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SWPS 2019-10 (June)

Trade Specialisation and Performance in Global Value Chains

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SPRU Working Paper Series (ISSN 2057-6668)

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Trade Specialisation and Performance in Global Value Chains

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Abstract

This paper investigates whether trade specialisation explains economies' trade performance within a Global Value Chain (GVC) context. We consider trade specialisation in natural resources, high and low tech manufacturing and business services, before and after the financial crisis. The aimed contribution of this paper is to shed light on the effects of trade specialisation as measured in domestic value added embodied in exports rather than gross exports. We add to the literature on GVCs by: (i) studying the role of the domestic productive structure in countries' trade specialisation and performance, (ii) accounting for the rate of changes in trade specialisation as affecting GVC performance. We employ Balassa indexes based on value added flows in a GMM dynamic panel framework.

We find that trade specialisation in low-tech manufacturing and natural resources have a negative impact on value added exported by countries. High-tech manufacturing and knowledge intensive services exhibit a positive effect during the crisis period. We discuss these findings in relation to the recent debates on the role of manufacturing and premature de-industrialisation in developing countries.

Keywords: Global Value Chains, Trade Specialisation, KIBS, Input-Output.
JEL: F14, F63

Acknowledgements: the author wishes the support of the SPRU Working Paper Series (SWPS) and the anonymous referee for the useful comments. The paper has also benefitted from discussions with Prof. Maria Savona, Dr Tommaso Ciarli and Dr. Ariel Wirkierman. All remaining mistakes are mine and the usual disclaimers apply.

Introduction

Countries' economic development and its relationship with the productive structure has been the subject of a long and established literature, spanning several decades, looking at the role of specific sectors, such as agriculture, manufacturing and services (Kaldor 1968; Matsuyama 2008; Szirmai and Verspagen 2015), the linkages across sectors (Guerrieri and Meliciani 2005; Hirschman 1958; Evangelista et al. 2015; Meliciani and Savona 2014; Lopez-Gonzalez et al. 2015), and the importance of trade structure for economic performance (Balassa 1978; Hausmann et al. 2007; Lederman and Maloney 2012; Lee 2011).

In the past decades, globalisation has brought about a much higher degree of interdependence and interconnectedness across countries, also in trade flows. A consequence of this, and arguably one of the most relevant changes in recent years concerning the nature of trade, is that intermediate goods account for an increasing share of trade flows (OECD, 2013). This is because production is scattered across countries, and global value chains (GVCs) represent a large proportion of trade (Gereffi 1994; Gereffi et al. 2005; Baldwin and Robert-Nicoud 2014). This paper studies countries' export performance in light of this significant change.

Foreign imported inputs constitute an increasing share of gross exports, which in turn are less representative of countries' domestic production structure (Koopman, Wang and Wei, 2014). As Baldwin (2011, p.33) puts it, while previously *"exporting engines was a sign of victory now it is a sign that the nation is located in a particular segment of an international value chain"*. Moreover, this phenomenon has turned foreign countries not only into export destinations, but also into co-producers; this changes the way in which we think about countries' trade specialisation and its impact on export performance.

In light of the growing importance of GVCs, this paper investigates the role of trade specialisation as a determinant of countries' export performance. In particular, we argue it is increasingly important to distinguish countries' domestic value added contribution from what other countries provide, rather than relying on gross exports. In sum, rather than "what you export matters", as posited by Hausmann et al. (2007), it is what a country produces (and then exports) that matters.

In addition, we characterise changes in trade specialisation, not only in terms of direction, i.e. in which sectors a country specialises, but also in terms of the rate of change, i.e. the speed at which such changes occur.

More specifically, we focus on the relationship between countries' acceleration in specialisation and the growth of export shares. This is quite a novel approach, and complements earlier studies on countries' trade and structural change, which focus on static effects.

We also include services (and in particular knowledge intensive business services - KIBS) in the analysis of output and export specialisation; as opposed to manufacturing, services have been comparatively overlooked in the literature on both trade and structural change, despite some exceptions (Anderson et al. 2013; Wolfmayr 2012; Varela and Hollweg 2016; Di Meglio et al. 2018). However, services represent an increasing share of trade and countries' productive structures (Anderson *et al.*, 2013). Being less tradable than manufactured goods, it is even more important to assess their contribution to countries' trade with a value added approach.

We build on Kowalski et al. (2015) and operationalise our questions by estimating the effect of the rate of change in countries' trade (in value added) specialisation on the growth of countries' share in domestic value added exported. We find that trade specialisation in low-tech and natural resources has a negative or not significant impact, while we detect a positive and significant effect of increases in specialisation in KIBS and high-tech manufacturing, although only after the financial crisis. These results suggest that countries increasing their specialisation towards low-tech manufacturing are likely to experience a decrease in the growth of export shares in value added terms. Relating this more in general to the debate on manufacturing as an engine of growth (Rodrik 2015b; Szirmai and Verspagen 2015; Szirmai 2012) this hints towards a differential impact of specialisation in high- versus low-tech manufacturing.

Our results are also relevant to the literature on the role of countries' trade specialisation and their performance (Hausmann, Hwang and Rodrik, 2007; Hidalgo *et al.*, 2007), which has so far overlooked the emergence of GVCs (Koopman, Wang and Wei, 2014). We provide a richer understanding of trade specialisation, not only through our value added approach, but also looking at the speed of changes in specialisation, which the literature has shown to have important effects on countries' long-term growth dynamics (de Vries et al. 2017; Timmer and de Vries 2009; Timmer et al. 2014).

The remainder of the paper is organised as follows: Section 1 reviews the relevant literature; Section 2 presents our value added based measures and some relevant descriptive evidence; Section 3 illustrates how they are computed and the overall empirical strategy as well as the data used; Section 4 presents the results and discusses the paper's findings; Section 5 concludes.

1. Trade specialisation and performance in the context of GVCs

1.1 Trade specialisation and the domestic productive structure

There is a long standing literature looking at exports as a driver of economic growth (Balassa, 1978; Marin, 1992). The export sector has been regarded as more productive (Feder, 1982), for reasons ranging from access to a larger market, economies of scale and scope, technological spillovers, and incentives for exporters to increase productivity (Bustos 2015; Rivera Batiz and Romer 1991). Moreover, access to international market has historically played an important role in the development of several developing countries, particularly in East Asia (Lee et al. 2011; Kim and Lee 1987; Kim 1980; Hobday 2015; World Bank 1993).

Economic theory has mainly stressed the role of factor endowment in shaping countries' comparative advantage and specialisation in trade. According to this view, countries should specialise in sectors in which they have a comparative advantage, regardless of the sector's specific characteristics.

In contrast with this sector-neutral approach, some scholars have also argued that countries' specialisation and its changes reflect their technological capabilities, endogenous technical change and thus their competitiveness (Fagerberg 1988; Uchida and Cook 2005). A well established literature has put forward the idea that not all sectors are the same, due to differences in the evolution of terms of trade, which tend to deteriorate over time for primary products, since they depreciate vis-à-vis the prices of manufactured goods, this is also known as the Prebish-Singer hypothesis and Harvey *et al.*, (2010) have found empirical support for it, in the very long run.

In the same vein of this stream of research, it has been argued that income and price elasticities vary across specialisation trajectories, determining demand and productivity growth dynamics (Thirlwall, 1979). So, trade specialisation and trade performance influence each other and, at times, countries go down specialisation patterns with low growth potential (Amable, 2000) as shown, for instance, by Matsuyama (1992) for the agriculture sector.

A more recent literature has looked at countries' trade specialisation, and revealed comparative advantage (RCA) in particular, to infer countries' underlying domestic capabilities. Hidalgo et al. (2007) and Hausmann and Klinger (2007) have argued that countries' export specialisation reflects their domestic capabilities as well as their development perspectives. As a result, Hausmann et al. (2007) show that export specialisation is a determinant of future economic growth and that therefore "what you export matters", as they argue in the title of their article.

Interestingly, Hausmann and co-authors (2007) link countries' export specialisation with their underlying domestic economic structure and ultimately study how this evolves and affects long-term growth. However, they do not account for the increasing fragmentation of production across countries that accompanies the emergence of global value chains (GVCs) and the limitations of using gross export data to infer on the domestic economic structure and capabilities (Koopman *et al.*, 2010; Baldwin, 2012).

The relationship between domestic productive structure and GVCs is not merely a methodological issue but represents a significant change in countries' specialisation opportunities. In fact, while globalisation has opened up new specialisation avenues for countries (Baldwin 2011), this has yielded rather diverse outcomes as developing countries have taken different specialisation patterns at different speeds, also depending on their pre-existing productive structure (McMillan et al. 2014).

1.2 Direction and pace of change in countries' trade specialisation and economic structure

Within the literature on structural change, manufacturing has traditionally been considered as the engine of growth; Szirmai (2012) provides a thorough discussion of the different arguments in favour of this hypothesis. The first Kaldor's Law (1968), postulates that manufacturing share and economic growth are positively correlated, and Verdoorn's Law posits a positive relationship between the manufacturing sector's size and its productivity. Furthermore, manufacturing has been argued to have many linkages with other sectors, for which it provides either inputs or demand for output (Hirschman, 1958), as well as opportunities for technology and knowledge spillovers. Rodrik (2013) finds that while the convergence between developing and advanced economies predicted by neoclassic growth models is conditional on a set of other factors, such as education and institutions, productivity in the manufacturing sector shows unconditional convergence, i.e. irrespective of countries' characteristics.

Recent evidence seems to question whether manufacturing is still playing its traditional role of a growth engine. In another contribution, Rodrik (2015a) argues that rapid industrialisation for developing countries is going to be more difficult in the future due to the strong Chinese competition in low-tech labour-intensive manufacturing sectors and the fragmentation of production.

Szirmai and Verspagen (2015) also find that an increasing amount of human capital is now needed in order for manufacturing to trigger its engine of growth effect. This evidence suggests that specialisation in high- and low-tech manufacturing may yield different outcomes in terms of countries' economic performance.

Services have traditionally not been considered to exert the same virtuous properties on economic growth. However, structural change towards services is an empirical regularity associated with economic growth (Bah, 2011), both in high and low income countries. Rodrik (2015b) finds that structural change towards services and away from manufacturing is happening in developing countries at much lower income levels than in the past; for this reason, he raises concerns for its implication for low-income countries' growth perspectives.

In contrast with this view on the contribution of services to economic development, recent studies on the emergence of GVCs in services have provided evidence on the opportunities of offshoring service activities from developed towards developing countries (Gereffi and Fernandez-Stark 2010; Gereffi and Fernandez-Stark 2010; Hernandez et al. 2014). However, most of the studies in this strand of work take a qualitative approach, while little quantitative evidence has been offered so far to the debate around GVCs and the role of services in developing countries.

While the body of literature on the direction of structural change is vast, still little is known on the dynamic effects of the pace at which countries specialise on their growth rate. It has been argued that the speed at which structural change takes place is key to countries' successful development (Matsuyama, 1992; Haraguchi, 2014). McMillan et al. (2014) stress the importance of the dynamic effects of structural change, distinguishing between structural change that is growth enhancing or growth reducing. In particular they argue that developing countries with significant productivity differences between sectors may have a lot to gain – or to lose – by simply reallocating the labour force from low to high productivity growth sectors.

For instance, when we compare Asian and Latin American countries, we see that while in the former structural change has favoured sectors with higher productivity dynamics, this has not happened in the latter (Timmer, de Vries and de Vries, 2014). More specifically, Asian economies have moved towards manufacturing sectors that had a faster technological dynamic and thus higher productivity growth rates. In contrast, Latin America and Africa have specialised in services that did have higher productivity *levels* than agriculture, but much lower productivity growth *rates* than other manufacturing sectors. The result has been a static, one-off, productivity boost rather than a dynamic one (de Vries et al. 2017; Timmer and de Vries 2009; Timmer et al. 2014).

The qualitative literature on GVCs has also emphasised the importance of speed when countries specialise in sectors with high value added content, in order to reap the benefits of the first-mover. Furthermore it is important that countries maintain their ability to specialise quickly so they can sustain a rent, deriving from constantly moving towards new high-value added sectors (Kaplinsky, 2004).

For this reason, it is particularly interesting to look at rates of change, rather than levels, in both export performance and specialisation.

1.3 Research question and paper's contribution

This paper sets out to study the relationship between trade specialisation and performance in the context of GVCs. We aim to take into account that the emergence of GVCs has made the relationship between export specialisation and the underlying domestic productive structure less straightforward, with the former being less and less representative of the latter. This requires a novel understanding of trade flows: they are no longer the outcome of exchanges of finished goods produced within countries' borders, but rather a process of production fragmented across borders in which countries are both destination and co-producers.

In addition, and in line with a growing literature, we argue that changes in countries' specialisation will have an impact on the dynamic of their export performance, i.e. the rate at which it will improve (or worsen), and that the speed at which countries change their specialisation will also be a determinant of their performance. This is something that the scholarship has already acknowledged (McMillan et al. 2014; Kaplinsky 2004), although the evidence on this remains scarce, compared to the vast body of studies looking at the relationship between levels of trade specialisation and levels of export performance.

Following on from this, this paper aims to answer the following research question: do changes in countries' trade specialisation affect their export performance, within a GVC context?

We bring this hypothesis to the data by computing measures of trade specialisation and of trade performance. In order to account for the emergence of GVCs and to explore the relationship between exports and domestic specialisation, we build on the growing literature on trade in value added, which we review in detail in the next section.

2. Measuring trade in a GVC context: descriptive evidence

In order to account for the emergence of GVCs and the gaping divide between trade in value added and gross exports, a recent and growing stream of research has developed a set of measures capturing countries' participation in GVCs. De Backer and Miroudot (2013) and, more recently, Johnson (2017) provide a quite complete review of the measures of both backward participation, i.e. the value added a country imports from other countries that is subsequently exported, and forward participation, i.e. the value added a country exports and is subsequently exported by third countries.

In line with the export-led growth models, the underlying assumption of this strand of literature is that GVC participation is desirable and that it should lead to economic growth. Without making such an assumption, Banga (2014) argues that linking into GVCs is not necessarily enough to trigger export-led growth. As an alternative measure of countries' GVC performance, she proposed to use the difference between backward and forward participation and found very unequal benefits being drawn from GVC participation across countries. Based on these results, she argues for policies favouring forward, rather than backward, participation.

Kowalski et al. (2015) show, however, that backward and forward participation may be complementary and propose an alternative measure of countries' trade performance in GVCs. They look at domestic value added embodied in countries' exports (DVA, henceforth), which corresponds to the share of exports that is used to remunerate domestic labour and capital. This measure captures the parts of countries' domestic productive structure that can compete in the international market and ultimately contributes to their export.

In order to measure countries' performance in GVCs, we follow Kowalski et al. (2015) and opt for DVA as our main variable of interest, which we use to compute both our outcome and explanatory variables. This variable is particularly interesting for us for two main reasons.

First, while DVA can be intuitively understood as the value added homologue of gross exports, it is worth stressing that this measure accounts for the fact that within each country value added exported by one sector may be generated by different sectors. This measure thus allows reallocating value added to the sector that originated it rather than the one that exported it. This is particularly relevant when looking at countries' export specialisation in relation to domestic structure, and *a fortiori* for business services that are often embodied in manufacturing goods and exported.

Second, the growth of a country's share in total DVA flows (which we will refer to as DVA share henceforth) is loosely related to countries' competitiveness. This is because an increasing growth rate in DVA share is arguably a manifestation of countries' increasing competitiveness in the export markets (Kowalski *et al.*, 2015).

The literature has yet to reach a consensus on a single approach to measuring DVA. Koopman et al. (2014) suggest using a vector of gross exports including both final and intermediate foreign demand. Johnson (2017) points out that in Koopman et al.'s (2014) approach, foreign intermediate demand is treated inconsistently because it is included in both the gross export vector and in the global Leontief Inverse, which leads to a double counting of a sort.

In an attempt to tackle all these issues, our measure of DVA includes the value added exported by a country either as final foreign demand or intermediate foreign demand, the latter being the value added demanded by other countries' production processes. However, we also exclude the value added generated by a country, exported to meet foreign intermediate demand and then re-imported to satisfy the country's own final demand[1].

We use the Inter-Country Input-Output (ICIO) tables compiled by the OECD, and compute countries' DVA shares and value added RCA in four sector groups: knowledge intensive business services (KIBS), natural resource (NR), low-tech and high-tech manufacturing (LTMF and HTMF respectively).

In Section 3 we explain in more detail how these measures are computed. However, we first present some descriptive evidence of how different our value added measures are compared with their gross export homologues, especially when looking at countries' trade specialisation. This evidence suggests that when countries export value added of a sector indirectly, i.e. embodied in exports of other sectors, a gross export approach is likely to underestimate trade specialisation.

We compare countries' RCA when computed in gross exports and DVA, and we show that using value added has a relevant impact on our trade specialisation measure. Figure 1 below shows how the average RCA in KIBS over the years changes across countries when using measures based on gross exports or DVA. We take KIBS as a particular example since, as we have already pointed out, this sector is more likely to be exported indirectly through manufactured exports. However, the same pattern can be found looking at the other three macro-sectors in our analysis[2].

[1] We provide a more formalised explanation of how this measure is computed in the Appendix.
[2] Figures reporting the same comparison between gross exports and domestic value added for the other three sector groups, NR, LTM and HTM can be found in the Appendix.

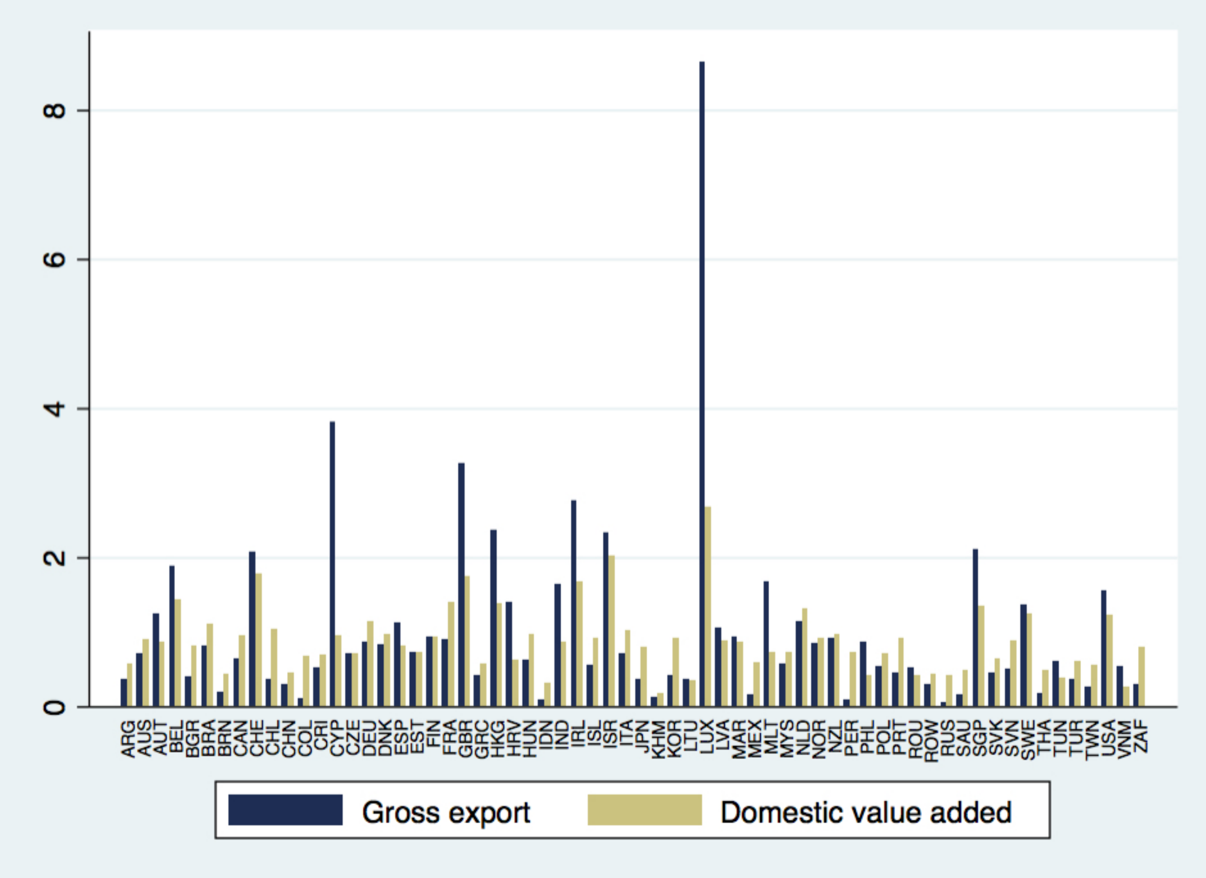

Figure 1: Country Average RCA in KIBS across years in gross exports and domestic value added

Note: Figure 1 compares countries' average RCA in KIBS across years in our sample, using gross exports and domestic value added in exports.

Source: Author's own calculation using ICIO tables.

We can see that using DVA does not simply reduce the RCA. For countries such as Chile, France, Germany, Italy or Japan, the gross export RCA underestimates their trade specialisation in KIBS. In contrast, countries such as Luxembourg, the UK, Cyprus, Ireland, India and Singapore, see their RCA increase significantly when measured in gross exports.

It is important to stress that using gross exports does not move all RCAs in the same direction, which makes the bias of using of gross exports particularly relevant when studying trade specialisation. The distribution of the two variables differs substantially, which means that estimates based on gross exports may lead to incorrect conclusions: RCAs based on gross exports capture values exported by services but possibly originating from other sectors (and countries), while they leave out value added originating from domestic services but exported by other sectors. This arguably explains the difference between DVA and gross export-based measures: sectors that are less tradable, such as services, may be traded through other sectors' exports, which would only be captured by DVA-based RCA.

In support of this conjecture we see in Figure 1 that gross export RCA inflates the KIBS specialisation of countries that are direct exporters of services (such as the UK, Luxembourg, Singapore, and India), while it underestimates the service specialisation of countries that are direct exporters of other sectors but that also have significant domestic provision of services (such as Australia, France, Germany, and Japan).

In conclusion, we argue that value added based measures better capture the link between trade specialisation and the underlying domestic economic structure. It does this by focusing on the parts of the domestic productive structure that contribute to countries' export performance, either directly or indirectly.

Within this value added based approach we are particularly interested in looking at how the evolution of countries export structure in relation to trade performance has changed over time. Figure 2 shows the average RCA across countries over years in our four sector groups. There is a clear trend of moving away from natural resources and low-tech manufacturing, while the trend seems to be positive, although less strong for high-tech manufacturing. Specialisation in KIBS initially decreases, but then picks back up again from 2005 onwards.

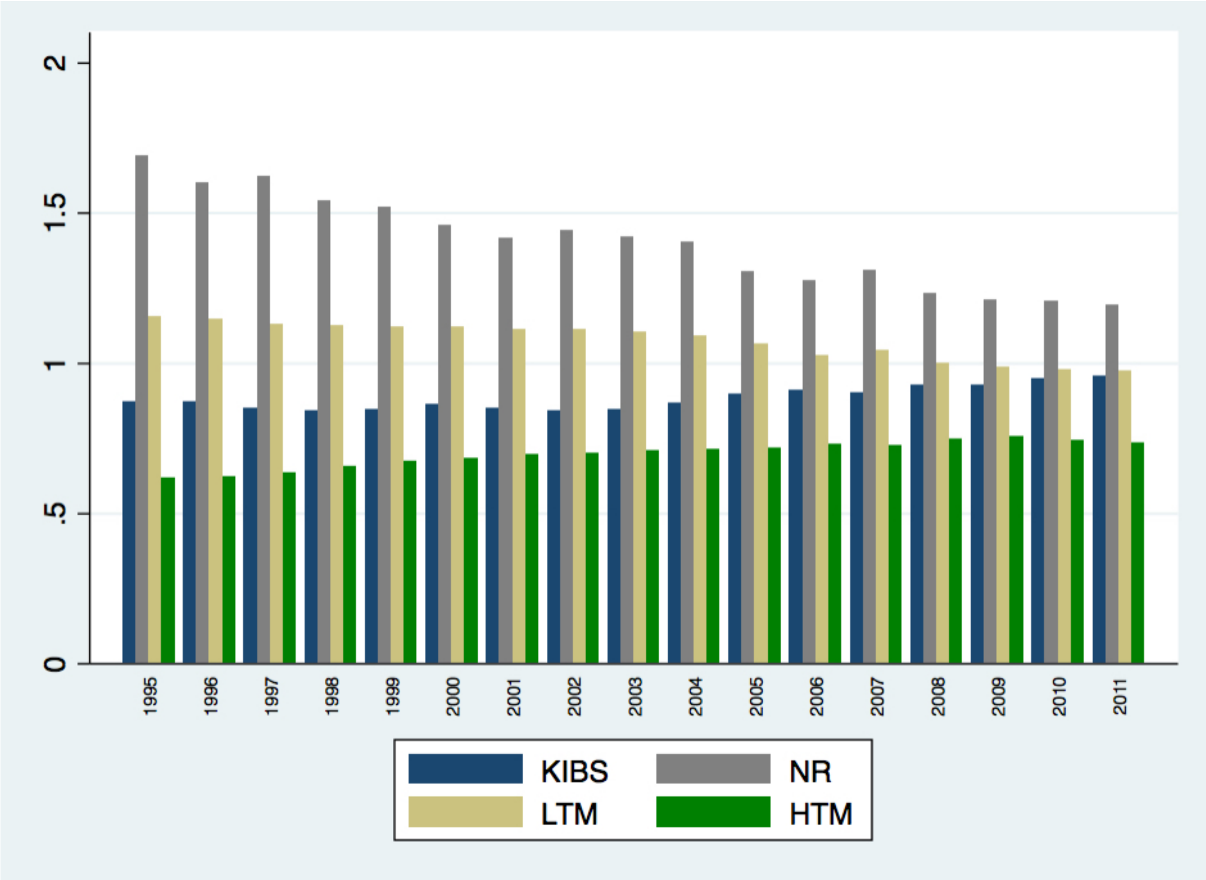

Figure 2: Average RCA across countries and over years

Note: Figure 2 shows trend in the average RCA, computed with domestic value added in exports, across countries in our sample, for four sector groups: knowledge business services (KIBS), natural resources (NR), low-tech manufacturing (LTM), and high-tech manufacturing (HTM).

Source: Author's own calculation using ICIO tables.

There is some significant heterogeneity of these measures of specialisation when we distinguish between high-income and developing countries in our sample[3]. In Figure 3 we see that developing countries tend to have much starker specialisations, especially in natural resources and low-tech manufacturing, although this seems to decrease over time. We note an increase over time of the specialisation in high-tech manufacturing; however, this remains much smaller than high-income countries. Developing countries seem to have been specialising away from KIBS, showing a slightly decreasing trend. It is worth bearing in mind that this does not contradict the evidence Rodrik (2015b) puts forward concerning countries' premature deindustrialisation and shift towards services; Rodrik refers to low-productivity services, such as retail or non-tradable services, that are not KIBS.

High-income countries have more homogeneous specialisations, with the RCA KIBS being consistently above 1. On average, natural resources also exhibit a high RCA among high-

[3] We use the WB threshold of US$ 12,236 of GDP per capita. Table A1.2 reports number of years in which each country is above this threshold and therefore considered as high-income.

income countries, which is most likely explained by the presence of few resource rich countries in our sample, such as Saudi Arabia, Brunei and South Africa. We can also see a decreasing trend in the specialisation in low-tech manufacturing among high-income countries.

Both this, and the strong specialisation in KIBS of high-income countries, are consistent with the established view that, as income in countries increases, their specialisation tends to move away from manufacturing towards services (Bah, 2011). The different specialisation between developing and high-income economies can also be explained by the fragmentation of productive activities, in particular the offshoring of manufacturing towards developing countries with lower wages, while higher value added activities have been retained in high income economies; Baldwin and Lopez-Gonzalez (2013) refer to these as head-quarter economies.

The fact that high-income countries tend to have more homogeneous specialisation across sectors, and be more specialised in high-tech and knowledge intensive industries, is also to be expected. This is because more advanced and sophisticated economies will have a larger set of capabilities and therefore be able to produce a larger set of goods and services in a competitive way (Hausmann and Hidalgo 2011; Hidalgo and Hausmann 2009; Felipe et al. 2012).

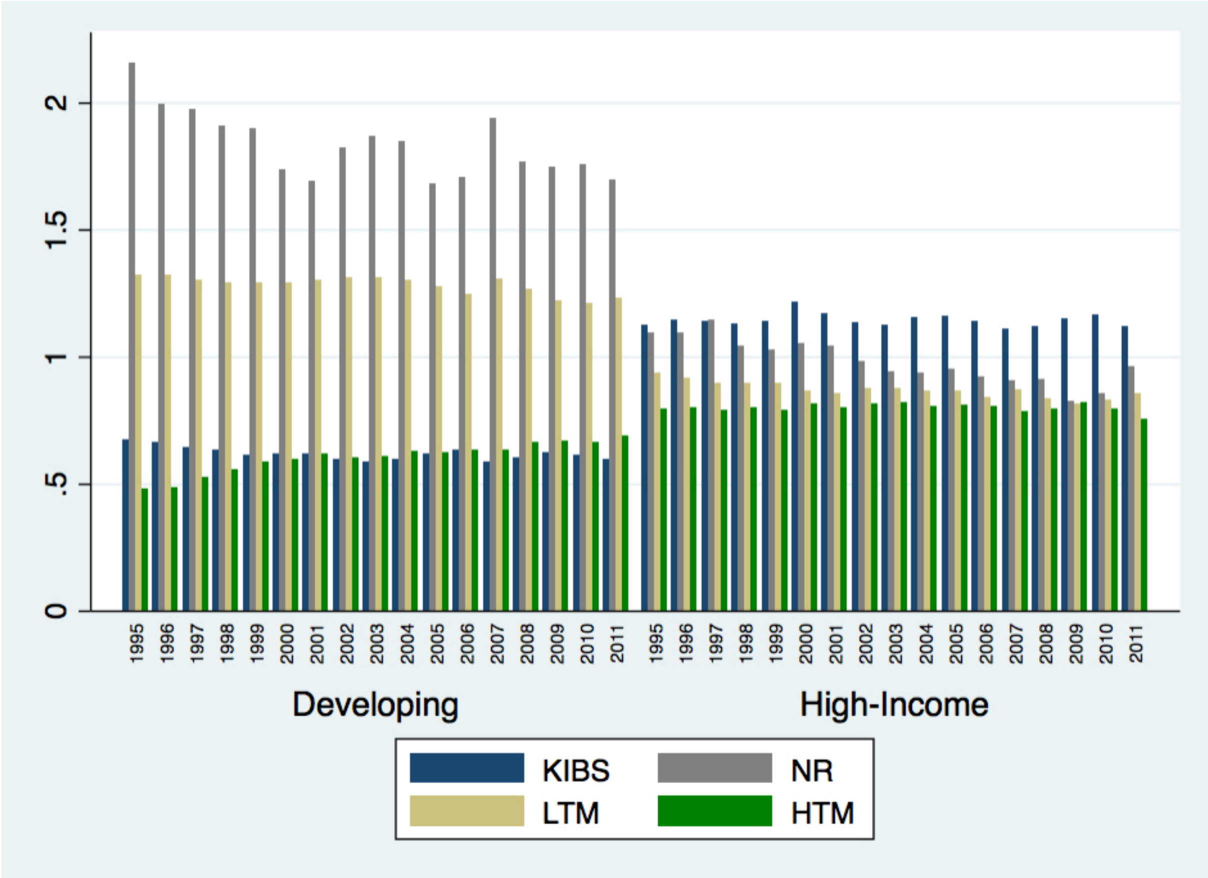

Figure 3: Average RCA over the years, comparing high-income and developing countries

Note: Figure 3 shows the average domestic value added based RCA computed across all countries for each year, dividing the sample between high-income and developing countries.

Source: Author's own calculation using ICIO tables.

Overall it seems that, over time, countries have specialised away from low-tech manufacturing (especially high-income ones) and natural resources (especially developing ones), with the largest changes taking place in these two sectors and in developing countries.

As this paper's aim is to study the effect of changes in trade specialisation on trade performance with a value added approach, we now turn to how domestic value added in exports has evolved over time, looking again at high-income and developing countries separately. Figure 4 reports the yearly average changes in domestic value added exported. We can clearly observe the impact of the financial crisis in 2007 and 2009. It is also interesting to see that, in its aftermath, developing countries' exports in value added have been growing at a higher rate than high-income countries. Note that Figure 4 reports (average) changes in thousands of USD and not percentage changes. This means that after the crisis developing countries have experienced levels of growth higher in absolute terms, as well as, naturally in percentage terms. The crisis years thus seem to be significantly different from the rest of our panel, which is why our analysis will also explore these separately.

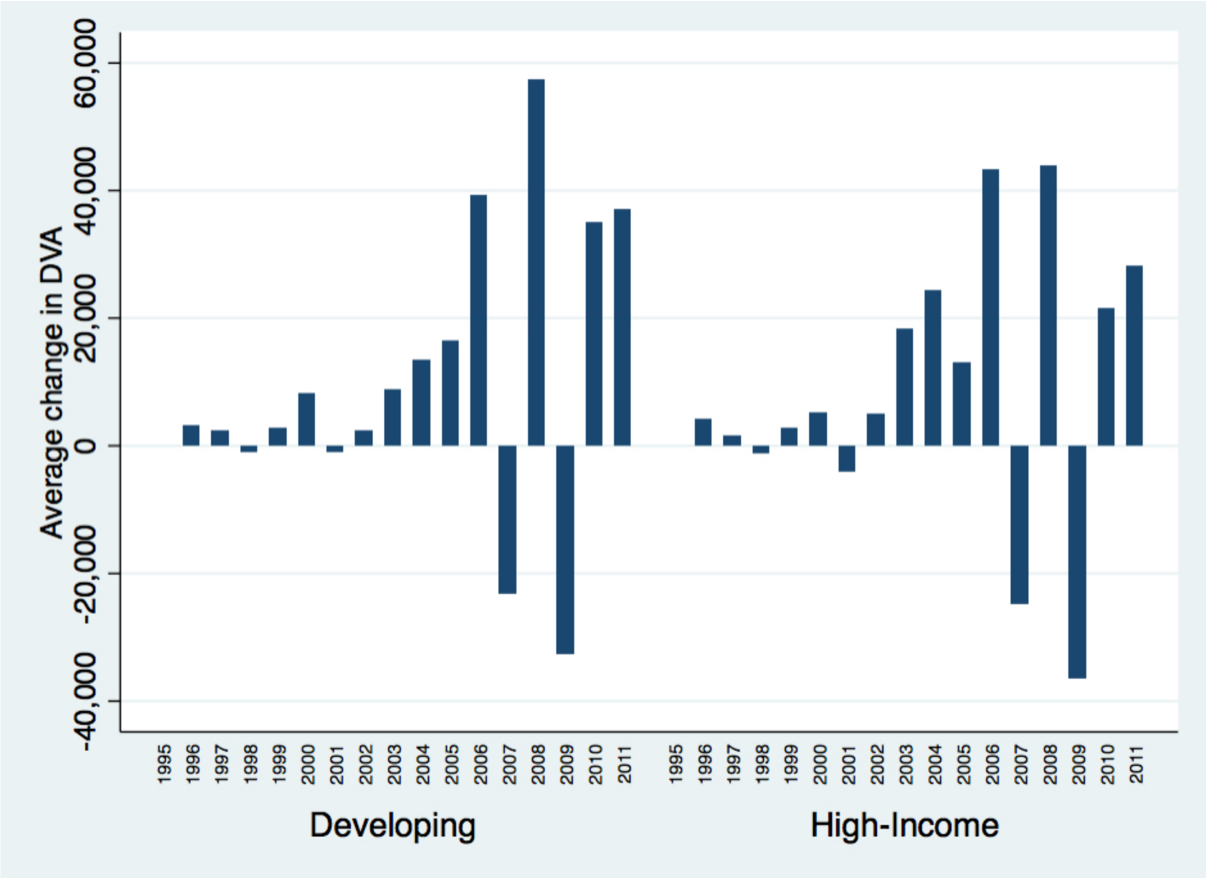

Figure 4: Average change in DVA across countries and over time, comparing high-income and developing countries

Note: Figure 4 shows the average change in DVA in thousands of USD, across countries for every year in our sample, dividing between developing and high-income countries.

Source: Author's own calculation using ICIO tables.

In conclusion, we find some significant changes in the specialisation pattern across developing and high-income countries. Specialisation in natural resources and low-tech manufacturing seem to have changed the most, with a decreasing trend, over the years. In contrast, specialisation in KIBS and high-tech manufacturing has been more stable over the years, despite a decreasing trend among developing countries.

These sectors appear to have been a more difficult specialisation trajectory for countries to undertake. Based on this preliminary evidence and the existing literature reviewed, we would expect a negative impact of the specialisation in natural resources and low-tech manufacturing on countries' growth in DVA shares.

We also know that the relationship between export specialisation and economic performance is likely to be affected by reverse causality (Amable, 2000) and serial correlation. In the next section we discuss how our econometric strategy deals with these, as well as how we compute the DVA and the RCA with ICIO data.

3. Methodology and empirical strategy

In the previous section we reviewed the growing literature on measurement of GVC participation and DVA in particular, arguing that such an approach would allow the capturing of countries' domestic contribution to exports in a more accurate way.

As has been emphasised, the notion of speed of structural transformation is particularly interesting from a theoretical point of view, as countries' ability to *rapidly* shift trade specialisation may be an advantage in itself. Secondly, looking at changes is conceptually closer to structural change and allows the capture of the dynamic effects related to growth rates rather than levels (Timmer, de Vries and de Vries, 2014). In order to investigate this dynamic aspect of changes in countries' trade specialisation, in our econometric approach we look at growth rates, i.e. changes in the log of the variables.

We compute the DVA-based measures using the OECD ICIO tables. Data are available for 64 countries (including a compound for the rest of the World), 33 sectors (including natural resources, manufacturing and services), for the years 1995 to 2011

We compute our measure of countries' DVA in gross exports as follows:

$$DVA_i = V'(I - A)^{-1}E$$

Where *V'* is a diagonalised vector, yielding a *ij* x *ij* diagonal matrix where all elements of the diagonal are populated with the value added output shares for each country *i* and sector *j*.

$(I\text{-}A)^{-1}$ is an inter-country Leontief inverse matrix capturing the inter-industry linkages. This matrix captures the relationship between all sectors from all countries.

E is a *ij x 1* column vector including sector's export in each country, i.e. the value added generated by country *i* and exported either through foreign final demand or foreign intermediate demand, netting out, however, the value added that is then reimported to meet country *i's own final demand*. We obtain DVA_{ij}, which is an *ij x 1* column vector containing each country *i*'s and sector *j*'s domestic value added in exports. We then aggregate across all sectors and obtain our variable *DVA*.

We then take each country *i*'s share in worldwide flows of DVA, and divide it by the share the country represents of the world population as follows:

$$DVASH = \frac{DVA_i / \sum_i DVA_i}{population_i / \sum_i population_i}$$

This ratio captures the extent to which a country accounts for total DVA flows, normalised by population, considering that larger countries account for a larger share of total DVA flows.

Our main explanatory variables are computed as the Balassa index (Balassa, 1965), but we use domestic value added flows rather than gross exports as follows:

$$RCA_{ij} = \frac{DVA_{ij} / DVA_i}{\sum_i DVA_{ij} / \sum_i DVA_i}$$

We use the share that our sector of interest *j* represents in the domestic value added embodied in the exports of country *i* and weight this with the share that domestic value added from sector *j* represents in world wide value added flows. We compute this RCA index for four groups of industries: KIBS, NR, LTMF and HTMF[4].

So, the general form of the estimated equation in our econometric analysis is the following:

$$dvash_t = \beta_0 + \beta_1 dvash_{t-1} + \beta_2 tfp_t + \beta_3 kibs_{rca_t} + \beta_4 nr\_rca_t + \beta_5 ltmf\_rca_t + \beta_6 htmf\_rca_t + \beta_7 secenrol_t + \beta_8 internetaccess_t + \alpha_i + \alpha_t + \varepsilon_t$$

Where $dvash_t$ is the growth rate of *DVASH* at time *t*, and all variables are expressed in changes; α_t and α_i are year and country fixed effects (FE) respectively; $\_rca_t$ are the growth rates of the RCA of the four groups of industries discussed above.

Both human capital and technological capabilities play a significant role in countries' trade specialisation and competitiveness (Guerrieri and Meliciani 2005). For this reason we control for both of them, using gross enrolment in secondary education (*secenrol)* and Internet users per 1,000 inhabitants (*internetaccess*), both taken from the World Bank's World Development Indicators.

Finally, we also acknowledge that having such aggregated data may not capture the inter-country differences in productivity and development, which are likely to be related to both our outcome and explanatory variables. For instance, being specialised in KIBS in Singapore is probably not the same as in Peru. More productive countries are also more likely to participate

[4] A detailed breakdown of how these sectors are aggregated is provided in the Appendix.

to trade and to have a specific specialisation. In order to deal with this issue we also control for countries' total factor productivity (*tfp*) using the Penn World Tables.

We perform our analysis using the system generalised methods of moments (GMM) developed by Blundell and Bond (1998), which deals more efficiently with models with high persistence like ours than the first-differences GMM developed by Arellano and Bond (1991). We estimate the two-step robust version of system GMM with the Windmeijer correction to deal with heteroscedasticity and finite sample (Windmeijer, 2005).

Using GMM allows us to deal with the potential reverse causality that could affect ordinary least squares (OLS) estimators. In fact, while trade specialisation may indeed impact countries DVA, it is also possible that countries that export more value added tend to specialise in some sectors in particular. Using lags to instrument within our sample allows us to deal with the simultaneity of the relationship between countries' trade specialisation and their trade performance within GVCs.

Finally, we opt for an autoregressive model as exports in panel data often present serial correlation. This means that the outcome variable and its lag are correlated by construction through the FE, and that OLS estimators would be biased and inconsistent. The system GMM, by instrumenting with past lags, deals with this issue too.

4. Econometric results and discussion

The ICIO data cover a rather long span of time including the financial crisis (2007 onwards), which we have seen shows a significantly different pattern from previous years.

Table 1 reports the results of our main model results for all years available in our data, as well as for the crisis years only. As expected, natural resources exert a negative and significant effect on the growth of export shares during all the years in our sample. This is largely consistent with an established view of natural resources as a sector with low productivity dynamic (Matsuyama, 1992).

Table 1: GMM results on the effect of increases in trade specialisation on growth of export shares, in value added terms

	(1)	(2)
VARIABLES	All years	Crisis years
dvash	-0.0606	-0.282***
	(0.0455)	(0.0488)
tfp	**0.715*****	**1.046*****
	(0.196)	(0.238)
kbs_rca	-0.00295	**0.118***
	(0.0392)	(0.0631)
nr_rca	**-0.170*****	-0.00891
	(0.0560)	(0.0540)
ltm_rca	**-0.183****	**-0.153****
	(0.0761)	(0.0741)
htm_rca	0.0104	0.0250
	(0.0561)	(0.0692)
secenrol	-0.00136	0.000180
	(0.00130)	(0.00149)
Internet access	0.00178	0.00151
	(0.00158)	(0.00254)
Constant	0.0870**	0.0118
	(0.0379)	(0.0162)
Observations	780	278
Number of groups	59	59
AR(2)	0.852	0.398
Hansen test overidentification	0.477	0.135
Difference-in-Hansen	0.606	0.473

System GMM estimates on the effect of increases in specialisation for each of the four sector groups on countries' share in domestic value added in exports. The four sector groups are: knowledge intensive business services (KIBS), natural resources (NR), low- and high-tech manufacturing (LTM and HTM, respectively). Education is gross enrolment in secondary education; Internet access is Internet users per thousand inhabitants. Crisis years are 2007-2011.

Standard errors in parentheses, all variables in changes, _rca and _dvash in natural logs.
For the AR and Hansen tests the p values are reported.
*** p<0.01, ** p<0.05, * p<0.1

Source: author's own calculation using ICIO tables.

Low-tech manufacturing also has a negative impact on our outcome variable, both when looking at the crisis years or at all the years. This was also expected and has significant implications for developing countries in particular for at least two reasons. First, these countries seem to be more specialised in low-tech manufacturing and are moving away from this sector at a slower pace than high-income countries (see Figure 3); second, while manufacturing has traditionally been regarded as the engine of growth, and low-tech manufacturing as a stepping-stone for structural change and industrial upgrading, we have seen while reviewing the literature that some doubt has been cast over this notion (Rodrik 2015a; Szirmai and Verspagen 2015).

Moreover, we do not detect any significant impact of high-tech manufacturing on the growth of export shares. However, this is not completely unexpected, both based on the descriptive evidence showing specialisation in this sector to be rather stable over the time span considered, and the evidence for a similar year period offered by Szirmai and Verspagen (2015). They examine structural change between 1950 and 2005, and, in the last decade, find a slowing down of manufacturing's beneficial effect on growth and an increased dependence on human capital.

Concerning KIBS, we do not detect any significant effect, except a weakly significant and positive coefficient for the crisis years. These results do not allow, however, the consideration of Rodrik's (2015b) concerns with respect to developing countries' structural change towards services and its consequences on economic development as unwarranted.

One of the main limitations of the ICIO data is the high level of aggregation of sectors, while a wide range of countries are included. As seen while discussing the descriptive evidence, our specialisation measures exhibit significant heterogeneity across countries based on the development level of the country. We try to account for this by including total factor productivity as a control, which has a consistently positive and significant effect, as expected.

We wish to explore more in depth whether specialisation in any of our four macro-sectors has different impacts on countries depending on their income level. We achieve this by interacting our specialisation variables with a dummy variable, *dvpd*, taking value 1 if the country is high-income and 0 otherwise.

Table 2: GMM results on the effect of increases in trade specialisation on growth of export shares, in value added terms, controlling for income level

VARIABLES	(1) All years	(2) Crisis years
dvash	-0.0522	-0.274***
	(0.182)	(0.0723)
dvpd	**-0.0618***	-0.0727
	(0.0366)	(0.0445)
tfp	1.152	**0.953*****
	(0.801)	(0.354)
kbs_rca	-0.277	**0.214*****
	(0.253)	(0.0560)
kibs_rca*dvpd	-0.249	-0.0396
	(0.368)	(0.155)
nr_rca	-0.303	-0.0179
	(0.295)	(0.109)
nr_rca*dvpd	-0.233	0.0183
	(0.179)	(0.0771)
ltm_rca	**-0.980*****	-0.0815
	(0.363)	(0.117)
ltm_rca*dvpd	0.279	-0.0158
	(0.211)	(0.118)
htm_rca	-0.00881	**0.218****
	(0.200)	(0.0976)
htm_rca*dvpd	-0.151	-0.0775
	(0.154)	(0.0682)
secenrol	0.000506	-0.00243
	(0.00912)	(0.00170)
internetaccess	-0.00300	0.00240
	(0.00351)	(0.00267)
Constant	0.0619	0.0352
	(0.0924)	(0.0505)
Observations	780	278
Number of groups	59	59
AR(2)	0.557	0.113
Hansen test overidentification	0.371	0.139
Difference-in-Hansen	0.278	0.735

System GMM estimates on the effect of increases in specialisation for each of the four sector groups on countries' share in domestic value added in exports. The four sector groups are: knowledge intensive business services (KIBS), natural resources (NR), low- and high-tech manufacturing (LTM and HTM, respectively). Education is gross enrolment in secondary education; Internet access is Internet users per thousand inhabitants; dvpd is a dummy variable taking value 1 if the country has a GDP per capita above US$ 12,236. Crisis years are 2007-2011.

Standard errors in parentheses, all variables in changes, _rca and dvash in natural logs. For the AR and Hansen tests the p values are reported.

*** p<0.01, ** p<0.05, *p<0.1

Source: Author's own calculation using ICIO tables.

When controlling for income levels we find some interesting results, although it is worth noting that the interacted terms are not statistically significant, hence specialisation patterns do not seem to affect high-income countries in a different way from low-income countries.

Low-tech manufacturing still exerts a negative effect, which is consistent with what we found in our previous specification. Natural resources, while maintaining a negative sign, do not seem to have any significant impact on export share growth, once we control for countries levels of income. This suggests that the negative impact of increasing specialisation in this sector on countries' DVA share depends on income rather than the natural resource sector *per se*. Interestingly, we also find high-tech manufacturing and KIBS to exert positive effects, although only during the crisis years; this suggests that when global demand contracts, this is likely to affect less high-tech manufacturing and KIBS. Concerning the latter, this result is consistent with our findings in Table 1.

While we find no evidence concerning the long-term effect of increasing specialisation in technology and knowledge intensive sectors on countries' export shares, these results suggest that in periods of crisis, such industries may prove to be a beneficial specialisation trajectory.

5. Discussion and concluding remarks

This paper has looked at the effect of the acceleration in the pace of trade specialisation on countries' trade performance. We also explore which sectors provide a beneficial specialisation path.

This paper shows that the emergence of GVCs has increased the divide between domestic productive structure and countries' trade specialisation, as an increasing share of gross exports stems from imported input produced abroad. In order for trade specialisation to be representative of countries' domestic contribution, it is therefore crucial to take a value added approach.

We take such an approach to compute both our specialisation measures and the export shares of each country. This methodological novelty reflects a different theoretical understanding of trade flows that are not the outcome of countries independent production but rather of cross-country interdependencies. This is the result of the fragmentation of production and emergence of GVCs that make gross exports an unreliable measure of countries' domestic production structure. As a consequence, researchers seeking to infer capabilities from countries' export structure should be wary of using gross exports; this is because they would be capturing part of the value added that has been provided by other countries.

This is also very relevant for policy makers designing export-oriented policies that need to ensure that changes in gross export specialisation also drive changes in countries' domestic productive structure.

In addition to this novel view on trade specialisation, which can now be linked to domestic economic structure, we also look at the dynamics of specialisation trajectory and its outcome in terms of export shares.

We find evidence that is, broadly speaking, in line with the large literature on manufacturing, in particular the most recent contributions highlighting a potential change in the role of this sector for economic growth. While taking a methodologically different approach, our results support the findings of Szirmai and Verspagen (2015) who look at structural change between 1950 and 2005 and find that "since 1990, manufacturing is becoming a somewhat more difficult route to growth than before" (Szirmai and Verspagen 2015, p.58).

Our results also suggest that countries increasing their specialisation towards low-tech manufacturing are unlikely to see their trade performance improve at a faster rate. This can be because competing in low-tech manufacturing has become harder as China rose to be the world's main manufacturer, exploiting its large endowment in low cost labour.

Another, speculative, explanation could be that before the emergence of GVCs, specialisation in low-tech manufacturing would also foster domestic linkages with the high-tech sectors, whereas now these linkages are across borders, as these two activities no longer need to take place in the same country or region.

Concerning high-tech manufacturing, we find rather weak evidence that this could be a beneficial specialisation pattern, since we only detect positive effects when looking at the crisis period and accounting for income differences across countries.

High-tech manufacturing is usually considered a sector with fast productivity growth, although in the last decade its effects on growth seem to be fading (Rodrik 2015a; Szirmai and Verspagen 2015; Szirmai 2012). From a development standpoint, high-tech manufacturing may prove to be a difficult industry in which to specialise, as can be seen in Figure 3, because it is likely to have higher barriers to entry. In addition, one could wonder how big a share of labour this sector will be able to absorb, especially in developing countries. This may explain why we find no significant results for high-tech manufacturing when we do not take into account income differences across countries.

Finally, a novel aspect of this research is the inclusion of services, that tend to be often exported indirectly, i.e. embodied in manufacturing exports, and for which our value added approach is particularly suited.

Services have traditionally been considered less dynamic by the literature on structural change and economic development (Baumol, 1967; Rodrik, 2013; Timmer, de Vries and de Vries, 2014), although an emerging stream of research has been looking at the off-shoring of services towards developing countries, as a consequence of the emergence of service GVCs, in a rather optimistic way (Gary Gereffi and Fernandez-Stark 2010).

Our results offer no strong evidence in support of the idea that increased specialisation in KIBS may be beneficial to countries' export performance in the long run. We find, as for high-tech manufacturing, a positive effect only during the crisis years. Overall, this evidence seem to justify Rodrik's concern about what he refers to as premature de-industrialisation of developing countries (Rodrik 2015a, 2015b).

Our results are somewhat weakened by the high level of aggregation and relatively short time span covered by our data. Taking stock on this, future research should look at more disaggregated sectors over longer time periods.

Exploring trade in value added at a more granular level is crucial because trade is involving more and more intermediates, and production is increasingly being fragmented across countries in terms of tasks rather than products (Grossman and Rossi-Hansberg 2006; Lanz et al. 2011): working with aggregated manufacturing and services categories may hide substantial differences. An additional advantage of focusing on tasks across sectors is that this allows exploring the relationship between the fragmentation of production and employment related issues such as skills requirement and wages. Unfortunately there is still a lack of reliable data to explore these issues at a high level of disaggregation both in high-income and especially in developing countries.

Moreover, the increasing fragmentation of production across countries, and the blur of the divide between manufacturing and services, brings up the issue of domestic inter-sectoral linkages. This in turn raises the question of the relationship between domestic economic structure and GVC participation and performance, which should also be explored by future work.

References

Amable, B. (2000) 'International specialisation and growth', *Structural Change and Economic Dynamics*, 11(4), pp. 413–431.

Anderson, J. E. *et al.* (2013) *Dark Costs, Missing Data: Shedding some Light on Services Trade*, *Journal of Chemical Information and Modeling*.

Arellano, M. and Bond, S. (1991) 'Some Tests of Specification for Panel Data: Monte Carlo Evidence and an Application to Employment Equations', *The Review of Economic Studies*, 58(2), pp. 277–297.

De Backer, K. and Miroudot, S. (2013) *Mapping Global Value Chains*, *OECD Trade Policy Papers*. 159.

Bah, E. M. (2011) 'Structural Transformation paths across countries', *Emerging markets Finance and Trade*, 47(2), pp. 5–19.

Balassa, B. (1965) 'Trade Liberalisation and "Revealed" Comparative Advantage', *The Manchester School*, 33(2), pp. 99–123.

Balassa, B. (1978) 'Exports and Economic Growth', *Journal of Development Economics*, 5, pp. 181–189.

Baldwin, Richard (2011) *Trade and Industrialization after Globalization's 2nd Unbundling: How Building and Joining a Supply Chain Are Different and Why It Matters*. NBER Working Paper 17716.

Baldwin, R. (2012) *Global Supply Chains: Why They Emerged, Why They Matter, and Where Ther Are Going*.

Baldwin, R. and Lopez-Gonzalez, J. (2013) *Supply-Chain Trade: a portrait of Global Patterns and Several Testable Hypotheses*, *Zhurnal Eksperimental'noi i Teoreticheskoi Fiziki*. 18975. Cambridge MA.

Baldwin, R. and Robert-Nicoud, F. (2014) 'Trade-in-goods and trade-in-tasks: An integrating framework', *Journal of International Economics*. Elsevier B.V., 92(1), pp. 51–62.

Banga, R. (2014) 'Linking int Global Value Chains Is Not Sufficient : Do You Export Domestic Value Added Contents?', *Journal of Economic Integration*, 29(2).

Baumol, W. J. (1967) 'Macroeconomics of Unbalanced Growht: the Anatomy of Urban Crisis', *American Economic Review*, 57(3), pp. 412–426.

Blundell, R. and Bond, S. (1998) 'Initial conditions and moment restrictions in dynamic panel data models', *Journal of Econometrics*, 87, pp. 115–143.

Bustos, B. P. (2015) 'Trade Liberalization , Exports , and Technology Upgrading : Evidence on the Impact of MERCOSUR on Argentinian Firms', *American Economic Review*, 101(1), pp. 304–340.

Evangelista, R., Lucchese, M. and Meliciani, V. (2015) 'Business services and the export performances of manufacturing industries', *Journal of Evolutionay Economics*, 25, pp. 959–981.

Fagerberg, J. (1988) 'International Competitiveness', *The Economic Journal*. doi: 10.2307/2233372.

Feder, G. (1982) 'On Exports and Economic Growth', *Journal of Development Economics*, 2, pp. 59–73.

Felipe, J. *et al.* (2012) 'Product complexity and economic development', *Structural Change and Economic Dynamics*. Elsevier B.V., 23(1), pp. 36–68. doi: 10.1016/j.strueco.2011.08.003.

Gereffi, G. (1994) 'The organization of buyer-driven global commodity chains: How U.S. retailers shape overseas production networks', in *Commodity Chains and Global Capitalism*. Westport, CT: Praeger, pp. 95–122.

Gereffi, Gary and Fernandez-Stark, K. (2010) *The Offshore Services Global Value Chain*.

Gereffi, G and Fernandez-Stark, K. (2010) 'The Offshore Services Value Chains. Developing Countries and the Crisis', *The World Bank Policy Research Working Papers*, 5262, pp. 1–31.

Gereffi, G., Humphrey, J. and Sturgeon, T. (2005) 'The governance of global value chains', *Review of International Political Economy*, 12(1), pp. 78–104.

Grossman, G. and Rossi-Hansberg, E. (2006) *The Rise of Offshoring: It is not Wine for Cloth Anymore*.

Guerrieri, P. and Meliciani, V. (2005) 'Technology and international competitiveness: The interdependence between manufacturing and producer services', *Structural Change and Economic Dynamics*, 16(4), pp. 489–502.

Haraguchi, N. (2014) *Patterns of Structural Change and Manufacturing Development*.

Harvey, D. I. *et al.* (2010) 'The Prebisch-Singer Hypothesis: Four Centuries of Evidence', *The Review of Economic Statistics*, 92(2), pp. 367–377.

Hausmann, R. and Hidalgo, C. a. (2011) 'The network structure of economic output', *Journal of Economic Growth*, 16(4), pp. 309–342.

Hausmann, R., Hwang, J. and Rodrik, D. (2007) 'What you export matters', *Journal of Economic Growth*, 12(December 2006), pp. 1–25.

Hausmann, R. and Klinger, B. (2007) *The Structure of the Product Space and the Evolution of Comparative Advantage*. CID Working Paper, Harvard University

Hernandez, R. *et al.* (2014) *Latin America ´ s emergence in global services*. Santiago: Economic Commission for Latin America and the Caribbean (ECLAC).

Hidalgo, C. A. *et al.* (2007) 'The Product Space Conditions the Development of Nations', *Science*, 317, pp. 482–487.

Hidalgo, C. A. and Hausmann, R. (2009) 'The Building block of Economic Complexity', in *The Health service journal*, p. 15.

Hirschman, A. O. (1958) *Strategy of economic development*. New Haven, Connecticut and London: Yale University Press.

Hobday, M. (2015) 'Editor's introduction : The scope of Martin Bell's Contribution', *Asian Journal of Technology Innovation*, 15:2(November).

Johnson, R. C. (2017) 'Measuring global value chains', *NBER Working Paper Series*.

Kaldor, N. (1968) 'Productivity and Growth in Manufacturing Industry: a Reply', *Economica*, 35(140), pp. 385–391.

Kaplinsky, R. (2004) 'Sustaining income Growth in a Globalising World: the Search for the Nth Rent', (January).

Kim, L. (1980) 'Stages of Development of Industrial Technology in a Developing Country : a Model', *Researc Policy*, 9, pp. 254–277.

Kim, L. and Lee, J. (1987) 'Korea ' s Entry into the Computer its Acquisition of Technological Industry and Capability', *Technovation*, 6, pp. 277–293.

Koopman, R. *et al.* (2010) *Give credit where credit is due: Tracing value added in global production chains* NBER Working Paper 16426.

Koopman, R., Wang, Z. and Wei, S. (2014) 'Tracing Value-Added and Double Counting', *American Economic Review*, 104(2), pp. 459–494.

Kowalski, P. *et al.* (2015) 'Participation of Developing Countries in Global Value Chains', OECD Trade Policy Paper 179.

Lanz, R., Miroudot, S. and Nordås, H. K. (2011) 'Trade in Tasks', OECD Trade Policy Paper 117.

Lederman, D. and Maloney, W. F. (2012) *Does What You Export Matter ? In Search of Empirical Guidance for Industrial Policies*. Washington DC: World Bank.

Lee, J. (2011) 'Export specialization and economic growth around the world', *Economic Systems*. Elsevier B.V., 35(1), pp. 45–63.

Lee, K., Jee, M. and Eun, J.-H. (2011) 'Assessing China's Economic Catch-Up at the Firm Level and Beyond: Washington Consensus, East Asian Consensus and the Beijing Model', *Industry & Innovation*, 18(5), pp. 487–507.

Lopez-Gonzalez, J., Meliciani, V. and Savona, M. (2015) *When Linder Meets Hirschman: Inter-Industry Linkages and Global Value Chains in Business Services*, *SPRU Working Papers*. 2015–20.

Marin, D. (1992) 'Is the Export-Led Growth Hypothesis Valid for Industrialised Countries?', *The Review of Economic Statistics*, 74(4), pp. 678–688.

Matsuyama, K. (1992) 'Agricultural productivity, comparative advantage, and economic growth', *Journal of Economic Theory*, 58(2), pp. 317–334.

Matsuyama, K. (2008) 'Structural Change in an Interdependent World: a Global View of Manufacturing Decline' 2008', pp. 1–11.

Mcmillan, M., Rodrik, D. and Verduzco-Gallo, I. (2014) 'Globalization, Structural Change and Productivty Growth, with an Update on Africa', *World Development*, 63, pp. 11–32.

Di Meglio, G. *et al.* (2018) 'Services in developing economies: The de-industrialization debate in perspective.', *Development and Change.*, Forthcomin(649186), pp. 1–31.

Meliciani, V. and Savona, M. (2014) 'The Determinants of Regional Specialisation in Business Services. Agglomeration Economies, Vertical Linkages and Innovation', *The Journal of Economic Geography*.

OECD (2013) *Implications of Global Value Chains for Trade, Investment, Development and Jobs.*

Rivera Batiz, L. and Romer, P. M. (1991) 'Economic Integration and Endogenous Growth', *Quarterly Journal of Economics*, 106(May), pp. 531–556.

Rodrik, D. (2013) 'Unconditional convergence in manufacturing', *Quarterly Journal of Economics*, 128(1), pp. 165–204.

Rodrik, D. (2015a) *An African Growth Miracle?*, *NBER Working Paper Series*. 20188.

Rodrik, D. (2015b) *Premature Deindustrialization*, *NBER Working Paper Series*. 20935.

Szirmai, A. (2012) 'Industrialisation as an engine of growth in developing countries, 1950-2005', *Structural Change and Economic Dynamics*. Elsevier B.V., 23(4), pp. 406–420.

Szirmai, A., Naudé, W. and Haraguchi, N. (2012) *Structural Change, Poverty Reduction and Industrial Policy in the BRICS*.

Szirmai, A. and Verspagen, B. (2015) 'Manufacturing and economic growth in developing countries , 1950 – 2005', *Structural Change and Economic Dynamics*. Elsevier B.V., 34, pp. 46–59.

Thirlwall, A. P. (1979) 'The Balance of Payments Constraint as an Explanation of International Growth Rate Differences', *BNL Quarterly Review*, 32(128), pp. 45–53.

Timmer, M. P., de Vries, G. and de Vries, K. (2014) *Patterns of Structural Change in Developing Countries*. GGDC Research Memorandum 149, University of Groningen.

Timmer, M. P. and de Vries, G. J. (2009) 'Structural change and growth accelerations in Asia and Latin America : a new sectoral data set', *Cliometrica*, 3, pp. 165–190.

Uchida, Y. and Cook, P. (2005) 'The transformation of competitive advantage in East Asia: An analysis of technological and trade specialization', *World Development*, 33(5), pp. 701–728.

Varela, G. and Hollweg, C. H. (2016) *Services and Manufacturing Linkages : An Empirical Analysis for Lao PDR,* Washington DC: World Bank..

de Vries, G., Timmer, M. and de Vries, K. (2017) 'Structural Transformation in Africa : Static Gains , Dynamic Losses Structural Transformation in Africa : Static Gains , Dynamic Losses', *The Journal of Development Studies*. Routledge, 51(6), pp. 674–688.

Windmeijer, F. (2005) 'A Finite Sample Correction for the Variance of Linear Efficient Two-Step GMM Estimators', *Journal of Econometrics*, 126, pp. 25–51.

Wolfmayr, Y. (2012) 'Export Performance and Increased Services Content in Manufacturing', *National Institute Economic Review*, 220(1), pp. R36–R52.

Appendix 1 – Data and variables

We present here some more detailed information on the data we use, in particular which sectors are included in our four macro-sectors and how we compute our measures.

In Table A1 below we present which sectors have been aggregated into the four sector groups. NR, LTMF and HTMF have been compiled following OECD sector classification.

Table A1: Macro sector groups and ISIC codes

Sector groups	**Included sectors**	**ISIC codes**
KIBS	Computer and related activities; R&D and other business services.	C72, C73T74.
NR	Agriculture, hunting, forestry and fishing; Mining and quarrying.	C01T05, C10T14.
LTMF	Food products, beverages and tobacco; Textiles, textile products, leather and footwear; Wood, products of wood, and cork; Pulp, paper, and paper products; Coke, refined petrol products, and nuclear fuel; Rubber and plastic products; Other non-metallic mineral products; Basic metals; Fabricated metal products; Manufacturing nec and recycling.	C15T16, C17T19, C20, C21T22, C23, C25, C26, C27, C28, C36T37.
HTMF	Chemicals and chemical products; Machinery and equipment; Computer, electric, and optical equipment; Electrical machinery and apparatus; Motor vehicles, trailers, and semi-trailers; Other transport equipment.	C24, C29, C30T33X, C31 C34 C35

Source: REQUIRED

Table A2 below gives the list of countries included in the high-income group in our analysis. As many of our countries become high-income over time, we report in the second column of the table the number of years they are among the high-income countries.

Table A2: High-income countries

Country	Number of years
ARG	1
AUS	17
AUT	17
BEL	17

BRA	1
BRN	17
CAN	17
CHE	17
CHL	2
CYP	17
CZE	7
DEU	17
DNK	17
ESP	17
EST	6
FIN	17
FRA	17
GBR	17
GRC	16
HKG	17
HRV	5
HUN	5
IRL	17
ISL	17
ISR	17
ITA	17
JPN	17
KOR	12
LTU	3
LUX	17
LVA	3
MLT	9
NLD	17
NOR	17
NZL	17
POL	3
PRT	11
RUS	1
SAU	7
SGP	17

SVK	6
SVN	9
SWE	17
USA	17

Note: The second column of the table reports the number of years each country has a GDP per capita above US$ 12,236 and is therefore considered as high-income for the purpose of our empirical analysis.

Source: Author's own calculation using ICIO tables.

The three figures below compare RCAs computed with gross exports and DVA for NR, LTM and HTM respectively. We observe that for all these three sectors, in addition to KIBS (cfr Figure 1), DVA RCAs compared to their gross export homologue do not simply "deflate" the RCA. In contrast, we observe that some countries have higher RCAs when we compute these with DVA compared to gross exports. This offers further support to the view that measuring trade specialisation in DVA changes the distribution of RCAs, and that choosing a value added approach will change the analysis's results.

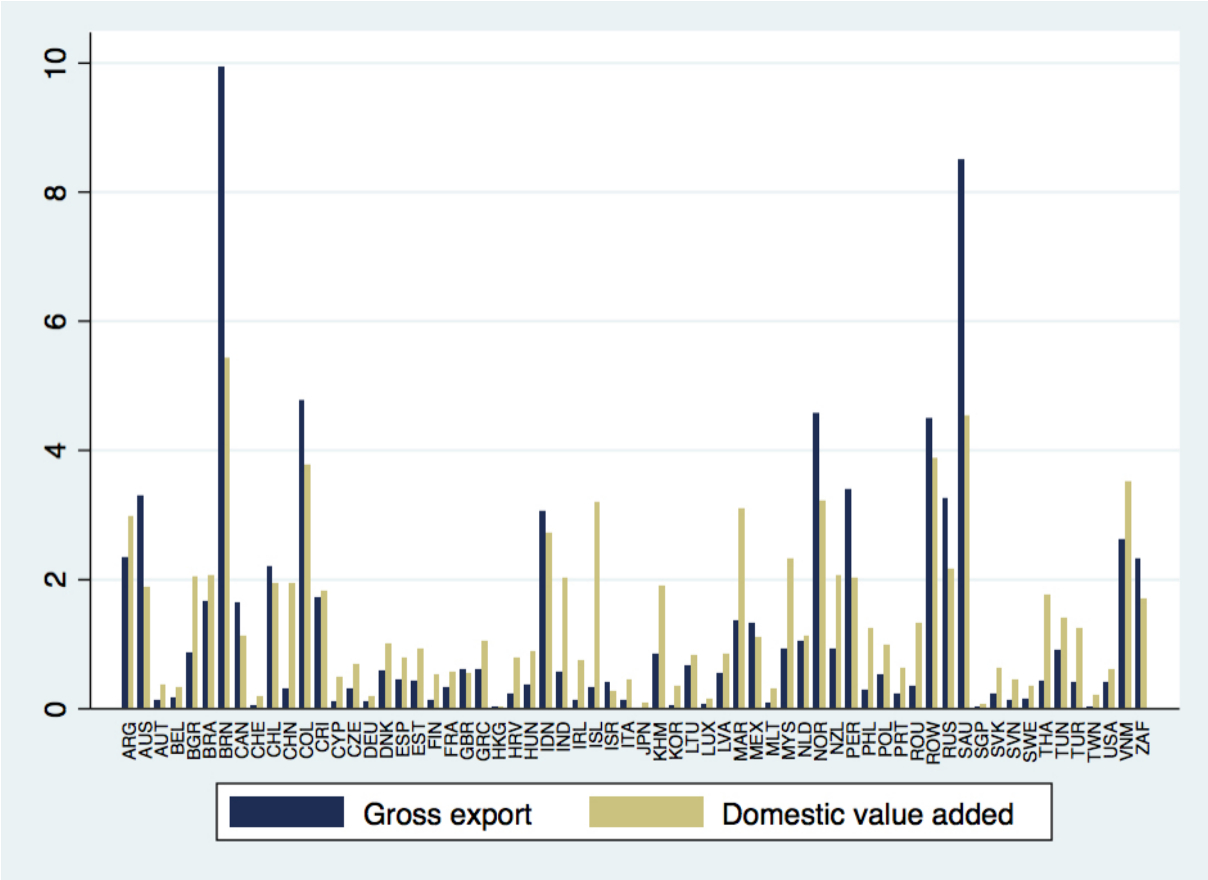

Figure A1.1: Country Average RCA in NR across years in gross exports and domestic value added

Note: Figure A1.1 compares countries' average RCA in NR across years in our sample, using gross exports and domestic value added in exports.

Source: Author's own calculation using ICIO tables.

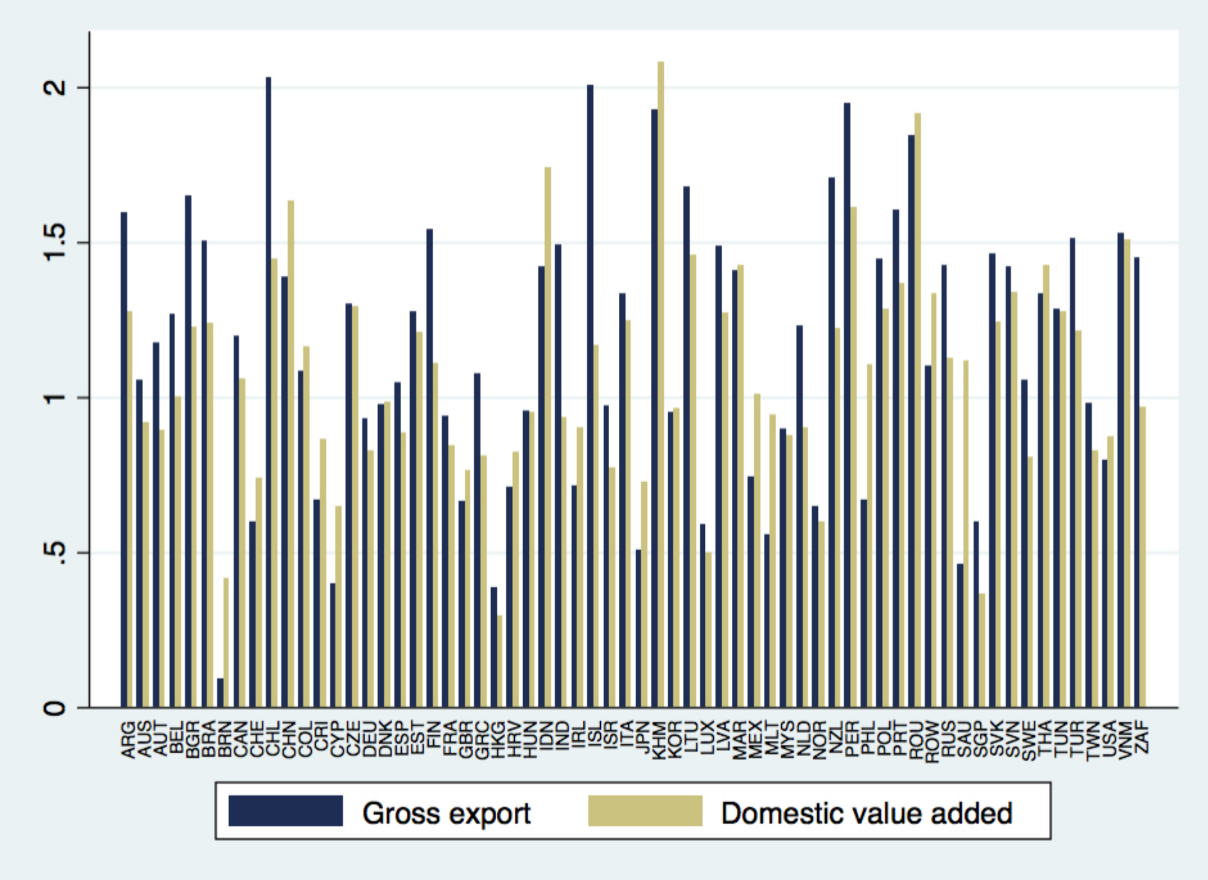

Figure A1.2: Country Average RCA in LTM across years in gross exports and domestic value added

Note: Figure A1.2 compares countries' average RCA in LTM across years in our sample, using gross exports and domestic value added in exports.

Source: Author's own calculation using ICIO tables.

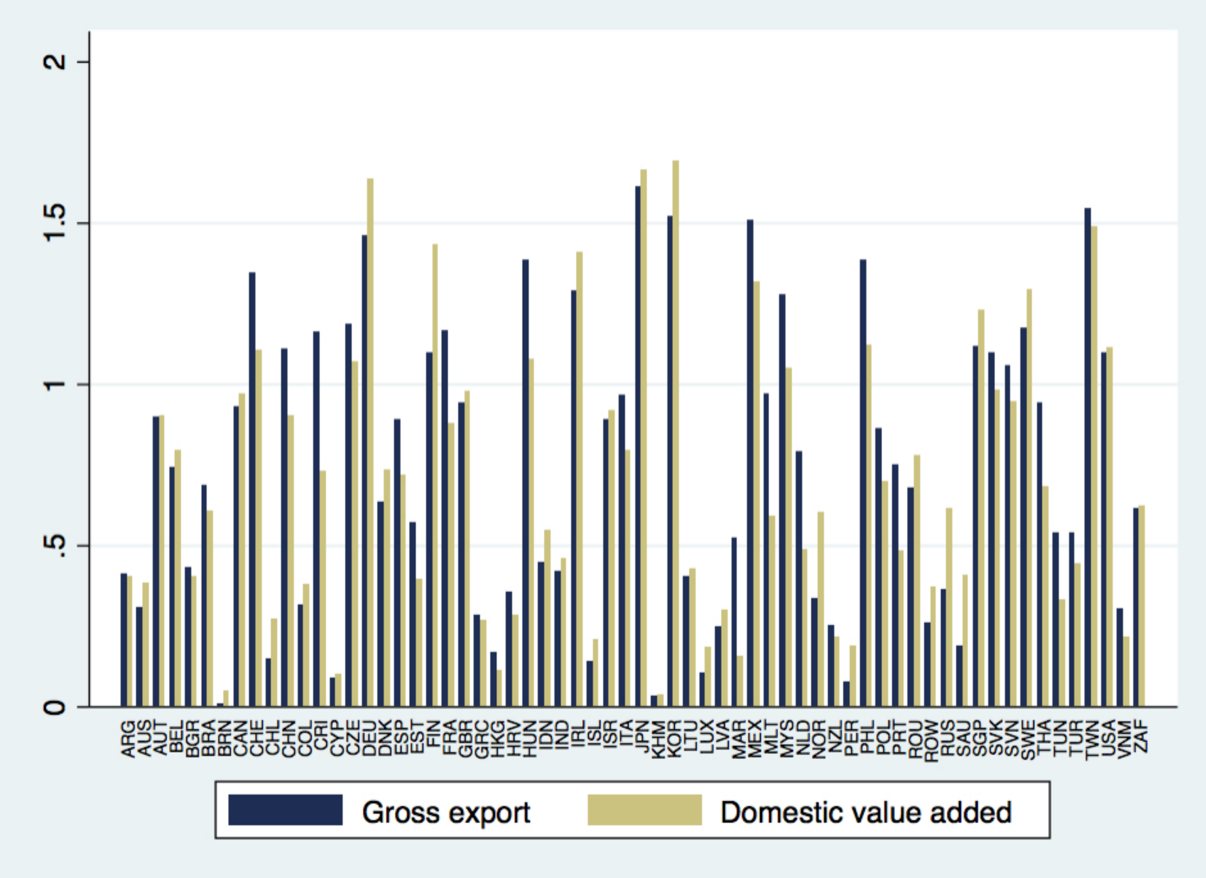

Figure A1.3: Country Average RCA in HTM across years in gross exports and domestic value added

Note: Figure A1.3 compares countries' average RCA in HTM across years in our sample, using gross exports and domestic value added in exports.

Source: Author's own calculation using ICIO tables.

Appendix 2 – Computation of domestic value added in exports

We now turn to how we compute our variables based on value added. The usual formula to look at value added in production is the following:

$$V'BF$$

Where V' is a diagonalised vector of value added shares, B is the usual Leontief inverse that reallocates value added based on the sector of production, and F is a vector of final demand.

If we take an example with three countries, a, b, and c, this can be depicted as follows:

$$\begin{pmatrix} v_a & 0 & 0 \\ 0 & v_b & 0 \\ 0 & 0 & v_c \end{pmatrix} * \begin{pmatrix} b_{aa} & b_{ab} & b_{ac} \\ b_{ba} & b_{bb} & b_{bc} \\ b_{ca} & b_{cb} & b_{cc} \end{pmatrix} * \begin{pmatrix} f_{aa} & f_{ab} & f_{ac} \\ f_{ba} & f_{bb} & f_{bc} \\ f_{ca} & f_{cb} & f_{cc} \end{pmatrix}$$

The letters in subscript refer to countries: when there are two of them it means that value added is flowing from the former to the latter; so b_{ab} is the intermediate demand going from a to b's production, while f_{ab} is the final demand in b triggering production in a. The matrix multiplication above yields:

$$\begin{pmatrix} v_a b_{aa} & v_a b_{ab} & v_a b_{ac} \\ v_b b_{ba} & v_b b_{bb} & v_b b_{bc} \\ v_c b_{ca} & v_c b_{cb} & v_c b_{cc} \end{pmatrix} * \begin{pmatrix} f_{aa} & f_{ab} & f_{ac} \\ f_{ba} & f_{bb} & f_{bc} \\ f_{ca} & f_{cb} & f_{cc} \end{pmatrix}$$

Which in turn is equal to:

$$\begin{pmatrix} v_a b_{aa} f_{aa} + v_a b_{ab} f_{ba} + v_a b_{ac} f_{ca} & v_a b_{aa} f_{ab} + v_a b_{ab} f_{bb} + v_a b_{ac} f_{cb} & v_a b_{aa} f_{ac} + v_a b_{ab} f_{bc} + v_a b_{ac} f_{cc} \\ v_b b_{ba} f_{aa} + v_b b_{bb} f_{ba} + v_b b_{bc} f_{ca} & v_b b_{ba} f_{ab} + v_b b_{bb} f_{bb} + v_b b_{bc} f_{cb} & v_b b_{ba} f_{ac} + v_b b_{bb} f_{bc} + v_b b_{bc} f_{cc} \\ v_c b_{ca} f_{aa} + v_c b_{cb} f_{ba} + v_c b_{cc} f_{ca} & v_c b_{ca} f_{ab} + v_c b_{cb} f_{bb} + v_c b_{cc} f_{cb} & v_c b_{ca} f_{ac} + v_c b_{cb} f_{bc} + v_c b_{cc} f_{cc} \end{pmatrix}$$

In the matrix above, each column represents the final demand of each country across origins. On the other hand, rows indicate the origin of value added across uses, i.e. different final demand and the intermediate demand it goes through.

For example, the first element in the top-left: $v_a b_{aa} f_{aa} + v_a b_{ab} f_{ba} + v_a b_{ac} f_{ca}$ is final demand consumed by a and originated entirely by country a divided as follows:

1. $v_a b_{aa} f_{aa}$ Value added produced and consumed within a, i.e. never exported.

2. $v_a b_{ab} f_{ba}$ Value added produced by *a,* for the production of country *b* that satisfies final demand in *a*, i.e. value added exported and re-imported in *a.*
3. $v_a b_{ac} f_{ca}$ It is the same as 2 but with country *c*.

From the matrix above, the components that are included in our DVA measure are those in bold in the matrix below:

$$\begin{pmatrix} v_a b_{aa} f_{aa} + v_a b_{ab} f_{ba} + v_a b_{ac} f_{ca} & \boldsymbol{v_a b_{aa} f_{ab} + v_a b_{ab} f_{bb} + v_a b_{ac} f_{cb}} & \boldsymbol{v_a b_{aa} f_{ac} + v_a b_{ab} f_{bc} + v_a b_{ac} f_{cc}} \\ \boldsymbol{v_b b_{ba} f_{aa} + v_b b_{bb} f_{ba} + v_b b_{bc} f_{ca}} & v_b b_{ba} f_{ab} + v_b b_{bb} f_{bb} + v_b b_{bc} f_{cb} & \boldsymbol{v_b b_{ba} f_{ac} + v_b b_{bb} f_{bc} + v_b b_{bc} f_{cc}} \\ \boldsymbol{v_c b_{ca} f_{aa} + v_c b_{cb} f_{ba} + v_c b_{cc} f_{ca}} & \boldsymbol{v_c b_{ca} f_{ab} + v_c b_{cb} f_{bb} + v_c b_{cc} f_{cb}} & v_c b_{ca} f_{ac} + v_c b_{cb} f_{bc} + v_c b_{cc} f_{cc} \end{pmatrix}$$

This is achieved by computing a vector of export for each country *i* that includes only final demand from other countries, and is multiplied by the V'B matrix, selecting then only the relevant rows belonging to country *i*.

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Suggested citation:

Filippo Bontadini (2019). Trade Specialisation and Performance in Global Value Chains. SPRU Working Paper Series (SWPS), 2019-10: 1-36. ISSN 2057-6668. Available at: www.sussex.ac.uk/spru/swps2019-10

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