9	-1.7
Transport Eq.	-18.5	-6.8	13.2	10.0	-25.3	-12.0	-2.0
Manufacturing	-51.1	-7.9	28.0	19.6	-59.1	-31.1	-11.5
Electricity	-57.8	34.7	48.5	36.3	-23.1	25.3	61.7
Construction	4.4	-1.3	-1.4	-1.2	3.1	1.7	0.5
Motor Sales	57.0	12.4	50.7	64.3	69.5	120.2	184.5*
Wholesale Trade	7.1	3.8	28.2	19.9	10.9	39.1	59.1
Retail Trade	-32.4	4.3	9.5	9.2	-28.1	-18.6	-9.4
Hotels	6.2	-12.7	-27.6	-23.0	-6.5	-34.1	-57.1
Inland Transport	50.7*	17.1	-17.2	-23.6*	67.8	50.7	27.0
Water Transport	45.4	32.0	16.4	35.6	77.5	93.8	129.5*
Air Transport	-36.4	-16.1	118.6	68.0	-52.5	66.1	134.1
Other Transport	-10.2	3.1	-18.0	23.5	-7.1	-25.1	-1.6
Telecom	21.2	-19.6	-54.9	-68.9*	1.7	-53.3	-122.2
Financial Services	2.1	4.7	11.7	16.2	6.8	18.5	34.7
Other Business	16.7	-3.8	1.8	5.3	12.9	14.7	20.0
Education	-100.0	-21.1	97.0	63.7	-121.1	-24.1	39.6
Health	26.2	8.0	-7.1	-1.7	34.2	27.1	25.4
Other Services	1.6	-1.7	1.0	0.8	-0.1	0.9	1.7
Adjusted R^2	0.032	0.006	0.207	0.562	-0.005	0.276	0.502
# significant coeff.	2	0	1	4	0	0	2

Endogenous variable is percentage point change in unemployment, OLS.
Shaded cells with significant coefficients; where * ** and *** indicate 10, 5 and 1 percent level.

Table A8 Value added RCA based share estimates

	Annual change in unemployment				Cumulative change since 2008		
Time	2009	2010	2011	2012	2008-10	2008-11	2008-12
Agriculture	17.1	11.4	-21.6	-15.9	28.5	6.8	-9.0
Mining	282.9**	190.6**	-46.9	-25.2	473.5***	426.6***	401.5**
Food	11.4	0.6	-0.6	-1.0	11.9	11.3	10.3
Textiles	4.7	-0.6	8.0	10.1	4.1	12.1	22.3
Leather	32.2	17.8	6.7	26.8	50.0	56.7*	83.6**
Wood	2.3	15.8	-7.3	-0.2	18.1	10.8	10.7
Publishing	77.9**	-5.2	-27.5	-32.0*	72.7**	45.1*	13.1
Petroleum	-29.4	-16.0	44.6**	42.1**	-45.3*	-0.7	41.4
Chemicals	51.4***	22.9**	3.1	-11.7	74.3***	77.3***	65.6***
Plastics	130.2*	-24.4	-129**	-84.9*	105.8	-23.5	-108.4
Other Mineral	-431.6	-50.8	65.7	135.1	-482.4	-416.7	-281.6
Basic Metals	-23.1	-24.3	63.2	38.3	-47.3	15.9	54.2
Machinery	20.3*	-3.4	-11.0	-10.4	17.0	5.9	-4.5
Electric & Optical	12.1	12.1**	1.7	-3.0	24.2**	25.9**	23.0**
Transport Eq.	15.3	-1.0	-0.9	-0.6	14.3	13.4	12.8
Manufacturing	56.6**	29.8*	-37.1*	-54.6***	86.4***	49.3*	-5.3
Electricity	88.1*	43.5	-60.7	-71.3**	131.7**	71.0	-0.3
Construction	15.8**	-2.6	-7.9*	-11.3**	13.2**	5.3	-6.0
Motor Sales	-81.2	50.1	8.0	-4.5	-31.1	-23.1	-27.6
Wholesale Trade	-15.3	12.1	19.4	24.9*	-3.2	16.2	41.0*
Retail Trade	58.4**	-3.5	-13.0	-8.3	54.9**	41.9*	33.6
Hotels	-2.7	4.1	21.3	17.1	1.4	22.7	39.8
Inland Transport	33.1	7.6	-12.7	-15.8	40.7	27.9	12.1
Water Transport	-38.6	27.6*	57.8**	64.1***	-11.0	46.8**	110.9***
Air Transport	100.6	-19.6	-10.0	-30.5	80.9	70.9	40.5
Other Transport	130.1*	33.2	30.2	25.1	163.3**	193.5**	218.7**
Telecom	-20.9	-33.8	-37.1	-82.7*	-54.7	-91.9	-174.5**
Financial Services	-15.0	11.2	-2.1	1.3	-3.8	-5.9	-4.5
Other Business	45.8**	8.3	-1.5	5.2	54.1**	52.6**	57.8**
Education	51.6	8.7	-14.8	-1.3	60.3	45.5	44.2
Health	-22.3	-7.6	-15.5	-10.3	-29.9**	-45.4***	-55.8***
Other Services	-37.1	-29.4**	15.2	10.0	-66.5**	-51.3**	-41.3
Adjusted R^2	0.706	0.689	0.536	0.719	0.834	0.875	0.880
# significant coeff.	11	6	5	9	13	12	10

Endogenous variable is percentage point change in unemployment, OLS.
Shaded cells with significant coefficients; where * ** and *** indicate 10, 5 and 1 percent level.