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Testing the Smile Curve:

Functional Specialisation in GVCs and Value Creation

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Abstract

According to the ‘smile curve hypothesis’ the potential for generating value added varies significantly across the various functions along a firm’s value chain. It suggests in particular that the production stage is the least promising value chain function in the entire manufacturing process. This logic implies that countries specialising as ‘factory economies’ are likely to generate comparatively little value added. To shed light on the relationship between functional specialisation along the value chain and value creation, this paper develops measures for functional specialisation derived from project-level data on greenfield FDI for a global sample of countries. These measures keep the industry and the functional dimension of specialisation strictly apart. They are used to test econometrically the negative relationship between value added creation and functional specialisation in production predicted by the smile curve hypothesis.

Keywords: functional specialisation, global value chains, smile curve, factory economy, greenfield FDI

JEL classification: F60, L23, F20

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1. Introduction

The emergence of global production networks gave rise to an ever more granular international division of labour. In particular it led to a geographically-dispersed production spread across a number of different locations to fabricate manufactured goods. This mode of production, which has received various labels such as fragmentation of production (Jones and Kierzkowski, 1990, 2001) or the second unbundling (Baldwin, 2014), added a new dimension of international specialisation to the usual specialisation in industries or sectors. In line with the recent literature (e.g. Timmer et al., 2018), I shall refer to this new dimension of specialisation as functional specialisation, which implies the assignment of the different value chain functions that are required for the production process of a manufacturing good to different countries or regions.

These value chain functions may be thought of as 'tasks' as in Grossman and Rossi-Hansberg (2008) but they are more concrete as I shall define these functions akin to those in the value chain model developed by Porter (1985). Therefore the framework of this paper emphasises the fragmentation of the production process of one particular product into tasks as opposed to a sequence of productions often associated with vertical specialisation (Hummels et al., 2001). [1] As this is a crucial point, an example may help illustrating the conceptual difference. Let's imagine the manufacturing process for a car as represented in Figure 1. The concept of functional specialisation, followed in this paper, is concerned with the identification of the value chain functions (e.g. R&D, production or logistics) each country or region is performing in the manufacturing process of that car. In contrast, when highlighting the vertical dimension of specialisation, the main interest is typically to trace back (or forward) the sequence of the production processes that finally make up a car. This approach focus on the origin of the value added contributions of industries related to the car industry such as the mining industry or the metallurgy industries (and many more), typically differentiating also by the country of origin[2]. Such analyses also provide deep insights into trading patterns and the internationalisation of production but they are not the subject of this paper.

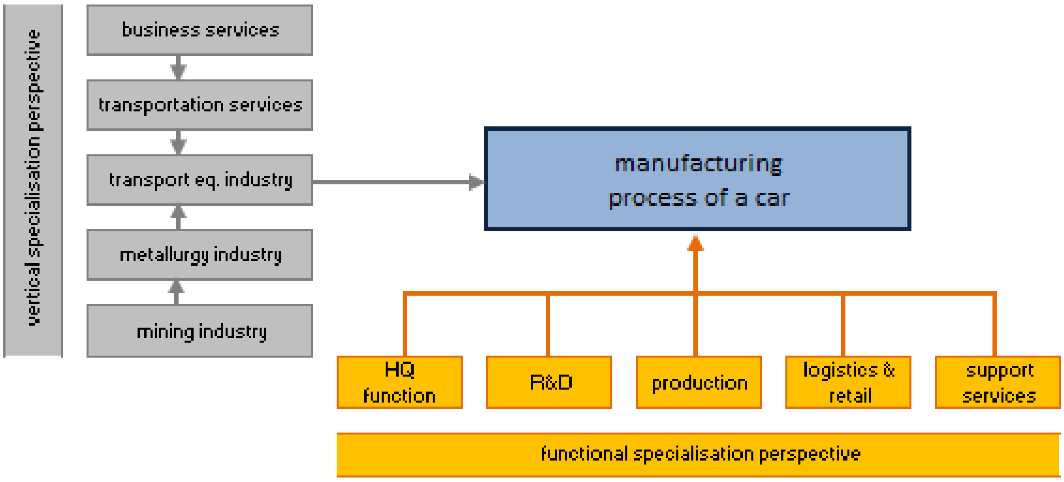
Rather this paper studies the functional specialisation patterns of countries in the context of what has been labelled the smile curve hypothesis. The essence of the smile curve hypothesis is that value chain functions differ in their potential for generating value added. It asserts that within manufacturing supply chains there is typically more potential for value added generation in the knowledge-intensive pre-production stages (such as R&D or design) and some post-production services (e.g. branding and retail) than in the actual production stage. This proposition originates from detailed analyses of the electronics industry by the former CEO of the Taiwanese IT company Acer, Stan Shih (see Shih, 1996), and has become something like a stylised fact in the business literature. In contrast, the economic literature on the smile curve is still underdeveloped (Baldwin et al., 2014) despite the recent contributions by Rungi

1 This is the reason why this paper prefers the term functional specialisation over the term vertical specialisation (Hummels et al., 2001) because the latter typically refers to a sequence of production processes involving raw materials, intermediate goods and final goods.

2 The common methodology for this is to use international input-output tables.

and Del Prete (2018) and Timmer et al. (2018) where the latter one, to my knowledge, is the only one to also focus on the functional dimension of the value chain in the sense described above.

Figure 1 / Functional fragmentation and vertical fragmentation of a car manufacturing process



Note: HQ=headquarter functions
Source: Own elaboration.

This paper contributes to the 'smile curve economics' in three ways. Firstly, it uses granular, that is project-level, data on greenfield FDI data which contains information not only on the industry of the transaction but also on the 'activity' that the project serves. These activities are mapped into five value chain functions which resemble those in Porter's value chain analysis. More precisely, these five functions are headquarter services; R&D; production activities; logistics and retail services; and support services.

Secondly, based on this mapping which is done at the project level, the data is aggregated to the country-industry level which allows the calculation of a measure for the relative functional specialisation (*RFS*) in GVCs. These *RFS* in GVCs are used to draw functional profiles of countries as a whole and of individual industries within countries. Methodologically, this *RFS* index is a simple Balassa index used for the identification of revealed comparative advantages but applied to value chain functions instead of goods (or industries). It should be emphasised once more that the analysis of the functional dimension is kept strictly apart from the industry dimension. This way it is possible to identify the *RFS* index not only at the country level but also at the country-industry level. Since my functional specialisation measure is based on greenfield FDI data, the *RFS* in GVCs, it can be seen as complementary to the trade-based functional specialisation index in Timmer at al. (2018) which is derived from jobs embodied in trade. If it is true that 21th century trade is characterised by a trade-investment-services nexus (Baldwin, 2011), the FDI-based *RFS* in GVCs should be an important complement.

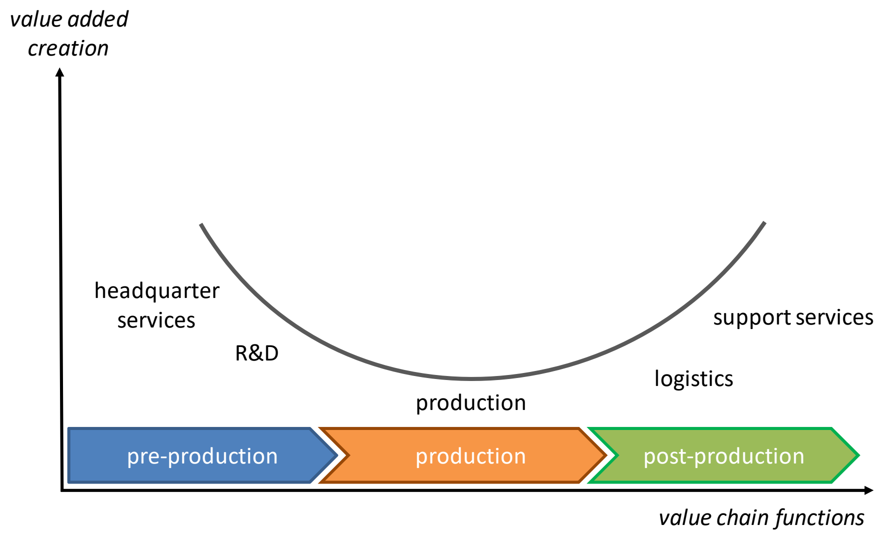
The third contribution of the paper is an econometric test of the smile curve hypothesis. To this end the *RFS* index is compressed into a one-dimensional measure for the extent of specialisation in the value chain function production for each country-industry. Denoting this measure as the relative production specialisation index (*RPSI*), it is possible to estimate the impact of a high degree of specialisation in production activities on the extent of value added capture.

The reminder of the paper is structured as follows. Section 2 revisits the key arguments of the 'smile curve economics', followed by the explanation of the key measures for functional specialisation as well as the main data sources in Section 3. Section 4 proceeds by presenting some of the functional profiles of countries of the EU, NAFTA and East Asia. Section 5 is dedicated to the empirical growth model and the main results. Section 6 concludes.

2. Economic rationale behind the smile curve

Smile curve economics does not represent a unified theoretical framework (yet). It is rather a concept that summarises a key empirical result from (mainly business literature) studies. A regular finding of these studies is that the potential for value creation varies considerably across the value chain of a manufacturing process, with the actual production segment, including assembly, typically capturing comparatively little value added (e.g. Mudambi, 2008; Shin et al., 2012; Milberg and Winkler, 2013). Generally, speaking the pre-production activities, including various headquarter services, and the post-production services create more value added. Plotting the value chains functions in their sequence against the value added to be earned yields the famous smile curve (Figure 2).

Figure 2 / The smile curve (schematic representation)



Source: Own elaboration inspired by Mudambi (2008).

Variations in the potential for value added capture across functions have gained in importance in times of global value chains. This is because as long as all value chain functions are performed by a firm in the same location, all countries will perform all these functions in similar amounts within an industry, as long as the production technologies are not entirely different. However, with the emergence of international production networks and the associated offshoring of individual value chain functions this has changed. International production networks operate on the basis of vertical FDI or outsourcing to (legally) independent firms and opened up the possibility for functional specialisation of countries. Put differently, with geographic fragmentation in place, the functional specialisation of countries is tightly related to and to a large extent determined by offshoring activities by multinational enterprises (MNEs). From this follows a heightened importance of the smile curve concept because, if its central proposition holds true, functional specialisation determines to a large extent the gains that individual countries can reap from this additional dimension of the international division of labour.

It is generally accepted that the geographic fragmentation of the value chain (Jones and Kierzkowski, 1990, 2001) has become feasible thanks to improved information and communication technologies which have lowered the co-ordination costs associated with offshoring (Baldwin, 2011; Baldwin 2013). And while technological progress made offshoring possible, it is the existence of large differences in wage costs between countries made it profitable (Jones and Kierzkowski, 1990). Both elements are related to the smile curve hypothesis and its increased importance in time of fragmented production.

To begin with, even with lowered co-ordination costs of offshoring (Baldwin and Robert-Nicoud, 2014), there is still a need for managing and controlling the geographically-dispersed value chain which requires particular skills and expertise. These management capabilities are typically found in large MNCs, so-called lead firms, and are not easy to emulate. Managing the production network is an essential headquarter functions. Together with property rights and intangible assets such management and general organisational capabilities form part of what in the OLI-paradigm is termed ownership-specific advantages (Dunning, 1977). For this reason, Wade (2018, p. 539) argues that *'Western, especially American, firms occupy the commanding heights of GVCs'*.

The key economic implication of such ownership-specific advantages is that, exactly because they are difficult to obtain, there is comparatively little competition in these activities. These would concern both pre-production functions of the value chain, i.e. headquarter services and R&D as well as several post-production activities. Given the relatively lower degree of competition, large economic rents accrue to knowledge-intensive and organisationally complex activities (Kaplinsky, 2010). R&D is a case in point as the protection of intellectual property rights convey temporary monopoly rents to innovators. Moreover, R&D is a costly, high-risk activity. For this reason, multi-country endogenous growth models predict that R&D activities are economically-viable only in the technologically most advanced countries (e.g. Howitt, 2000; Howitt and Mayer-Foulkes, 2005). From a system theoretical approach this is due to the fact that in their R&D activities, firms have to rely on and benefit from the National Innovation System (Pavitt, 1995) of the country in which they operate.

In the smile curve concept this line of argumentation implies that countries specialising in the knowledge-intensive pre-production activities reap high economic rents which lead to high profits and allows paying higher wages. In sum, this results in high value added capture. Consequently, since firms in developed countries have a large share of intangible assets under their control – be it in the form of legally defensible rents as in the case of patents, copyrights and brands or in inimitable organisational structures – they will specialise in the high value added function in the pre-production segment of the value chain (Mudambi, 2008). Note that this is fully in line with the idea maintained before that countries' specialisation reflects their comparative advantages, taking into account the existence of economic rents.

Let's turn to the situation of countries with abundant endowment of unskilled labour. For these countries the emergence of GVCs facilitates their entry into new manufacturing industries, including into technology-intensive industries. The reason is that with international production networks in place, it suffices for a country to master a segment of the production process only instead of having to acquire the entire range of capabilities needed for the manufacturing process of a product (Collier and Venables, 2007). For firms in low and middle income countries these segments will typically be labour-intensive production activities, including final assembly.

The flipside of this GVC-induced refinement in the division of labour is that the easier entry into manufacturing activities led to a 'commodification' of manufacturing production. This is because assembly and other simple production activities can be performed by a wide array of firms in almost any country. According to Kaplinsky (2010) this development has contributed to the relative decline in the terms of trade of manufactures, especially those of developing countries. Therefore the growing competition among low wage countries for the technologically-less challenging segments of the value chain in manufacturing industries – mainly production itself – can be seen as a contemporary version of the Prebisch-Singer dilemma (Milberg and Winkler, 2013; Szalavetz, 2017). Increased competition and a decline in the terms of trade tend to squeeze the profit margins of firms involved in simple production activities and wages will reflect marginal productivity yielding comparatively little value added.

The main distinguishing feature between high and low value added functions is therefore the varying degree of competition in the realm of R&D and headquarter functions (as well as post-production services such as branding or retail) on the one hand and (commodified) production activities on the other hand.

These arguments are at the heart of the smile curve hypothesis, i.e. that production activities are the least promising part of a manufacturing firm's value chain. There is also ample evidence from case studies on specific GVCs suggesting that countries may end up being specialised in unfavourable segments of the value chain with little potential for capturing value added (Sturgeon and Memedovic, 2011; Kaplinsky, 2005; Kaplinsky and Farooki, 2010)[3].

Hence, with a slight risk of oversimplifying the matter, the functional division of labour can be characterised in the following way: in line with their capabilities and comparative advantages, developing countries will engage in the more or less routine-tasks in manufacturing production facing stiff competition and generating little value added. In contrast, developed countries use their technological leadership and comparative advantages in knowledge and intangible assets to specialise in headquarter functions, R&D and profitable post-production services including retail services. The technological asymmetry in international production networks has also been pointed out by Baldwin and Lopez-Gonzalez (2015, p. 1696), noting that *'the headquarter economies […] arrange the production networks'* while *'factory economies provide the labour'*. I shall use this terminology in the discussion of the functional profiles of countries as they emerge from their *RFS*[4].

Hence, despite the lack of a unified theoretical framework for the 'smile curve economics', the existing differences in the degree of competition and the asymmetric distribution of rents are strong arguments that can explain the varying potentials for capturing value added along the value chain that have been identified in case studies (see e.g. Mudambi, 2008).

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3 Note that formal models of offshoring (e.g. Baldwin and Robert-Nicoud, 2014; Grossman and Rossi-Hansberg, 2008) the issue of economic rents is largely absent. This is mainly due to the assumption of perfectly competitive markets and the optimal degree of offshoring in each industry to a point where the marginal costs of offshoring equals the cost-savings resulting from the wage differential between the offshoring country and the destination of offshoring. However, Deardorff (2001) provides a theoretical framework in which internationally fragmented production can lead to factor price divergence with wages falling in the 'South' but rising in the 'North'. This pattern *can* emerge if fragmentation of production leads to production in different diversification cones. While wages are not the only determinant of value added capture, they are still an important part, especially in labour abundant activities.

4 Note that there is some similarity between this characterisation of the international division of labour with those of core-periphery frameworks in dependency theory (Prebisch, 1950) and world system analysis (e.g. Wallerstein, 1974; 2004).

3. Capturing functional specialisation in GVCs

This paper suggests a novel approach to pinpoint the functional specialisation patterns in GVCs of countries. At the core of this approach are project level data from the fDi Markets crossborder investment monitor database maintained by the Financial Times Ltd.[5] This database records individual crossborder greenfield investment projects[6] by multinational enterprises (MNEs) globally by host country. Importantly, the fDI crossborder investment monitor database does not only contain information on the industry of the newly established enterprise but also on the activity it serves. This is the essential feature of the database because these activities can be mapped into value chain functions. More precisely, the activities are grouped into five functions. These functions are *(i)* R&D, *(ii)* headquarter services, *(iii)* production, *(iv)* logistics and retail services and *(v)* support services[7]. The former two – R&D and headquarter services – constitute pre-production activities, while logistics and retail services and after-sales services are post-production activities.

The functional assignment of projects is undertaken for all projects in manufacturing industries plus some business-related services industries which are directly linked to manufacturing such as Software & IT services or logistics and transportation services[8]. Overall the sample of crossborder greenfield projects comprises 91,324 observations, mainly from manufacturing industries (NACE 10 to 32), enriched with some greenfield FDI projects in closely related services industries such as land transport (49), warehousing (52), legal and accounting activities, telecommunications services (61), computer programming (62), activities of head offices (69), architectural and engineering activities (70); scientific research and development (71) and advertising and market research (72). Figure 3 presents the functional break-up of the number of greenfield FDI projects undertaken globally over the period 2003 to 2015. As can be seen the value chain function production is the largest of the five categories followed by the two post-production activities whose importance has been increasing over time.

The functional distribution of projects matters for the measurement of countries' functional specialisation. This is because I use a relative measure of functional specialisation. That is, the share of projects in a particular function (e.g. R&D) in a country is normalised with the global average. The rational for using this relative measure is that if one took simply the share of projects in each of the functions, almost all countries would show a specialisation in production activities. Hence, functional shares are expressed relative to those of the world and are labelled the relative functional specialisation (*RFS)* measure.

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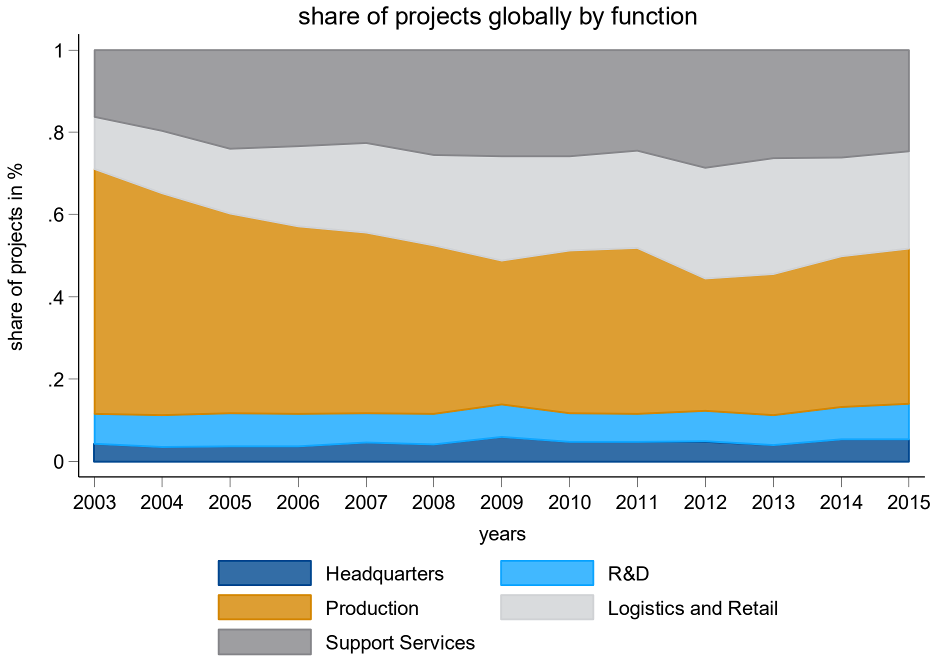
5 See: http://www.ftspecialist.com/fdi_markets.html.

6 The database only records new investment projects referred to as greenfield investments as well as major extensions of existing projects. The records reflect the announcement of new investments. Hence, it may well be that some of the projects do not materialise. According to the Financial Times Ltd. the database is regularly updated and cleaned from unrealised projects. In order minimise the number of projects which in the end do not materialise, the sample period is limited to 2015 despite the fact that data until 2018 would be available.

7 See Appendix 1 for details of the mappings.

8 For the details on all included NACE Rev. 2 industries see Appendix 1.

Figure 3 / Share of global FDI greenfield investments by value chain function, 2003-2015



Source: fDi markets; own calculations.

More formally, the *RFS* measure of any country *c* in value chain function *f* is defined as:

$$RFS_c^f = \frac{p_c^f / p_c}{p_{world}^f / p_{world}}.$$

where p_c^f is the number of projects serving function *f* in country *c* and p_c is the total number of projects realised in country *c* and analogously for the world.

Importantly, the *RFS* is also calculated at the country-industry level. For this, the analysis is limited to ten industries – those with the largest number of observations[9]. Analogously to the country level, the RFS at the country-industry level is defined as

$$RFS_{c,i}^f = \frac{p_{c,i}^f / p_{c,i}}{p_{world,i}^f / p_{world,i}}$$

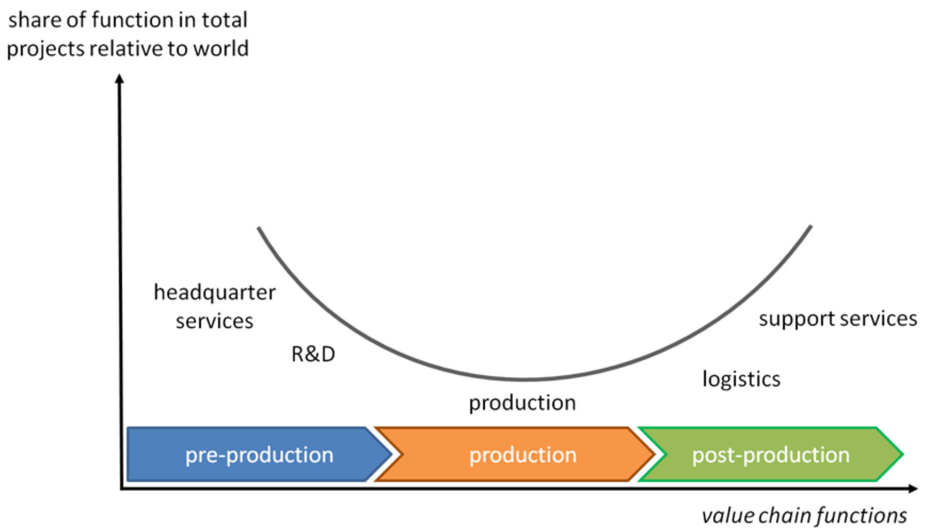
where *i* indicates industries.

9 For the industry-level analysis, the sectors and sub-sectors indicated in the fDi crossborder monitor database had to be mapped to NACE industries. See Appendix 1 for details.

This relative functional specialisation measure is methodologically identical to the concept of revealed comparative advantages in the trade literature (see Balassa, 1965). The essential difference is though that it is applied to inward FDI (instead of exports) and that it is defined on the basis of value chain functions (instead of industries). Since the information on the functions is derived from the activities that foreign-owned subsidiaries are performing, the *RFS* is reflecting the functional role in GVCs that countries are assigned by the investment activities of MNCs. At this stage it should be mentioned that the functional division of labour in international production networks may also rely on contract-manufacturing instead of FDI, as is often the case in buyer-driven supply chains. Therefore, driven by data availability, the methodology presented here captures mainly the functional specialisation patterns as they emerge in producer-driven supply chains that rely more on FDI (see Milberg et al., 2014).

The aggregation of the inward greenfield FDI by value chain functions to the country level establishes a link between the firm-level concept of the smile curve and country-level specialisation patterns. Plotting the value chain functions against their relative frequency yields the 'functional profile' of a country which reflects how intensively a host country is used as a location for establishing a greenfield FDI company fulfilling a particular function. For example, a country that specialises functionally in pre-production and post-production functions would have a functional profile that looks similar to the well-known smile curve suggested by Shin (1996) and discussed in Mudambi (2008). Such a case is shown schematically in Figure 4.

Figure 4 / Functional profile of an economy with relative function specialisation in pre and post-production activities



Source: Own elaboration.

The essential difference between the original smile curve (as shown in Figure 2) and the functional profiles based on the *RFS* in Figure 4 is of course that the latter shows a country's share of the respective function relative to that of the world on the vertical axis (instead of the value added). The link between the functional specialisations and the value added creation is established in the econometric analysis in Section 5.

The fact that the *RFS* can be calculated for industries individually makes clear that the methodology indeed treats functions and industries as two distinct dimensions. This makes sense because as pointed out in Timmer et al. (2018), and earlier by Duranton and Puga (2005) in an urban economics context, functions are different from industries and there is no simple one-to-one mapping between the two. Timmer et al. (2018) solve this problem with the help of employment data by occupations which they match with value chain functions. As explained earlier, I retrieve the information of value chain functions directly from greenfield FDI data.

Obviously, the identification of value chain functions is an essential issue in all smile curve related papers. In this respect much of the existing literature such as Baldwin et al. (2014) and Baldwin et al. (2015) derive the functional specialisation of countries from their sectoral specialisation. They rely on inter-country input-output (ICIO) tables to pin down the position of countries and industries along the value chain. Baldwin et al. (2014), for example, investigate how the value added contributions of broad sectors (primary, manufacturing, services) to the exports of South East Asian countries changed between 1985 and 2005. In the case of almost all countries, the value added contributions of the manufacturing sector declined quite strongly with corresponding increases in the services sector as well as partly also in the primary sectors. This methodology also yields a kind of country-level smile curve even though the link to value chain function in this case may be somewhat loose[10].

Another type of country-level smile curves has been developed by Ye et al. (2015) who base their analysis on the concept of 'upstreamness' (Fally, 2011; Antràs et al., 2012). They position industries and countries along their upstreamness which indicates the distance to final consumers and they show the associated value added coefficients. For several industries, such as the Chinese electronics industry, this approach yields a smile curve, indicating that the most upstream and the most downstream industries generate more value added per unit of output than the middle segment. Similarly, Hagemejer and Ghodsi (2017) use the upstreamness index to analyse how the positions of new EU Member States within global value chains have changed over time.

This paper is closest related to Rungi and Del Prete (2018) who estimate the relationship between the value added content in gross output of firms and the upstreamness measure of Antràs and Chor (2013) at the firm level. Using highly disaggregated industry data at the NACE 4-digit industries level, they obtain a quadratic fit between firms' upstreamness measure and their value added coefficients. When visualised, this relationship creates a firm-level smile curve as firms with a medium upstreamness – which can be associated with production activities – capture less value added per unit of output. My econometric model draws upon Rungi and Del Prete (2018) as I also use the value added coefficients as the dependent variable. There is, however, a crucial methodological difference between the contribution by Rungi and Del Prete (2018) and this paper with regards to the positioning of firms respectively projects along the value chain. Rungi and Del Prete (2018) derive their key measure for the position along the smile curve from firms' industry affiliation. In contrast, this paper treats the functional specialisation apart from the specialisation in industries. In particular, since the value chain functions in my data are defined at the project level, the same investor firm can create foreign subsidiaries serving various functions.

10 Often the emerging pattern resembles a 'smirk curve' because graphs shows changes in the value added contributions on the vertical axis of the three broad sectors and the increase in the value added generation of services regularly exceeds that of the primary sector.

A common feature of all the mentioned papers is that the smile curves reflect a sequence of production processes. That is, it captures sequences of industries from raw materials to a final good or service – for example from the mining of iron ore, to the production of steel, to the production of cars. This contrasts with my approach which identifies the individual value chain functions of FDI subsidiaries *within* an industry and country. This approach, I believe is closer to the firm-level value chain and the original idea of the smile curve, than international input-output based methodologies.

In this respect this paper is closely related to Timmer et al. (2018). To my knowledge, these authors are so far the only ones to avoid the mingling of functions and industries by mapping occupations into business functions, such as engineers and related professionals into R&D or assemblers into the fabrication stage[11]. With the help of this mapping and using international input-output tables to calculate the labour by occupations embodied in value added exports (see Johnson and Noguera, 2012), the authors are able to calculate countries' functional specialisation of trade[12]. While the value added exports and the associated jobs embodied therein are calculated at the country-industry level, the results are reported at the country level only. They find, inter alia, that a functional specialisation in R&D is positively associated with GDP per capita while this correlation is negative for functional specialisation in fabrication.

Having outlined my methodology for calculating the *RFS* measure and having positioned it in the existing literature, I shall proceed with the presentation of functional profiles of selected countries.

11 For the details of the mapping of occupations according to the International Standard Classification of Occupations (ICIO) into functions see the online appendix to Timmer et al. (2018) available at: https://academic.oup.com/joeg/advance-article/doi/10.1093/jeg/lby056/5210032#supplementary-data.

12 Their functional specialisation index, like the one used in this paper, is methodologically equivalent to the Balassa index – applied to value chain functions.

4. Functional profiles in the Triad

The descriptive analysis of the functional specialisation patterns is most interesting for regions that are heavily involved in international production sharing because, as pointed out in the previous section, the functional specialisation is intensified by GVCs. Therefore I focus the discussion of the *RFS*-based specialisation profiles on the 'economic triad', that is, the EU, NAFTA and East Asia[13]. These functional portrays are interesting in themselves but they also serve as a plausibility check on the *RFS* measure derived from the greenfield FDI data.

4.1. EUROPEAN UNION

One of the most striking structural features within the European Union is the creation of the Central European (CE) Manufacturing Core comprising Germany, Austria as well as the Visegrád countries, i.e. the Czech Republic, Hungary, Poland, Slovakia (see IMF, 2013; Stöllinger, 2016). These countries are of particular interest because they are characterised by a particularly intensive integration in international production networks, mainly under the control of German MNEs. A consequence of this deep economic integration within the CE Manufacturing Core is that the production structures of its members have converged considerably (Baker et al., 2015; Stehrer and Stöllinger, 2015).

However, the structural convergence with respect to industrial specialisation hides diverging patterns in the realm of functional specialisation. This can be visualised with the *RFS* for the five value chain functions, i.e. headquarter services, R&D, production, logistics and retail services and support services. In fact, Germany has a functional profile which is rather distinct from that of, for example, Slovakia (Figure 5, panel (a)). While both countries form part of the CE manufacturing core and their industry structures have converged, they have complementary functional specialisations. Slovakia, as one of the Visegrád countries, attract relatively more production-related projects compared to the world average giving them comparatively high values in the RFS yielding values of about 1.5[14]. Since this is significantly above one, which is the value a country with an equal share of production-related projects equal to that of the world would obtain, Slovakia possesses revealed comparative advantages in the value chain function production. In contrast, the skill- and knowledge-intensive pre-production functions – HQ functions and R&D activities – are underrepresented. Exactly, the opposite is true for Germany[15] which has a revealed comparative disadvantage in the value chain function production. At first sight this may seem surprising given Germany's reputation as Europe's manufacturing powerhouse. However, Germany's *RFS* profile simply reflects that within Germany's strong manufacturing sector, it performs mainly headquarter functions and support services. The pattern found in our data is therefore in line with indications of 'origin' of the kind *'Designed and developed in Germany'* found on various products ranging from household appliances to bicycles. To illustrate that the case of Germany and Slovakia is

13 The specialisation profiles for all countries in our sample are presented in Appendix 3.

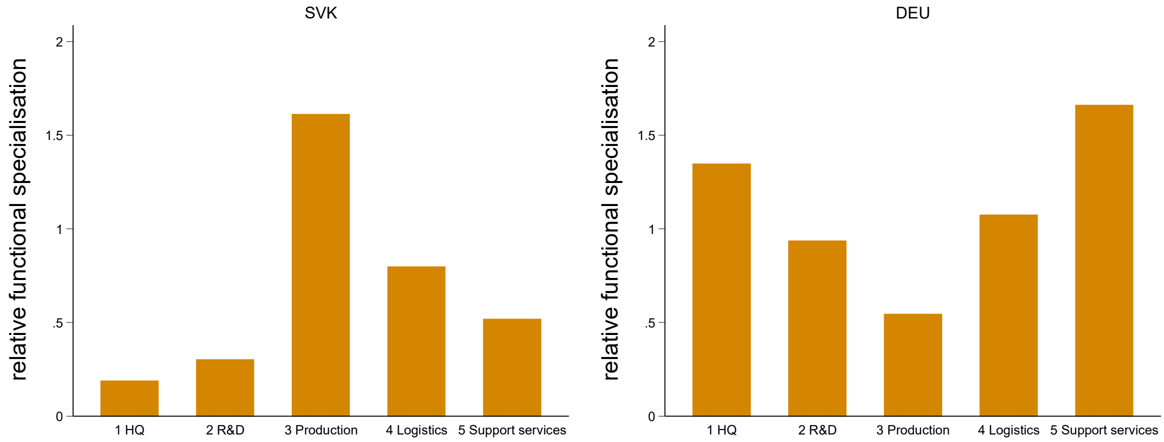
14 A country with the functional specialisation identical to that of the world would have an RFS of 1.

15 In the functional profiles such as those in Figure 5, the 'smile curve' emerges only for countries that is functionally 'well-positioned', meaning they country attract a large number of projects in the pre-production and the post-production segments of the value chain

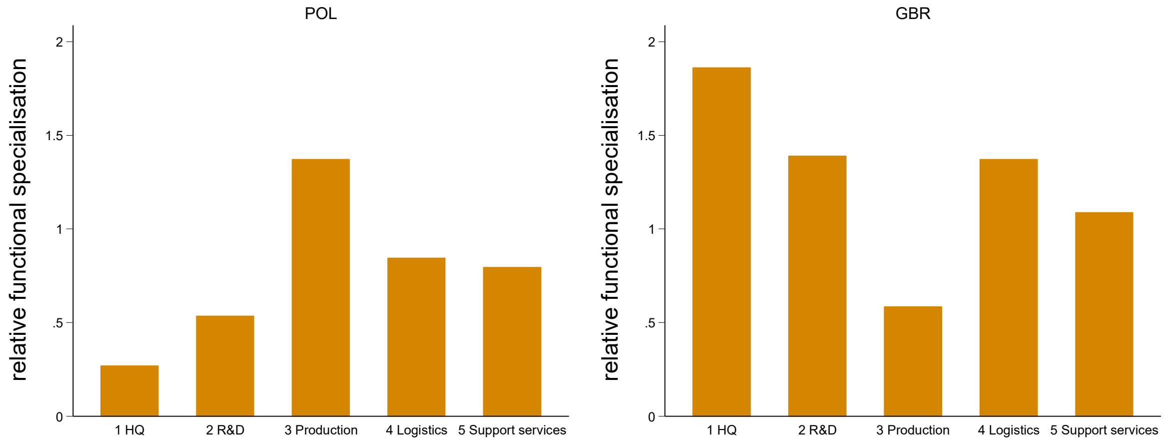
not particular to these two countries but rather representative of the functional division of labour, panel (b) in Figure 5 presents the *RFS* profiles of Poland and the United Kingdom as further examples. The revealed patterns are also interesting because they reveal that the functional profile of Germany and the United Kingdom, while not identical, are much more similar than those of the Central and Eastern European countries that joined the EU in 2004 or later.

Figure 5 / Relative functional specialisation (RFS) in selected EU Member States, 2003-2015

(a) Slovakia and Germany



(b) Poland and the UK



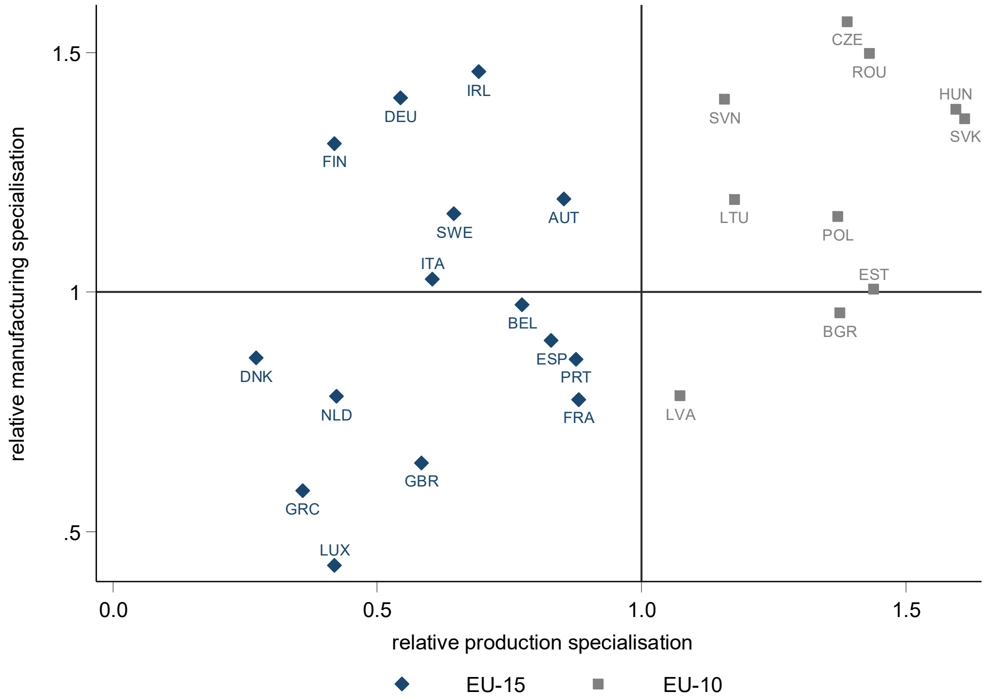
Note: HQ=headquarter functions; Logistics = logistics and retail services. A country which has a functional share in any of the functions that is equal to that of the world will have an RFS of 1 in that particular function.
Source: fDi markets database; own calculations.

At this stage it is worth emphasising again that industrial specialisation is rather different from functional specialisation when comparing all EU Member States. Figure 6 focuses on the manufacturing share in value added of Member States relative to the EU average (on the vertical axis) together with the *RFS* of the value chain function production (on the horizontal axis)[16]. The figure shows the well-known fact that Germany, Austria as well as Ireland but above all also the great majority of the Central and Eastern

[16] The full *RFS* profiles of the Triad countries are shown in Appendix 3.

European Member States have maintained relatively large manufacturing industries. In contrast, the United Kingdom, the Netherlands and France are countries have become specialised in services industries (Baker et al., 2015), resulting in comparatively smaller manufacturing shares. The more interesting fact in Figure 6 is that the functional specialisation in production of Germany and the United Kingdom is quite similar despite their distinct industrial specialisations. In contrast, Germany's relative manufacturing specialisation resembles that of Slovakia or Hungary but their functional specialisations are just the opposite.

Figure 6 / Relative manufacturing specialisation versus relative production specialisation in the EU, 2003-2015

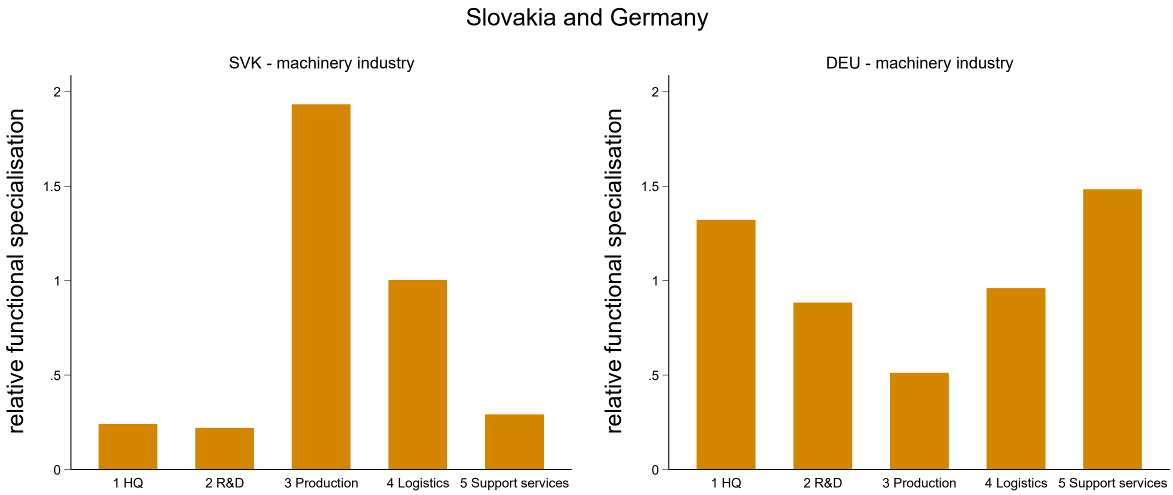


Note: Relative manufacturing specialisation is measured as the share of manufacturing in total value added relative to that of the EU28. Relative functional specialisation is the RFS for the value chain function production. Both measures are averages over 2003-2015.
Source: Eurostat, fDi markets database; own calculations.

Admittedly, these patterns of functional specialisation in GVCs are hardly surprising. It is nevertheless comforting to see that the *RFS* profiles derived from the greenfield FDI data are in line with the notion that the offshoring activities within the EU involve mainly the setting up of production facilities in the relatively low-wage Central and Eastern European EU members (see Stehrer and Stöllinger, 2015). The more knowledge-intensive value chain functions, in contrast, remain in the 'offshoring economies' in line with offshoring models (e.g. Grossman and Rossi-Hansberg, 2008). Hence, in the terminology of Baldwin and Lopez□Gonzalez (2015) – Central and Eastern European Countries are serving as factory economy, attracting mainly production activities (Szalavetz, 2018) while Germany and other high-wage economies such as the UK or France take the position of headquarter economies. Importantly, these quite marked functional specialisations persist irrespective of the impressive structural upgrading process in Central and Eastern European Countries. In all likelihood, the structural convergence process has in fact accentuated the complementary functional specialisations of Germany on the one hand and the Visegrád countries on the other hand because the convergence process was fuelled by the establishment of GVCs. As already discussed, GVCs also opened up the possibility for more pronounced functional specialisation.

Finally, it is also possible to create functional profiles like the ones in **Fehler! Verweisquelle konnte nicht gefunden werden.** at the industry level. To illustrate, that the economy-wide functional patterns are not the result of different industry compositions, **Fehler! Verweisquelle konnte nicht gefunden werden.** shows the RFS profile *within* the machinery industry, again for Germany and Slovakia. Again, Slovakia is functionally specialised in the value chain function production, while Germany's functional revealed comparative advantages lie within R&D and support services. This is a general pattern in the country-industry analysis, thereby confirming the economy-wide patterns.

Figure 7 / Relative functional specialisation (RFS) in the machinery industry in selected EU Member States, 2003-2015

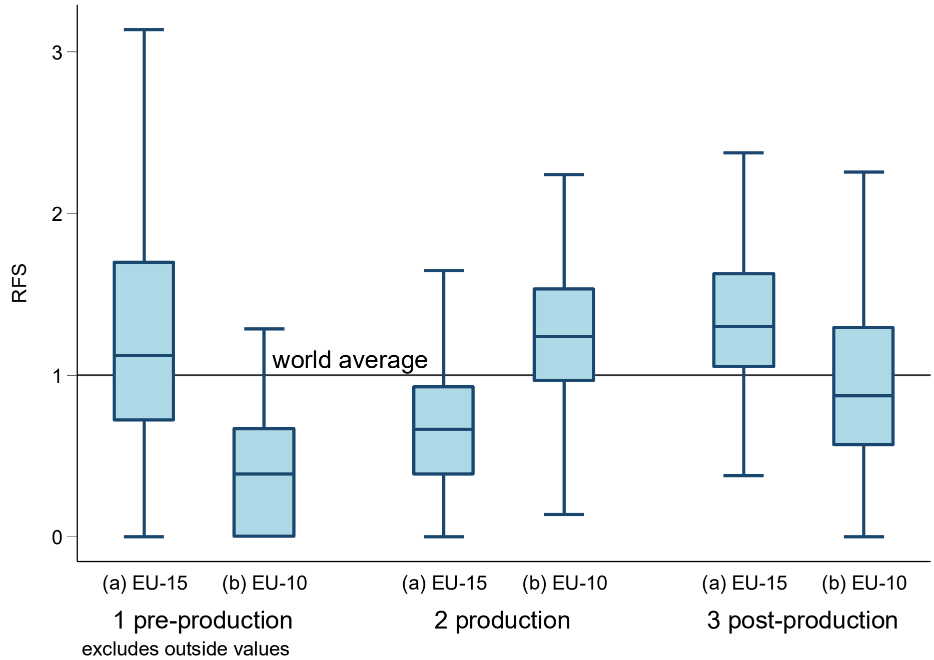


Note: HQ=headquarter functions; Logistics = logistics and retail services. A country which has a functional share in any of the functions that is equal to that of the world will have an RFS of 1 in that particular function.
Source: fDi markets database; own calculations.

While there is some heterogeneity across countries and industries, the pattern shown in Figure 7 is quite representative of the functional specialisation of EU-15 countries, on the one hand, and the Central and Eastern European Member States (EU-10), on the other hand. This EU-internal pattern can be shown with the help of a box plot diagram, differentiating between the pre-production, production and post-production segment of the value chain (Figure 8).

The length of the box indicates the lower and upper quartiles of the *RFS* for the countries in the respective country groups across all industries. It is referred to as the interquartile range (IQR). The line within the box indicates the median. As can be seen in Figure 8, the median *RFS* in the pre-production and post-production segments are above the world average (equal to 1) and considerably above that of the EU-10. The opposite is true for the actual production activities. In this case the RFS for the EU-15 is only 0.66 while with a value of 1.24 the RFS of the EU-10 exceeds by far the world average. It is also interesting to note that the positions of the boxes – which comprise the 2nd and 3rd quartile of each group – along the vertical axis hardly overlap, with the exception of the post-production services. This means that across industries the *RFS* of the EU-15 and the EU-10 for the three segments of the value chains are quite different. This does not rule out the case that an EU-10 country has a high *RFS* in the pre-production part of the value chain or that an EU-15 country has a high *RFS* in the value chain function production in an individual industry. This occurs from time to time, for example in the vehicles equipment industry where Austria has an RFS of 1.5. This value is still inside the upper adjacent value for the value chain function production for the EU-15.

Figure 8 / RFS for pre-production, production and post-production functions within the EU, 2003-2015



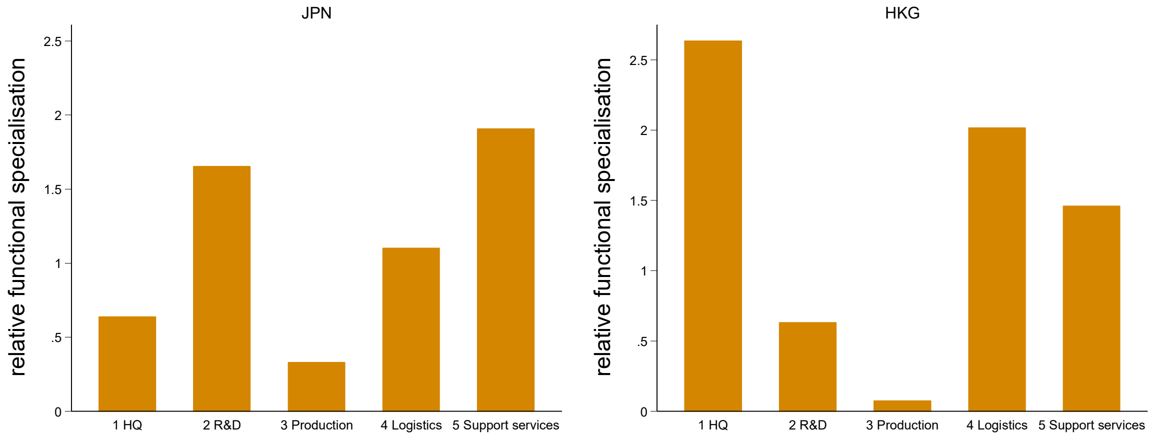
Note: The line in the middle of the box indicates the median value. The length of the box indicates the lower and upper quartiles of the *RFS* of all countries in the country group across all industries. Lower and upper adjacent values ('whiskers') are calculated at 1st quartile minus interquartile range and 3rd quartile plus interquartile range respectively. Outside values are not shown. The horizontal line indicates the RFS of the world average in the respective industry.
Source: Eurostat, fDi markets database; own calculations.

4.2. EAST ASIA

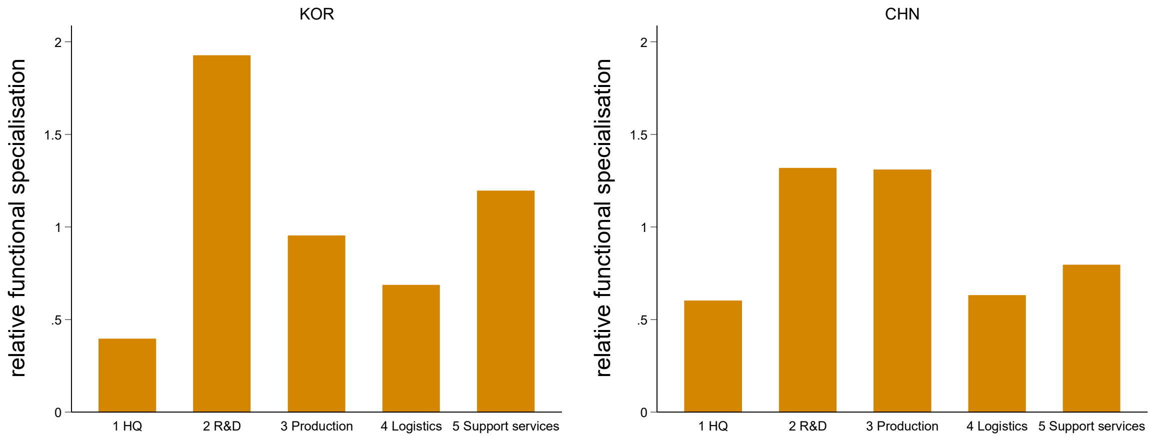
Interesting functional specialisation patterns also emerge in the East Asian region (Figure 9). These patterns are by and large in line with country's position in the flying geese model (Akamatsu, 1962). Japan as the first economy in East Asia to industrialise, and since then taking the role of the main technology provider for the region, has the typical profile of 'headquarter' economy. That is, it attracts a comparatively high number of R&D-related projects but few production facilities. The same is true for Hong Kong. In Korea, the *RFS* is also very high for the R&D function but is exceptional in that it also has average specialisation in production.

Figure 9 / Relative functional specialisation (RFS) in selected East Asian economies, 2003-2015

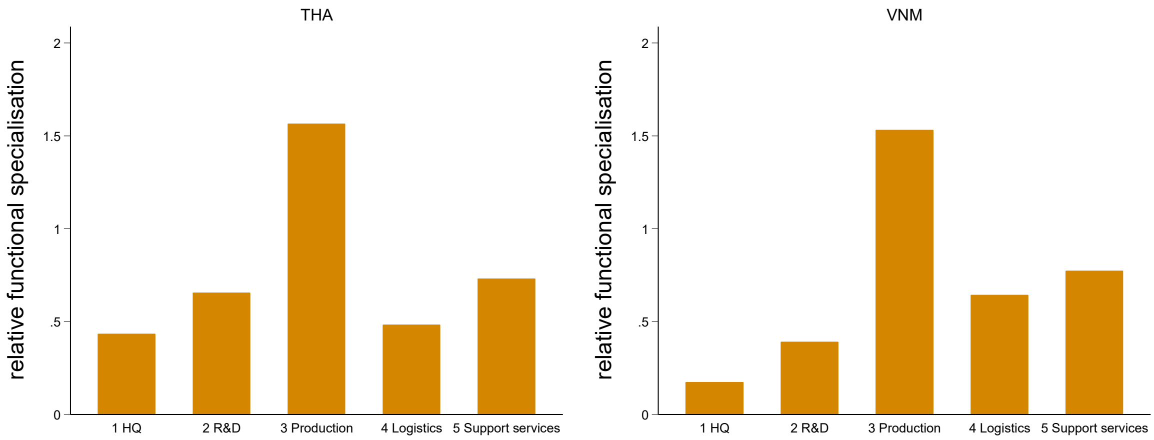
(a) Japan and Hong Kong



(b) Korea and China



(c) Thailand and Vietnam



Note: HQ=headquarter functions. Logistics = logistics and retail services. A country which has a functional share in any of the functions that is equal to that of the world will have an RFS of 1 in that particular function.
Source: fDi markets; own calculations.

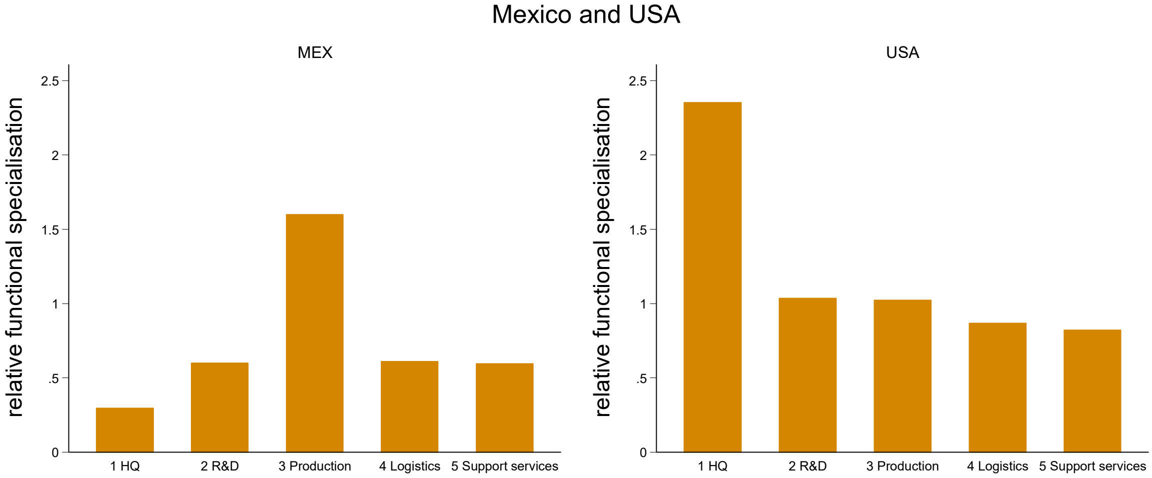
Of particular interest is the functional profile of China. Often considered to be the 'workshop of the world' (e.g. Baldwin and Lopez-Gonzalez, 2015), China's functional profile suggests not only a functional specialisation in production but equally a specialisation in R&D. Hence, China may not be a pure 'factory economy' anymore but has emancipated itself from this role and manages to attract a large number of greenfield FDI companies serving other value chain function too, while at the same time remaining an attractive location for production facilities as well. It should be noted though, that to some extent China's high *RFS* in R&D is influenced by its large market size. In the econometric part, this will be taking into account by controlling for market size.

Finally, countries positioned towards the back of the flying geese formation, such as Thailand and above all Vietnam show the typical profile of a factory economy, i.e. a strong functional specialisation in production but attracting hardly any R&D labs.

4.3. NAFTA

Finally, the factory versus headquarter constellation is also present in the international division of labour in North America. Within NAFTA, recently renamed US-Canada-Mexico Agreement (USMCA), the functional roles appear to be clearly established with Mexico – including its maquiladoras – serving as the factory economy. The US, in contrast, is strongly specialised in headquarter functions. Interestingly, though, the US also attracts a relatively large share of production-related activities that is close to the world average.

Figure 10 / Relative functional specialisation (RFS) in NAFTA/USMCA, 2003-2015

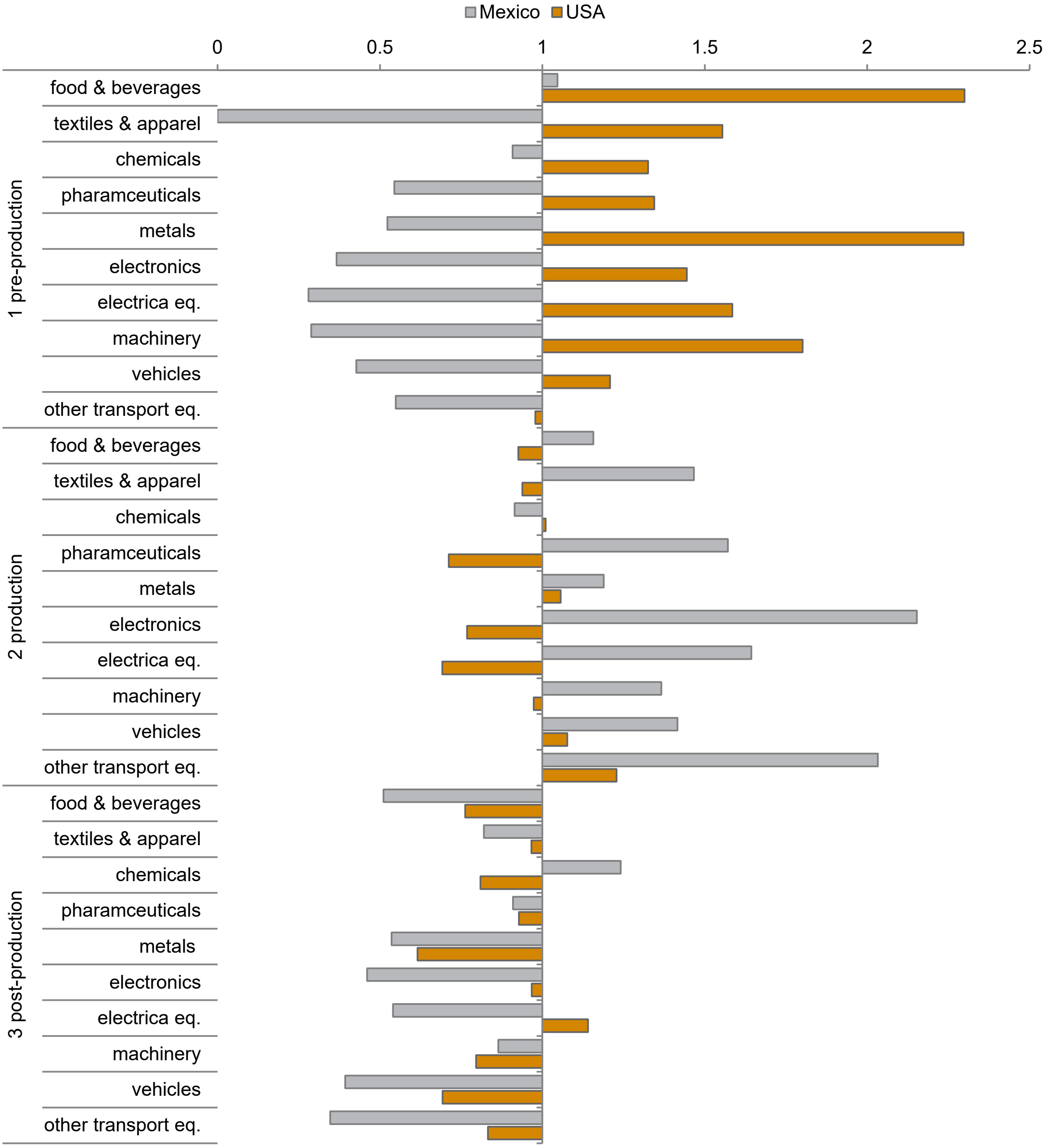


Note: HQ=headquarter functions. Logistics = logistics and retail services. A country which has a functional share in any of the functions that is equal to that of the world will have an RFS of 1 in that particular function.
Source: fDi markets; own calculations.

This overall picture at the level of the economy for this country pair can be supplemented with more detailed country-industry results for the *RFS*. For this purpose the value chain functions are categorised into a pre-production, production and a post-production segment as before in the case of the EU (Figure 11). The country-industry *RFS* confirm the economy wide picture: the US specialise functionally in pre-production functions across all industries, with other transport equipment being a slight exception.

Mexico is functionally specialised as a factory economy in almost all industries, the sole exception being the chemicals industry. Therefore the US and Mexico have strongly supplementary functional specialisations with respect to pre-production and production activities. The picture is less clear with regards to post-production activities. Neither Mexico nor the US appears to be functionally specialised in post-production activities which in the case of the latter comes a bit as a surprise.

Figure 11 / Relative functional specialisation (RFS) in NAFTA/USMCA at the industry level, 2003-2015



Note: A country which has a functional share in any of the functions that is equal to that of the world will have an RFS of 1 in that particular function.
Source: fDi markets; own calculations.

In sum, the patterns for the functional specialisation in GVCs that I obtain from the greenfield FDI data seem very plausible. It should also be mentioned that my functional specialisations in GVCs in many instances suggest the same revealed comparative advantages as the functional specialisations in trade by Timmer et al. (2018)[17] despite the fact they are using a completely different methodology. Naturally, there are also a number of deviations. For example, Timmer et al. (2018) suggest that Japan has a revealed comparative advantage in the function fabrication, whereas in my data Japan emerges as being functionally specialised predominantly in R&D and support services.

[17] See Table 2 on p. 20 of that paper.

5. Testing the Smile Curve

The econometric analysis focuses on the central hypothesis of the firm-level concept of the smile curve, namely that the value chain function entails comparatively little value added compared to the pre- and post-productions segments of the value chain. It is also here in the econometric analysis that the link between the functional specialisation patterns just described and value creation is made.

For this purpose, the *RFS* measure at the country-industry level across the five value chain functions is compressed into a single indicator, the relative production specialisation index (*RPSI*). The *RPSI* distinguishes only between the value chain function production, on the one hand, and pre-production and post-production functions, on the other hand. This differentiation is due to the fact that production activities according to the smile curve hypothesis is special as it is assumed to entail less potential for value creation. Hence, the *RPSI* is derived by forming the ratio between countries' *RFS* in production on the one hand and the RFS in pre-production and post-production functions and the other hand. Importantly, since the methodology aims at keeping value chain functions entirely distinct from the industry dimension (*i*), the *RPSI* used in the econometric work is defined at the country-industry level:

$$RPSI_{c,i} = \frac{RFS_{c,i}^{production}}{RFS_{c,i}^{pre-production} + RFS_{c,i}^{post-production}}$$

A natural benchmark for the *RPSI* is 0.5. This is because a country which has exactly the same function specialisation as the world would have an *RFS* of 1 in all functions and industries and therefore an RPSI of 0.5.

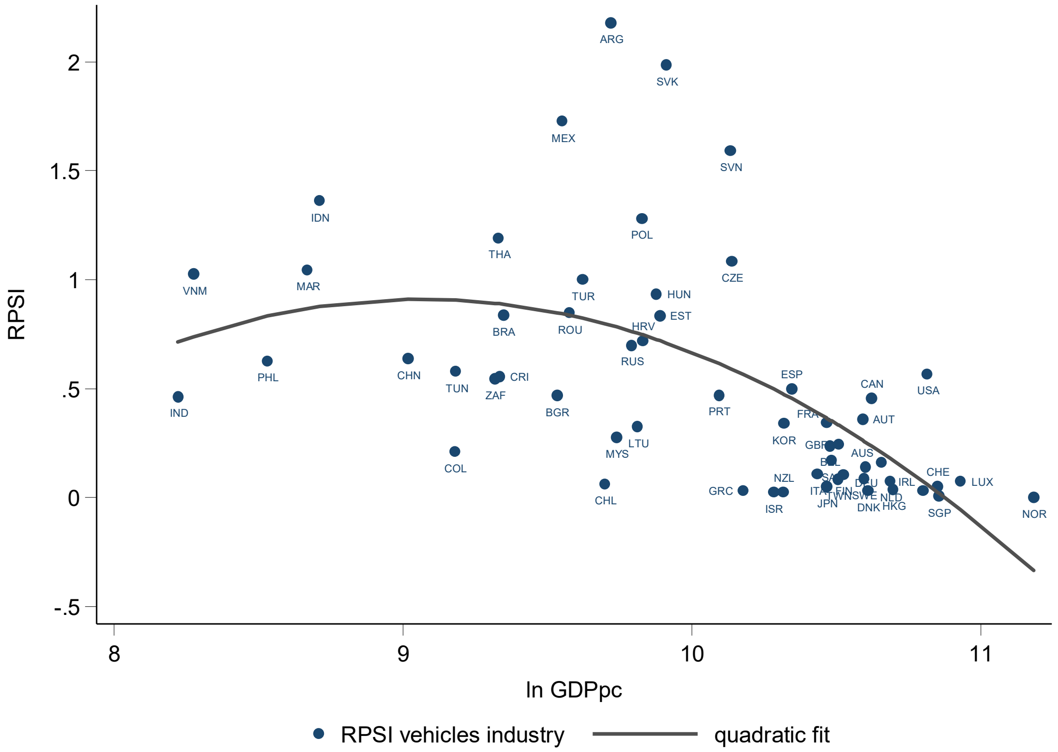
Remember that the *RFS* and therefore also the *RPSI* reflect the information on the value chain functions assigned to the respective FDI subsidiary. This way, the functional specialisation measures remains tightly connected to the original idea of the smile curve. In particular, this measure ensures that the *RPSI* really reflects differences in the propensity to attract greenfield FDI related to production activities versus all other value chain functions *within* each industry, e.g. in the pharmaceutical industry. So the question addressed in the econometric model is whether establishing a production facility in the pharmaceutical industry has different implications for value creation than the set-up of a pharmaceutical R&D laboratory.

By definition, countries with a high *RFS* in production tend to have also high scores in the *RPSI*. Given the functional profiles described in the previous section, it is not surprising that there is a strong relationship between countries stage of development, proxied by their GDP per capita, and the RPSI. This relationship is shown for the pharmaceutical industry in Figure 12 using a quadratic fit[18]. The relationship shows that initially the *RPSI* is increasing with income per capita but that at an income level of about USD 9,000 the correlation becomes negative. This quadratic relationship stems from the fact that at rather low levels of income, countries are less involved in GVCs and hence their profile as a 'factory economy' is not very pronounced yet.

[18] The relationship also holds at the country level and for other industries.

The functional specialisation in production then increases as the intensity of international production sharing increases. Countries with even higher incomes, however, tend to change their functional specialisation and the RPSI becomes very low for developed countries.

Figure 12 / RPSI in the vehicles industry and GDP per capita, 2003-2015



Note: ln GDPpc = log of GDP per capita.
Source: Own estimations.

Given this relationship between GDP per capita and the RPSI, the former will be used as a control variable in some specifications of the econometric model to capture the stage of development.

Given that some of the post-production services captured by our indicator may be less-knowledge intensive (e.g. retail activities) than the pre-production activities an alternative functional specialisation measure that focuses on dichotomy between production and pre-production activities is calculated which is labelled the relative factory economy index (*RFEI*). This labelling refers to the distinction between 'headquarter' economies and 'factory' economies within global value chains used by Baldwin and Lopez-Gonzalez (2015). The *RFEI* is used as an alternative measure for the relative specialisation in production activities. Importantly, the econometric model is estimated at the country-industry level. Formally, the *RFEI* for any country *c* and industry *i* is defined as:

$$RFEI_{c,i} = \frac{RFS_{c,i}^{production}}{RFS_{c,i}^{pre-production}}$$

In the case of the *RFEI* a value of 1 indicates that a country in a particular industry has the same extent of production specialisation (relative to pre-production activities) as the world on average.

5.1. ECONOMETRIC MODEL

The econometric model follows Rungi and Del Prete (2018) in using the industry-level value added coefficients of countries as the dependent variable in our model. The main explanatory variable is the relative production specialisation indicator. This is of key importance as it ensures that the industry-dimension *i* and the functional dimension *f* are kept apart. This way, it can be ruled out that differences in the functional specialisation are the outcome of an aggregation bias. Such as aggregation bias may arise if industries differ with respect to their functional intensity. For example, the pharmaceutical industry tends to feature for R&D activities than for example the textile industry. Using the RPSI at the country-industry level rules out the possibility this aggregation bias influences the econometric result.

The *RPSI* and the *FEI* are averaged over the sample period 2003-2015 in order to ensure that they are based on a sufficient number of observations. The sample contains the ten manufacturing industries mentioned in the methodology section and listed in Appendix 1. For the same reason, the preferred specification of the model is based on a restricted sample of country-industries whose *RPSI* is based on at least 50 greenfield FDI projects. This way, the reliability of the functional specialisation measure is strongly enhanced.

The smile curve hypothesis is tested with a model that relates the industry-level value added coefficients of countries, $va_{c,i}$, to the corresponding relative production specialisation index, $RPSI_{c,i}$. Given that the value added coefficients are bound between zero and one, all models are estimated as fractional probit response models (see Papke and Wooldridge, 1996). Therefore the main model takes the following form:

(1) $$E(va_{c,i}|RPSI_{c,i}, X_{c,i}, \mu_c, \iota_i) = \Phi(\beta \cdot RPSI_{c,i} + X_{c,i} \cdot \varphi + \mu_c + \iota_i)$$

where $\Phi(\cdot)$ is the standard normal cumulative distribution function. $X_{c,i}$ denotes control variables which in this case are the import intensity and the export intensity, i.e. exports and imports per capita. The expectation is that the import intensity is typically negatively correlated with the value added captured by the industry, while the opposite is true for the export intensity. Given the panel structure of the data it is possible to control for a full set of industry (ι_i) and country (μ_c) fixed effects[19].

In addition to this model, a number of alternative models which include country-level controls variables. This requires removing the country fixed-effects from the model. Instead of these I include country dummies for world regions and for income groups. Both world regions and the income groups are those used by the World Bank, where the latter refer to the classification in the year 2000, i.e. in a year preceding the sample period. The additional country-level controls include the real GDP per capita and real GDP, both in logarithmic form[20]. The latter serves as a control for the economic size of the country. The former is included as it may be expected that more advanced countries capture higher value added shares. So it serves as a measure for the development stage of countries. Such a negative relationship between specialisation in production and GDP per capita is shown in Figure 12 above and is also documented in Timmer et al. (2018).

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19 Appendix 4 reports the results of the corresponding ordinary-least-squares(OLS) model which takes the simple form $va_{c,i} = \alpha + \beta \cdot RPSI_{c,i} + X_{c,i} \cdot \varphi + \mu_c + \iota_i + \varepsilon_{c,i}$ where $\varepsilon_{c,i}$ denotes the error term.

20 The real GDP per capita used is the average over the sample period 2003-2015. However, using initial GDP per capita, such as the average over the period 2000-2003, does not change the results. Results are available upon request.

The real GDP per capita variables is also interesting because it allows testing a second, related hypothesis in the context of functional specialisation and value added capture. This hypothesis is that a high specialisation in production activities has different implications for value added capture across countries' stages of development. Hence, one may expect that low and lower-middle income countries benefit from specialising in production activities whereas such a functional specialisation may be less beneficial in terms of value added captures as countries grow richer. This possibility is tested by including an interaction term between the RPSI measure and the income per capita. This yields a non-linear model which – in the main specification – takes the form:

(2) $$E(va_{c,i}|RPSI_{c,i}, X_{c,i}, \mu_c, \iota_i) = \Phi(\beta \cdot RPSI_{c,i} + \gamma \cdot (RPSI_{c,i} \times GDPpc_c) + X_{c,i} \cdot \varphi + \mu_c + \iota_i)$$

The data underlying the RPSI has been discussed in section 2. Additional data sources include Eurostat National Accounts and OECD National Accounts data for the industry-level value added and output data. For countries covered by neither data source, data from the World Input-Output Database (WIOD) (Timmer et al., 2015)[21] and OECD's Inter-Country Input Output (ICIO) Database[22] is used. For these data sources, the averages of the value added coefficient comprise the period 2003-2014 and 2003-2011 respectively. Information on real GDP, population and real GDP per capita are taken from the Penn World Tables version 9 (PWT 9) (Feenstra et al., 2015)[23]. The export and import data stems from UN Comtrade.

5.2. RESULTS

The results from the fractional probit response model are summarised in Table 1. These results are based on a sample that comprises all observations for which the industry-level *RPS*I is based on at least 50 greenfield FDI projects.

The implicit assumption of the firm-level concept of the smile curve is that the specialisation in the pure production stage – including assembling – would constitute such an unfavourable specialisation. If this is the case, our model should deliver a negative sign for β, the coefficient of the RPSI variable. The unconditional model (specification 1) yields a statistically highly significant and negative coefficient of the *RPSI* in line with the smile curve hypothesis. The implied average marginal effect, calculated as the average over the marginal effects of all observations, is about 0.04. This suggests that a decrease in the *RPSI* by 10 percentage points (e.g. from 0.6 to the world average of 0.5) is associated with a 0.4 percentage points increase in the value added coefficient (e.g. from 0.36 to 0.4).

The inclusion of additional control variables as well as of the industry fixed effects and regional and income group dummies reduces the statistical significance of β and also the magnitude of the effect (specifications 2 to 5). This is mainly due to the GDP per capita which has the expected positive sign. As mentioned earlier this result indicates that economies with higher income per capita tend to have higher value added coefficients. In specification (5) also the trade variables – the import intensity and the export intensity – are statistically significant at the 10 per cent level. Both variables have the expected sign: higher import intensity in an industry tends to reduce the value added captured whereas the opposite is

21 Data available at: http://www.wiod.org/database/wiots16

22 Data available at: http://www.oecd.org/sti/ind/inter-country-input-output-tables.htm

23 Data available at: https://www.rug.nl/ggdc/productivity/pwt/.

true for the export intensity. Finally, by including country fixed effects (specifications 6 and 7), the model yields again a coefficient of the *RPSI* that is statistically significant at the 1% level and similar in magnitude to the unconditional model.

Table 1 / Value added capture and RPSI, restricted sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RPSI	-0.1176***	-0.0645*	-0.0679*	-0.0663*	-0.0715*	-0.1271***	-0.1244***
	(0.0337)	(0.0375)	(0.0378)	(0.0377)	(0.0381)	(0.0424)	(0.0437)
ln GDPpc		0.2382***	0.2547***	0.2503***	0.2580***		
		(0.0549)	(0.0555)	(0.0554)	(0.0552)		
ln GDP		0.0236*	0.0179	0.0198	0.0151		
		(0.0121)	(0.0125)	(0.0123)	(0.0126)		
import intensity			-0.0124		-0.0540**		-0.0419
			(0.0098)		(0.0233)		(0.0343)
export intensity				-0.0055	0.0236*		0.0077
				(0.0050)	(0.0136)		(0.0217)
industry effects	no	yes	yes	yes	yes	yes	yes
region effects	no	yes	yes	yes	yes	no	no
income group effects	no	yes	yes	yes	yes	no	no
country fixed effects	no	no	no	no	no	yes	yes
Obs.	223	223	223	223	223	223	223
Log pseudolikelihood	-135.3	-133.2	-133.2	-133.2	-133.1	-132.5	-132.4
Pseudo R2	0.0023	0.0181	0.0183	0.0182	0.0185	0.0232	0.0236
average marginal effect							
RPSI	*-0.0406*	*-0.0219*	*-0.0230*	*-0.0225*	*-0.0243*	*-0.0429*	*-0.0420*

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. Sample is restricted to observations with 50 or more greenfield FDI projects at the country-industry level. RPSI are averages over the period 2003-2015. Estimated with STATA using the *fracreg probit* estimation command.

Hence, the negative coefficients of the RPSI variable in the econometric model provide support for the smile curve hypothesis. The results are also in line with those in Rungi and Del Prete (2018) derived from firm-level data. Using a quadratic model, they find that firms which have their core activities in the middle segment of the range of the upstreamness index, which they associated manufacturing activities, capture less value added.

Switching from the restricted sample to the full sample[24] (Table 2) confirms the above result with one important exception, however: the main specifications which include country fixed effects (specifications 6 and 7) do not yield a statistically significant coefficient of the *RPSI*. In contrast, in all other specifications a statistically highly significant coefficient for the RPSI is found.

One possible explanation for the lack of statistical significance in the main specification is that there is a non-linear relationship between functional specialisation and the extent of value added capture. More precisely, there is the possibility that the effect of the *RPSI* on the value added coefficient depends on the income level of countries. This assumption corresponds to the non-linear model in equation (2) featuring an interaction term between the *RPSI* variable and GDP per capita.

[24] The full sample also includes all observations for which a *RPSI* could be calculated, irrespective of the number of greenfield FDI on which the *RPSI* is based.

Table 2 / Value added capture and RPSI, full sample

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RPSI	-0.0766***	-0.0667***	-0.0663***	-0.0653***	-0.0676***	-0.0385	-0.0363
	(0.0244)	(0.0241)	(0.0242)	(0.0242)	(0.0243)	(0.0289)	(0.0293)
ln GDPpc		0.1438***	0.1645***	0.1574***	0.1687***		
		(0.0371)	(0.0385)	(0.0378)	(0.0377)		
ln GDP		-0.0105	-0.0141*	-0.0124	-0.0154*		
		(0.0083)	(0.0084)	(0.0083)	(0.0084)		
import intensity			-0.0193		-0.0385**		0.0104
			(0.0123)		(0.0183)		(0.0246)
export intensity				-0.0092	0.0110		-0.0119
				(0.0065)	(0.0117)		(0.0141)
industry effects	no	yes	yes	yes	yes	yes	yes
region effects	no	yes	yes	yes	yes	no	no
income group effects	no	yes	yes	yes	yes	no	no
country fixed effects	no	no	no	No	no	yes	yes
Obs.	461	461	461	461	461	461	461
Log pseudolikelihood	-286.9	-284.0	-283.9	-284.0	-283.9	-282.2	-282.1
Pseudo R2	0.001	0.0108	0.0112	0.0111	0.0112	0.0173	0.0174
average marginal effect							
RPSI	*-0.0272*	*-0.0234*	*-0.0233*	*-0.0229*	*-0.0237*	*-0.0134*	*-0.0127*

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. RPSI are averages over the period 2003-2015. Estimated with STATA using the *fracreg probit* estimation command.

The results of the extended model including the interaction terms are summarised in Table 3 for specification (5) and the main specification (7). As can be seen, the interaction term seem to matter in the main specification (specification 7' in Table 3) for the full sample. In all other specifications, the addition of the interaction term improves the statistical significance of the main effect of RPSI but the interaction term itself is not statistically significant at conventional levels of significance.

While it is not entirely clear, why the main specification for the full sample detects this conditional effect of the *RPSI* on the value added coefficient, one explanation could be that the sample restriction eliminates primarily observations in smaller economies with lower GDP per capita. The OLS estimations of the extended models with the interaction term indicate that for the countries with the lowest income in our sample actually benefit from a functional specialisation in production, i.e. a high *RPSI*[25]. In contrast, beyond a real GDP per capita of 8,460 USD the effect turns negative. This turning point is less relevant, in the restricted sample because the overwhelming number of observations is beyond that turning point. (see Appendix 4).

[25] The non-linearities arising from the interaction term are more easily analysed in the OLS specification. Appendix 4 shows that the OLS estimates are almost identical to the average marginal effect obtained from the fractional probit response model. This is due to the fact that the predictions from the model do not surpass the [0,1]-interval.

Table 3 / Value added capture and RPSI, non-linear specifications

sample	restricted sample		full sample	
	(5')	(7')	(5')	(7')
RPSI	-0.0807**	-0.1581***	-0.0948***	-0.0942***
	(0.0401)	(0.0477)	(0.0308)	(0.0363)
RPSI x ln GDPpc	-0.0368	-0.0878	-0.0530	-0.0998**
	(0.0626)	(0.0684)	(0.0358)	(0.0411)
ln GDPpc	0.2429***		0.1412***	
	(0.0599)		(0.0419)	
ln GDP	0.0146		-0.0155*	
	(0.0126)		(0.0084)	
import intensity	-0.0558**	-0.0504	-0.0434**	0.0014
	(0.0233)	(0.0346)	(0.0189)	(0.0254)
export intensity	0.0247*	0.0158	0.0138	-0.0061
	(0.0136)	(0.0225)	(0.0120)	(0.0146)
industry effects	yes	yes	yes	yes
region effects	yes	no	yes	no
income group effects	yes	no	yes	no
country fixed effects	no	yes	no	yes
Obs.	223	223	461	461
Log pseudolikelihood	-133.1	-132.4	-283.9	-282.1
Pseudo R2	0.0185	0.0236	0.0113	0.0177
average marginal effect				
RPSI	*-0.0274*	*-0.0534*	*-0.0333*	*-0.0328*
RPSI x ln GDPpc	*-0.0125*	*-0.0296*	*-0.0186*	*-0.0348*

Note:Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. RPSI and ln GDP per capita enter the regression in centred form. RPSI are averages over the period 2003-2015. Estimated with STATA using the fracreg probit estimation command.

5.3. ROBUSTNESS TESTS

The main measure for functional specialisation in production is the *RPSI*. As a robustness check additional results based on the relative factory economy index (*RFEI*) are presented. As a reminder, the *RFEI* is constructed in a similar manner as the RPSI but it disregards the post-production activities in the value chain and instead contrasts production with pre-production activities only. Table 4 presents the combined results for the base model and the model featuring the interaction term between the *RFEI* and the GDP per capita, in both cases for the restricted sample[26]. While the *RFEI* variable does not turn out to be statistically significant across all specifications, the results are confirmed insofar as the main specification that corresponds to equation 1 is statistically significant at the 1% level (specification 5). Including the interaction term does not change the result as is shown in specification 7.

Hence, the *RFEI* as an alternative measure for the functional specialisation in production confirms the results obtained with the RPSI in the previous section.

[26] In Table 4 these are referred to as ‘linear’ and ‘non-linear’ models respectively. This is for convenience only as it is clear that the fractional probit response model yields non-linear effects for each of the explanatory variables. Hence, the term linear shall signify that no interaction term is included.

Table 4 / Value added capture and the Relative Factory Economy Index (RFEI), restricted sample

	'linear' models			'non-linear' models	
	(1)	(4)	(5)	(6)	(7)
RFEI	-0.0312***	-0.0148	-0.0352***	-0.0173	-0.0417***
	(0.0095)	(0.0107)	(0.0108)	(0.0130)	(0.0142)
RFEI x ln GDPpc				-0.0077	-0.0153
				(0.0223)	(0.0298)
ln GDPpc		0.2870***		0.2758***	
		(0.0506)		(0.0625)	
ln GDP		0.0196		0.0195	
		(0.0131)		(0.0131)	
import intensity		-0.0494**	-0.0292	-0.0501**	-0.0313
		(0.0240)	(0.0346)	(0.0240)	(0.0347)
export intensity		0.0211	-0.0029	0.0215	-0.0009
		(0.0142)	(0.0217)	(0.0141)	(0.0219)
industry effects	no	yes	yes	yes	yes
region effects	no	yes	no	yes	no
income group effects	no	yes	no	yes	no
country fixed effects	no	no	yes	no	yes
Obs.	223	223	223	223	223
Log pseudolikelihood	-135.4	-133.2	-132.4	-133.2	-132.4
Pseudo R2	0.0018	0.0183	0.0236	0.0183	0.0236
average marginal effect					
RFEI	*-0.0108*	*-0.0050*	*-0.0119*	*-0.0059*	*-0.0141*
RFEI x ln GDPpc				*-0.0026*	*-0.0052*

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. Sample is restricted to observations with 50 or more greenfield FDI projects at the country-industry level. In the regressions with interaction terms, RFEI and ln GDP per capita enter the regression in centred form RFEI are averages over the period 2003-2015. Estimated with STATA using the *fracreg probit* estimation command.

A second robustness checks re-introduces the *RPSI* as the functional specialisation measure but it is a measure that is derived not on the number of inward greenfield FDI projects but on the number of jobs that are created by through the respective project. This is another interesting metric as job creation is a key objective of FDI strategies. There are, however, two severe shortcomings to the use of jobs created for the calculation of the *RFS* and therefore the *RPSI*. First of all, the use of jobs makes the data 'lumpy' in the sense that one large FDI project may drive the whole functional profile of a country irrespective of what else is going on in the country. It is therefore all the more important in this case that the RPSI is derived from a sufficient number of observations which will be 50 projects as before. Secondly, the information on the number of jobs created is not complete in the fDI markets database so that for a relative large number of projects the number has to be estimated.

Despite these shortcomings the model is estimated with this job-based variant of the *RPSI* which is labelled $RPSI^{jobs}$. The major results are summarised in Table 5. The strong negative correlation between the $RPSI^{jobs}$ and the value added coefficient is present in the unconditional model (specification 1) as was the case in the original version of the *RPSI*.

Table 5 / Value added capture and the jobs-based RPSI, restricted sample

	'linear' models			'non-linear' models	
	(1)	(4)	(5)	(6)	(7)
$RPSI^{jobs}$	-0.0769***	-0.0506	-0.0439	-0.0992***	-0.1560***
	(0.0281)	(0.0327)	(0.0382)	(0.0344)	(0.0419)
$RPSI^{jobs}$ x ln GDPpc				-0.0918**	-0.1845***
				(0.0406)	(0.0512)
ln GDPpc		0.2967***		0.2640***	
		(0.0500)		(0.0502)	
ln GDP		0.0247**		0.0217*	
		(0.0124)		(0.0123)	
import intensity		-0.0508**	-0.0309	-0.0604***	-0.0540
		(0.0232)	(0.0344)	(0.0224)	(0.0365)
export intensity		0.0222	-0.0014	0.0273**	0.0197
		(0.0136)	(0.0216)	(0.0130)	(0.0238)
industry effects	no	yes	yes	yes	yes
region effects	no	yes	no	yes	no
income group effects	no	yes	no	yes	no
country fixed effects	no	no	yes	no	yes
Obs.	223	223	223	223	223
Log pseudolikelihood	-135.5	-133.2	-132.5	-133.1	-132.4
Pseudo R2	0.0014	0.0183	0.023	0.0188	0.0239
average marginal effect					
$RPSI^{jobs}$	*-0.0266*	*-0.0172*	*-0.0148*	*-0.0337*	*-0.0526*
$RPSI^{jobs}$ x ln GDPpc				*-0.0311*	*-0.0622*

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. Sample is restricted to observations with 50 or more greenfield FDI projects at the country-industry level. In the regressions with interaction terms, RFEI and ln GDP per capita enter the regression in centred form *$RPSI^{jobs}$* are averages over the period 2003-2015. Estimated with STATA using the *fracreg probit* estimation command.

The main specifications suggest that the effect of the *$RPSI^{jobs}$* on the value added coefficient is strongly dependent on the GDP per capita. Hence, the 'non-linear' models in specifications 6 and 7 pick up a highly statistically significant effect of the jobs-based production specialisation variable. In specification 7, the average marginal effect amounts to -0.05 and is therefore pretty much of the same magnitude as in the model with the original version of the *RPSI* (compare Table 3)[27]. This negative average marginal effect is getting even more negative at higher levels of income as indicated by the negative interaction term between the *$RPSI^{jobs}$* and the GDP per capita.

To summarise, the jobs-based *RPSI* version of the model also confirms the main results with the nuance that also for the restricted sample a strong non-linear effect in dependence of the GDP per capita is detected. For the restricted sample, this was not the case in the original version of the *RPSI*.

[27] This marginal effect of the *$RPSI^{jobs}$* itself is larger for higher values of the *RPSI* in the fractional probit response model.

6. Conclusions

The functional division of labour has become a major characteristic of the global economy. The functional specialisation patterns revealed in this paper are shaped by international production networks. These specialisation patterns I described with a functional variant of the revealed comparative advantage measure, which I labelled *RFS* in GVCs. It has been shown that the functional profiles for the countries with the strongest involvement in internationally fragmented production, i.e. those in the Triad, are plausible with clearly discernible roles as factory and headquarter economy respectively in the EU, NAFTA and South Asia. Importantly, the functional dimension is distinct from the industry dimensions with convergence in the latter does not necessarily imply convergence in the former as was shown in the European context.

Compressing the *RFS* into a single measure for the relative production specialisation, it has been shown that those countries which are specialised as factory economies, i.e. a high relative production specialisation index (*RPSI*), tend to capture less value added per unit of output. Since this result is obtained at the country-industry level it is certainly not due to a potential industry bias. It is also robust to disregarding post-production activities. An ambiguity remains though which is the question whether the relationship between the RPSI and value added capture is linear or dependent on countries' income level.

The latter is quite plausible as at very low stages of development, countries may indeed benefit from a functional specialisation in production within manufacturing industries if it takes place in the context of a structural move towards manufacturing production. However, as countries develop a persistent specialisation as factory economy is, according to my estimates, is suboptimal in terms of value added capture.

Irrespective of whether the negative relationship between functional specialisation in production and value added capture is linear or varying with the income level, it is clear that countries functionally specialised as factory economies are disadvantaged vis-à-vis headquarter economies. This is due to the asymmetric allocation of economic rents across the countries participating in GVCs which in turn is due to the increased competition in production activities. This way, the current patterns of functional specialisation reinforce the existing core-periphery structure that some economists have detected in the global production and trading system (e.g. Wade, 2018).

Certainly, this structuralist approach to specialisation suggests that it does matter for value creation whether a country is performing mainly production activities or mainly R&D – even when controlling for income levels. Moreover, the result could point towards a link between functional specialisation and the debate about the middle income trap (see Stöllinger, 2018). Many authors consider the lack of domestic knowledge and technological capabilities as the underlying reason of the middle income trap (Cherif and Hasanov, 2015). Since the lack of these capabilities is likely to impede R&D and headquarter activities, it is possible that several countries find themselves first of all in a functional trap which hinders them to surpass the high income ceiling. To substantiate this point more research is needed.

Literature

Akamatsu, K. (1962), A historical pattern of economic growth in developing countries', *Journal of Developing Economies*, 1(1), pp. 3-25.

Antràs, P., Chor, D., Fally, T., Hillberry, R. (2012), 'Measuring the Upstreamness of Production and Trade Flows', *American Economic Review: Papers & Proceedings*, 102(3), pp. 412-416.

Antràs, P., Chor, D. (2013), 'Organizing the global value chain', *Econometrica,* 81(6),pp. 2127–2204.

Baker, P., Foster-McGregor, N., Johannes, K., Leitner, S.M., Schricker, J., Stehrer, R., Strobel, T., Vermeulen, J., Vieweg, H.-G., Yagafarova, A. (2015), The Relation between Industry and Services in Terms of Productivity and Value Creation, *wiiw Research Report*, 404, July.

Balassa, B. (1965), 'Trade liberalisation and "revealed" comparative advantage', *The Manchester School*, 33, pp. 99-123.

Baldwin, R. (2011), '21st Century Regionalism: Filling the gap between 21st century trade and 20th century trade rules', *CEPR Policy Insight* No. 56.

Baldwin, R. (2013), 'Global supply chains: why they emerged, why they matter, and where they are going', in: Elms, D.K., Low, P. (eds), *Global Value Chains in a Changing World*, Geneva.

Baldwin, R. (2014), 'Trade and Industrialization after Globalization's Second Unbundling: How Building and Joining a Supply Chain Are Different and Why It Matters', in: Feenstra, R.C., Taylor, A.M. (eds), *Globalization in an Age of Crisis. Multilateral Economic Cooperation in the Twenty-First Century*, University of Chicago Press.

Baldwin, R., Venables, A.J. (2013), 'Spiders and snakes: Offshoring and agglomeration in the global economy', *Journal of International Economics*, 90(2), pp. 245-254.

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

Baldwin, R., Lopez-Gonzalez, J. (2015), 'Supply-chain Trade: A Portrait of Global Patterns and Several Testable Hypotheses', *The World Economy*, 38(11), pp. 1682-1721.

Baldwin, R., Ito T., Sato, H. (2014), 'Portrait of Factory Asia: Production networks in Asia and its implications for growth – the "smile curve" ', *IDE-JETRO Joint Research Program Series*, No. 159, http://www.ide.go.jp/English/Publish/Download/Jrp/pdf/159_cover.pdf.

Baldwin, R., Forslid, R., Ito, T. (2015), 'Unveiling the evolving sources of value added in exports', *IDE-JETRO Joint Research Program Series*, No. 161, http://www.ide.go.jp/English/Publish/Download/Jrp/pdf/161.pdf.

Cherif, R., Hasanov, F. (2015), The leap of the tiger: How Malaysia can escape the middle-income trap, *IMF Working Paper*, No. 15/131, Washington DC.

Collier, P., Venables, A.J. (2007). 'Rethinking Trade Preferences: How Africa Can Diversify its Exports', *The World Economy*, 30(8), pp. 1326-1345.

Deardorff, A.V. (2001), 'Fragmentation across Cones', in: Arndt, S.W., Kierzkowski, H. (eds), *Fragmentation. New Production Patterns in the World Economy*, Oxford University Press.

Dunning, J.H. (1977), 'Trade, Location of Economic Activity and the MNE: A Search for an Eclectic Approach', in: Ohlin, B., Hesselborn, P.-O., Wijkman, M.P. (eds), *The International Allocation of Economic Activity*, Macmillan, London.

Duranton, G., Puga, D. (2005), 'From sectoral to functional urban specialization', *Journal of Urban Economics*, 57, pp. 343-370.

Fally, T. (2011), 'On the Fragmentation of Production in the US', University of Colorado-Boulder, mimeo, October.

Feenstra, R.C., Hanson, G.H. (1996), 'Foreign Investment, Outsourcing and Relative Wages', in: R.C. Feenstra, G.M. Grossman and D.A. Irwin (eds), *The Political Economy of Trade Policy: Papers in Honor of Jagdish Bhagwati*, MIT Press, pp. 89-127.

Feenstra, R.C., Inklaar, R., Timmer, M.P. (2015), 'The Next Generation of the Penn World Table', *American Economic Review*, 105(10), pp. 3150-3182.

Grossman, G.M., Rossi-Hansberg, E. (2008), 'Trading Tasks: A Simple Theory of Offshoring', *American Economic Review*, 98(5), pp. 1978-1997.

Hagemejer, J., Ghodsi, M. (2017), 'Up or down the value chain? The comparative analysis of the GVC position of the economies of the new EU member states', *Central European Economic Journal*, I(48), pp. 1-18.

Howitt, P. (2000), 'Endogenous Growth and Cross-country Income Differences', *American Economic Review*, 90(4), pp. 829–846.

Howitt, P., Mayer-Foulkes, D. (2005), 'R&D, Implementation, and Stagnation: A Schumpeterian Theory of Convergence Clubs', *Journal of Money, Credit, and Banking*, 37, pp. 147-177.

Hummels, D., Ishii, J., Yi, K. (2001), 'The nature and growth of vertical specialization in world trade', *Journal of International Economics*, 54(1), pp. 75-96.

IMF (2013), IMF Multi-Country Report. German-Central European Supply Chain – Cluster Report, *IMF Country Report* No. 13/263.

Johnson, R.C., Noguera, G. (2012), 'Accounting for intermediates: Production sharing and trade in value added', *Journal of International Economics*, 86(2), pp. 224-236.

Jones, R., Kierzkowski, H. (1990), 'The role of services in production and international trade: A theoretical framework', in: Jones, R., Krueger, A. (eds), *The Political Economy of International Trade*, Basil Blackwell, Oxford.

Jones, R., Kierzkowski, H. (2001), 'A Framework for Fragmentation', in: Arndt, S.W., Kierzkowski, H. (eds), *Fragmentation. New Production Patterns in the World Economy*, Oxford University Press.

Kaplinsky, R. (2005), *Globalization, Poverty and Inequality*, Polity Press. Cambridge.

Kaplinsky, R. (2010), 'Globalisation and unequalisation: What can be learned from value chain analysis?', *Journal of Development Studies*, 37(2), pp. 117-146.

Kaplinsky, R., Farooki, M. (2010), 'Global Value Chains, the Crisis, and the Shift of Markets from North to South', in: Cattaneo, O., Gereffi, G., Staritz, C. (eds), *Global Value Chains in a Postcrisis World. A Development Perspective,* World Bank, Washington DC, pp. 125-153.

Milberg, W., Winkler, D. (2013), *Outsourcing Economics: Global Value Chains in Capitalist Development*, Cambridge University Press.

Milberg, W., Jiang, X., Gereffi, G. (2014), 'Industrial policy in the era of vertically specialized industrialization', in: Salazar-Xirinachs, J.M., Nübler, I., Kozul-Wright, R. (eds), *Transforming Economies: Making industrial policy work for growth, jobs and development*, International Labour Office, Geneva.

Mudambi, R. (2008), 'Location, control and innovation in knowledge-intensive industries', Journal *of Economic Geography*, 8, pp. 699-725.

Papke, L.E., Wooldridge, J.M. (1996), 'Econometric methods for fractional response variables with an application to 401 (k) plan participation rates', *Journal of Applied Econometrics*, 11(6), pp. 619-632.

Pavitt, K. (1995), 'National Systems of innovation: Towards a theory of innovation and interactive learning', *Research Policy*, 24(2), pp. 320-320.

Prebisch, R. (1950), *The Economic Development of Latin America and Its Principal Problems*, United Nations Publications, New York.

Rungi, A., Del Prete, D. (2018), 'The smile curve at the firm level: Where value is added along supply chains', *Economics Letters*, 164, pp. 38-42.

Shih, S. (1996), *Me-Too is not my Style: Challenge Difficulties, Break Through Bottlenecks, Create Values*, The Acer Foundation, Taipei, https://www.cmlab.csie.ntu.edu.tw/~chenhsiu/reading/metoo.pdf

Shin, N., Kraemer, K.L., Dedrick, J. (2012), 'Value capture in the global electronics industry: Empirical evidence for the smiling curve concept', *Industry and Innovation*, 19(2), pp. 89-107.

Stehrer, R., Stöllinger, R. (2015), The Central European Manufacturing Core: What is Driving Regional Production Sharing?, *FIW-Research Report* 2014/15(2).

Stöllinger, R. (2016), 'Structural change and global value chains in the EU', *Empirica*, 43, pp. 801-829.

Stöllinger, R. (2018), 'Functional specialisation in CESEE: Key to escaping the semi-periphery trap?', in: *wiiw Forecast Report*, Spring 2018, pp. 54-66.

Sturgeon, T., Memedovic, O. (2011), Mapping Global Value Chains: Intermediate Goods Trade and Structural Change in the World Economy, *UNIDO Working Paper* 5/2010.

Szalavetz, A. (2017), 'Upgrading and Value Capture in Global Value Chains in Hungary: More Complex than What the Smile Curve Suggests', in: Szent-Ivány,B. (ed.), *Foreign Direct Investment in Central and Eastern Europe. Post-crisis Perspectives*, Palgrace McMillan.

Timmer, M. P., Dietzenbacher, E., Los, B., Stehrer, R., de Vries, G.J. (2015), 'An Illustrated User Guide to the World Input–Output Database: the Case of Global Automotive Production', *Review of International Economics*, 23(3), pp. 575-605.

Timmer, M.P., Miroudot, S., de Vries, G.J. (2018), 'Functional specialisation in trade', *Journal of Economic Geography*, pp. 1-30.

Wade, R.H. (2018), 'The Development State: Dead or Alive?', *Development and Change*, 49(2), pp. 518-546.

Wallerstein, I. (1974), *The Modern World-System I. Capitalist Agriculture and the Origins of the European World-Economy in the Sixteenth Century*, Academic Press, New York, London.

Wallerstein, I. (2004), *World-system Analysis. An Introduction*, Duke University Press, Durham and London.

Ye, M., Meng, B., Wei, S.-J. (2015), Measuring Smile Curves in Global Value Chains, *IDE Discussion Paper*, No. 530, August.

Appendix

APPENDIX 1: CLASSIFICATION OF FUNCTIONS AND INDUSTRIES

Appendix Table A.1.1 / Mapping of business functions into value chains functions

<table>
<tr><th>business function
in the fDi crossborder monitor</th><th>value chain function
(narrow categories)</th><th>value chain functions
(broad categories)</th></tr>
<tr><td>Research & Development
Design, Development & Testing
Education & Training</td><td>R&D and related services</td><td rowspan="2">Pre-production</td></tr>
<tr><td>Headquarters
ICT & Internet Infrastructure</td><td>Headquarter services</td></tr>
<tr><td>Manufacturing
Recycling
Extraction*</td><td>Production</td><td>Production</td></tr>
<tr><td>Business Services
Logistics, Distribution & Transportation
Retail</td><td>Logistics and retail services</td><td rowspan="2">Post-production</td></tr>
<tr><td>Sales, Marketing & Support
Maintenance & Servicing
Customer Contact Centre
Shared Services Centre
Technical Support Centre</td><td>Support services</td></tr>
</table>

* for chemicals sector only

Appendix Table A.1.2 / NACE Rev. 2 industries used for the analysis at the function-industry-country level

Description	NACE Rev. 2
Manufacture of	
food and beverages	10
textiles; wearing apparel; leather	13-15
chemicals	20
pharmaceuticals	21
metals and metal products	24-25
computer, electronic and optical products	26
electrical equipment	27
machinery and equipment	28
motor vehicles	29
other transport equipment	30

Appendix Table A.1.3 / Mapping from fDI Markets crossborder investment monitor to NACE Rev. 2 industries

sector	*sub-sector*	*NACE Rev. 2 correspondence*
Aerospace	Aircraft	30
	Aircraft engines, other parts & auxiliary equipment	30
	Other (Aerospace)	30
Automotive Components	Automobiles	29
	Communication & energy wires & cables	27
	Motor vehicle body & trailers	29
	Motor vehicle brake systems	29
	Motor vehicle electrical & electronic equipment	29
	Motor vehicle gasoline engines & engine parts	29
	Motor vehicle seating & interior trim	29
	Motor vehicle stamping	29
	Motor vehicle steering & suspension components	29
	Motor vehicle transmission & power train parts	29
	Other motor vehicle parts	29
Automotive OEM	All other transportation (Automotive OEM)	29
	Automobiles	29
	Heavy duty trucks	29
	Light trucks & utility vehicles	29
	Motor vehicle gasoline engines & engine parts	29
	Motor vehicle transmission & power train parts	29
	Other motor vehicle parts	29
Beverages	Breweries & distilleries	10
	Other (Beverages)	10
	Soft drinks & ice	10
Biotechnology	Biological products (except diagnostic)	21
	In-Vitro diagnostic substances	21
	Other (Biotechnology)	21
Building & Construction Materials	Asphalt paving, roofing, & saturated materials	23
	Cement & concrete products	23
	Other (Building & Construction Materials)	23
	Commercial & service industry machinery	28
	Computer & peripheral equipment	26
	Other (Business Machines & Equipment)	26
Business Services	Accounting, tax preparation, bookkeeping, & payroll services	69
	Advertising, PR, & related	73
	Architectural, engineering, & related services	71
	Business schools, computer & management training	62
	Business support services	82
	Custom computer programming services	62
	Educational support services	74
	Employment services	78
	Environmental consulting services	70
	General purpose machinery	28
	Heavy & civil engineering	71
	Legal services	69
	Management consulting services	70
	Other support services	74
	Professional, scientific & technical services	72
	Specialised design services	74
Ceramics & Glass	Clay product & refractory	23
	General purpose machinery	28
	Glass & glass products	23
	Other (Ceramics & Glass)	23

tbc.

Appendix Table A.1.3 / tbc.

sector	sub-sector	NACE Rev. 2 correspondence
Chemicals	Basic chemicals	20
	Other chemical products & preparation	20
	Paints, coatings, additives & adhesives	20
	Pesticide, fertilisers & other agricultural chemicals	20
	Resin & artificial synthetic fibres & filaments	20
	Soap, cleaning compounds, & toilet preparation	20
Communications	Communications equipment	29
	Navigational instruments	26
Consumer Electronics	Audio & video equipment	26
	Household appliances	27
	Other (Consumer Electronics)	26
Consumer Products	Audio & video equipment	26
	Cosmetics, perfume, personal care & household products	20
	Cutlery & handtools	28
	Dolls, toy, & games	32
	Furniture, homeware & related products (Consumer Products)	31
	Jewellery & silverware	32
	Office supplies	47
	Other (Consumer Products)	n.a.
	Pesticide, fertilisers & other agricultural chemicals	20
	Sign manufacturing	25
	Sporting goods, hobby, books & music	n.a.
Electronic Components	Aircraft engines, other parts & auxiliary equipment	30
	All other electrical equipment & components	26
	Audio & video equipment	26
	Batteries	27
	Communication & energy wires & cables	27
	Computer & peripheral equipment	26
	Electric lighting equipment	27
	Electrical equipment	27
	Magnetic & optical media	26
	Wiring devices	27
Engines & Turbines	Engines & Turbines	28
	Other (Engines & Turbines)	28
Food & Tobacco	All other food	10
	Animal food	10
	Coffee & tea	10
	Dairy products	10
	Fruits & vegetables & specialist foods	10
	Seafood products	10
	Seasoning & dressing	10
	Snack food	10
	Sugar & confectionary products	10
	Tobacco	12
	Bakeries & tortillas	10
Industrial Machinery, Equipm. & Tools	Agriculture, construction, & mining machinery	28
	All other industrial machinery	28
	Boiler, tank, & shipping container	28
	Commercial & service industry machinery	28
	Cutlery & handtools	28
	Food product machinery	28
	General purpose machinery	28
	Measuring & control instruments	27
	Metalworking machinery	28
	Paper industry machinery	28
	Plastics & rubber industry machinery	28
	Power transmission equipment	28
	Printing machinery & equipment	28
	Sawmill & woodworking machinery	28
	Semiconductor machinery	28
	Semiconductors & other electronic components	26
	Textile machinery	28
	Ventilation, heating, air conditioning, and commercial refrigeration eq. manuf.	28

tbc.

Appendix Table A.1.3 / tbc.

sector	sub-sector	NACE Rev. 2 correspondence
Medical Devices	Electromedical and Electrotherapeutic Apparatus	26
	Medical equipment & supplies	26
	Other (Medical Devices)	26
Minerals	Lime & gypsum products	23
	Other (Minerals)	23
	Other non-metallic mineral products	23
Metals	Alumina & aluminium production and processing	24
	Architectural & structured metals	24
	Coating, engraving, heat treating, & allied activities	25
	Forging & stamping	25
	Foundries	24
	Hardware	25
	Iron & steel mills & ferroalloy	24
	Machine shops, turned products, screws, nuts & bolts	25
	Nonferrous metal production & processing	24
	Other (Metals)	24
	Other fabricated metal products	25
	Other non-metallic mineral products	23
	Spring & wire products	25
	Steel products	24
Non-Automotive Transport OEM	All other transportation (Non-Automotive OEM)	30
	Motorcycle, bicycle, & parts	29
	Motorcycle, bicycle, & parts	29
	Railroad rolling stock	30
	Ships & boats	30
Paper, Printing & Packaging	Converted paper products	17
	Other (Paper, Printing & Packaging)	17
	Plastic bottles	22
	Pulp, paper, & paperboard	17
Pharmaceuticals	Medicinal & botanical	21
	Other (Pharmaceuticals)	21
	Pharmaceutical preparations	21
	Unspecified	21
Plastics	Artificial & synthetic fibres	22
	Laminated plastics plates, sheets & shapes	22
	Other plastics products	22
	Plastic bottles	22
	Plastic pipes, pipe fitting & unlaminated profile shapes	22
	Plastics packaging materials & unlaminated film & sheets	22
	Polystyrene foam products	22
	Urethane, foam products & other compounds	22
Rubber	Other rubber products	22
	Rubber hoses & belting	22
	Tyres	22
Semiconductors	Other (Semiconductors)	26
	Semiconductor machinery	28
	Semiconductors & other electronic components	26
Software & IT services	All other information services	63
	Business support services	82
Space & Defence	Guided missile & space vehicles	30
	Military armoured vehicle, tank, & components	30
	Other (Space & Defence)	30
Textiles	Apparel accessories & other apparel	13
	Apparel knitting	13
	Clothing & clothing accessories	14
	Cut & sew apparel	14
	Footwear	15
	Furniture, homeware & related products (Textiles)	31
	Leather & hide tanning and finishing	15
	Other (Textiles)	13
	Other leather & allied products	15
	Resin & artificial synthetic fibres & filaments	20
	Textiles & Textile Mills	13

tbc.

Appendix Table A.1.3 / tbc.

sector	*sub-sector*	*NACE Rev. 2 correspondence*
Transportation	Freight/Distribution Services	49
	Truck transportation	49
Warehousing & Storage	Warehousing & storage	52
Wood Products	Furniture, homeware & related products (Consumer Products)	31
	Furniture, homeware & related products (Wood Products)	31
	Other (Wood Products)	16
	Wood products	16

APPENDIX 2: COUNTRY CODES AND GROUPINGS

Appendix Table A.2.1 / Country codes

country code	country	world region	income group
ARG	Argentina	Latin America & Caribbean	UM
AUS	Australia	East Asia & Pacific	H
AUT	Austria	Europe & Central Asia	H
BEL	Belgium	Europe & Central Asia	H
BGR	Bulgaria	Europe & Central Asia	UM
BRA	Brazil	Latin America & Caribbean	UM
BRN	Brunei	East Asia & Pacific	H
CAN	Canada	North America	H
CHE	Switzerland	Europe & Central Asia	H
CHL	Chile	Latin America & Caribbean	UM
CHN	China	East Asia & Pacific	UM
COL	Colombia	Latin America & Caribbean	UM
CRI	Costa Rica	Latin America & Caribbean	UM
CZE	Czech Republic	Europe & Central Asia	H
DEU	Germany	Europe & Central Asia	H
DNK	Denmark	Europe & Central Asia	H
ESP	Spain	Europe & Central Asia	H
EST	Estonia	Europe & Central Asia	H
FIN	Finland	Europe & Central Asia	H
FRA	France	Europe & Central Asia	H
GBR	United Kingdom	Europe & Central Asia	H
GRC	Greece	Europe & Central Asia	H
HKG	Hong Kong	East Asia & Pacific	H
HRV	Croatia	Europe & Central Asia	H
HUN	Hungary	Europe & Central Asia	H
IDN	Indonesia	East Asia & Pacific	LM
IND	India	South Asia	LM
IRL	Ireland	Europe & Central Asia	H
ISR	Israel	Middle East & North Africa	H
ITA	Italy	Europe & Central Asia	H
JPN	Japan	East Asia & Pacific	H
KOR	South Korea	East Asia & Pacific	H
LTU	Lithuania	Europe & Central Asia	UM
LUX	Luxembourg	Europe & Central Asia	H
LVA	Latvia	Europe & Central Asia	UM
MAR	Morocco	Middle East & North Africa	LM
MEX	Mexico	Latin America & Caribbean	UM
MLT	Malta	Middle East & North Africa	H
MYS	Malaysia	East Asia & Pacific	UM
NLD	Netherlands	Europe & Central Asia	H
NOR	Norway	Europe & Central Asia	H
NZL	New Zealand	East Asia & Pacific	H
PER	Peru	Latin America & Caribbean	UM
PHL	Philippines	East Asia & Pacific	LM
POL	Poland	Europe & Central Asia	H
PRT	Portugal	Europe & Central Asia	H
ROU	Romania	Europe & Central Asia	UM
RUS	Russia	Europe & Central Asia	UM
SAU	Saudi Arabia	Middle East & North Africa	H
SGP	Singapore	East Asia & Pacific	H
SRB	Serbia	Europe & Central Asia	UM
SVK	Slovakia	Europe & Central Asia	H
SVN	Slovenia	Europe & Central Asia	H
SWE	Sweden	Europe & Central Asia	H
THA	Thailand	East Asia & Pacific	UM
TUN	Tunisia	Middle East & North Africa	UM
TUR	Turkey	Europe & Central Asia	UM
TWN	Taiwan	East Asia & Pacific	H
USA	United States	North America	H
VNM	Viet Nam	East Asia & Pacific	LM
ZAF	South Africa	Sub-Saharan Africa	UM

Note: H= high income country; UM= upper-middle income country; LM= lower income country. World regions and income categories according to World Bank. Countries' categorisation in income groups as of 2000.

APPENDIX 3: FUNCTIONAL PROFILES

Appendix Table A.3.1 / Functional profiles based on RFS, 2003-2015 (country level)

	pre-production		production	post-production	
	HQ	R&D	Production	Logistics & retail	support services
European Union					
AUT	1.13	**1.24**	0.85	1.19	0.98
BEL	**1.22**	1.13	0.77	**1.57**	0.79
BGR	0.08	0.25	**1.37**	0.82	0.93
CYP			0.50	**2.83**	0.68
CZE	0.35	0.76	**1.39**	0.77	0.75
DEU	**1.35**	0.93	0.54	1.07	**1.66**
DNK	**2.76**	**1.38**	0.27	**1.33**	**1.49**
ESP	**1.35**	0.96	0.83	**1.33**	0.93
EST	0.19	0.46	**1.44**	1.05	0.53
FIN	0.36	0.84	0.42	**1.26**	**1.92**
FRA	0.96	1.08	0.88	1.16	1.04
GBR	**1.86**	1.39	0.58	**1.37**	1.09
GRC	1.03	0.52	0.36	**1.48**	**1.79**
HRV		0.37	1.03	**1.25**	1.11
HUN	0.27	0.58	**1.60**	0.75	0.49
IRL	1.96	2.00	0.69	1.25	0.81
ITA	0.61	**1.32**	0.60	**1.32**	**1.35**
LTU	0.31	0.75	1.18	0.70	1.18
LUX	**2.06**	1.06	0.42	**2.05**	0.82
LVA	0.13	0.08	1.07	1.14	**1.20**
MLT	0.86	0.52	0.90	**1.24**	1.12
NLD	**2.67**	0.77	0.42	**1.64**	1.15
POL	0.27	0.53	**1.37**	0.84	0.79
ROU	0.29	0.44	**1.43**	0.85	0.71
PRT	0.15	0.53	0.88	**1.56**	1.01
SVK	0.19	0.30	**1.61**	0.80	0.52
SVN	0.57	0.58	1.16	1.06	0.89
SWE	1.06	**1.45**	0.65	**1.24**	**1.23**
NAFTA/USMCA					
CAN	0.99	0.92	0.84	**1.35**	0.97
MEX	0.30	0.60	**1.60**	0.61	0.59
USA	**2.35**	1.04	1.02	0.87	0.82
South East Asia					
BGR	0.08	0.25	**1.37**	0.82	0.93
BRN	**1.22**	0.74	0.27	**2.51**	0.91
CHN	0.60	**1.32**	**1.31**	0.63	0.79
HKG	**2.63**	0.63	0.07	**2.02**	**1.46**
IDN	0.08	0.44	**1.50**	0.70	0.77
JPN	0.64	**1.65**	0.33	1.10	**1.91**
KHM	0.22	0.39	**1.21**	0.71	**1.24**
KOR	0.39	**1.92**	0.95	0.68	1.19
LAO		0.20	**1.73**	0.54	0.61
MMR	0.11	0.13	0.79	1.37	1.45
MYS	0.74	0.96	1.10	0.90	0.98
PHL	0.31	0.67	0.78	0.78	**1.80**
SGP	**2.45**	**1.97**	0.42	**1.42**	1.04
THA	0.43	0.65	**1.56**	0.48	0.73
TWN	0.68	**2.79**	0.72	0.55	**1.39**
VNM	0.17	0.39	**1.53**	0.64	0.77

Note: HQ = headquarter services. *RFS* of 1.2 or more in bold.

APPENDIX 4: ADDITIONAL REGRESSION RESULTS

This appendix contains the main regressions results presented in Section 5.2 of the main text estimated with a conventional ordinary-least-square estimator (OLS). Appendix Tables A.4.1 – A.4.3 hence correspond to Tables 1 – 3 of the main text.

Appendix Table A.4.1 / Value added capture and RPSI, restricted sample – OLS estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RPSI	-0.0392***	-0.0211*	-0.0224*	-0.0218*	-0.0236*	-0.0426***	-0.0420**
	(0.0107)	(0.0126)	(0.0128)	(0.0128)	(0.0129)	(0.0158)	(0.0163)
ln GDPpc		0.0792***	0.0847***	0.0831***	0.0863***		
		(0.0194)	(0.0196)	(0.0195)	(0.0195)		
ln GDP		0.0083*	0.0063	0.0070	0.0053		
		(0.0044)	(0.0045)	(0.0044)	(0.0046)		
import intensity			-0.0043		-0.0193**		-0.0143
			(0.0034)		(0.0083)		(0.0139)
export intensity				-0.0019	0.0085*		0.0030
				(0.0018)	(0.0049)		(0.0089)
industry effects	no	yes	yes	yes	yes	yes	yes
region effects	no	yes	yes	yes	yes	no	no
income group effects	no	yes	yes	yes	yes	no	no
country fixed effects	no	no	no	no	no	yes	yes
Obs.	223	223	223	223	223	223	223
R-sq.	0.068	0.543	0.55	0.547	0.555	0.697	0.706
R-sq.-adj.	0.063	0.497	0.503	0.500	0.506	0.597	0.605
F-test	13.43	13.28	12.76	12.69	12.33	10.02	8.667

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. Sample is restricted to observations with 50 or more greenfield FDI projects at the country-industry level. RPSI are averages over the period 2003-2015. Estimated with STATA.

Appendix Table A.4.2 / Value added capture and RPSI, full sample – OLS estimations

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
RPSI	-0.0267***	-0.0230***	-0.0229***	-0.0226***	-0.0233***	-0.0131	-0.0124
	(0.0082)	(0.0085)	(0.0085)	(0.0085)	(0.0086)	(0.0108)	(0.0110)
ln GDPpc		0.0500***	0.0572***	0.0548***	0.0587***		
		(0.0134)	(0.0138)	(0.0136)	(0.0136)		
ln GDP		-0.0036	-0.0048	-0.0043	-0.0053*		
		(0.0030)	(0.0031)	(0.0030)	(0.0031)		
import intensity			-0.0066		-0.0135**		0.0035
			(0.0041)		(0.0066)		(0.0094)
export intensity				-0.0032	0.0039		-0.0040
				(0.0022)	(0.0042)		(0.0054)
industry effects	no	yes	yes	yes	yes	yes	yes
region effects	no	yes	yes	yes	yes	no	no
income group effects	no	yes	yes	yes	yes	no	no
country fixed effects	no	no	no	no	no	yes	yes
Obs.	461	461	461	461	461	461	461
R-sq.	0.031	0.342	0.352	0.35	0.353	0.545	0.548
R-sq.-adj.	0.028	0.312	0.321	0.318	0.320	0.464	0.465
F-test	10.50	13.64	13.06	13.04	12.62	15.13	12.89

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. RPSI are averages over the period 2003-2015. Estimated with STATA.

The OLS regressions fully confirm the results from the fractional probit response estimator. The OLS result in the main specification (specification 7) in Table A.4.1 for the restricted sample suggests a coefficient of -0.0420 for the *RPSI*. This coincides exactly with the average marginal effect found in the fractional probit response model (compare Table 1 in the main text).

Switching to the results for the full sample in Table A.4.2 the coefficient of the RPSI is statistically not significant as in the corresponding Table 2 when the model is estimated with the fractional probit response estimator. As mentioned in the main text, an explanation for this is that the relationship between the *RPSI* and the value added coefficients may be dependent on the GDP per capita of countries. This is the case too in the OLS specification for the full sample as shown in specification 7' in Table A.4.3.

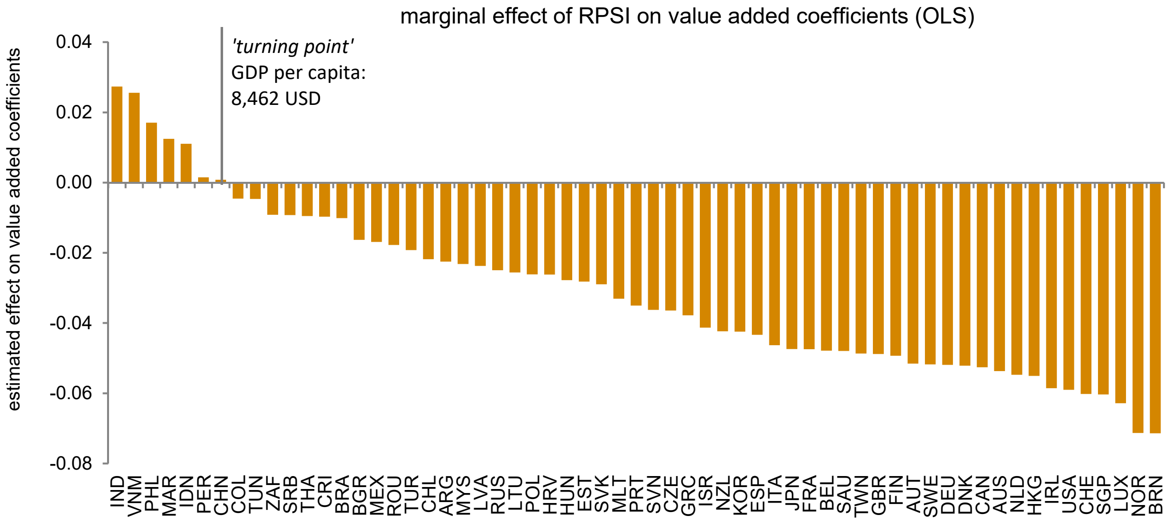
Appendix Table A.4.3 / Value added capture and RPSI, non-linear specifications

Sample	restricted sample		full sample	
	(5')	(7')	(5')	(7')
RPSI	-0.0272*	-0.0539***	-0.0332***	-0.0319**
	(0.0138)	(0.0183)	(0.0108)	(0.0136)
RPSI x ln GDPpc	-0.0127	-0.0284	-0.0191	-0.0333**
	(0.0215)	(0.0256)	(0.0127)	(0.0157)
ln GDPpc	0.0823***		0.0489***	
	(0.0205)		(0.0151)	
ln GDP	0.0051		-0.0053*	
	(0.0046)		(0.0031)	
import intensity	-0.0198**	-0.0169	-0.0152**	0.0007
	(0.0083)	(0.0140)	(0.0068)	(0.0096)
export intensity	0.0088*	0.0056	0.0049	-0.0022
	(0.0048)	(0.0091)	(0.0043)	(0.0055)
industry effects	yes	yes	yes	yes
region effects	yes	no	yes	no
income group effects	yes	no	yes	no
country fixed effects	no	yes	no	yes
Obs.	223	223	461	461
R-sq.	0.5557	0.7084	0.3571	0.5561
R-sq.-adj.	0.504	0.605	0.323	0.472
F-test	11.92	8.892	11.93	12.25

Note: Robust standard errors in parentheses. ***, **, and * indicate statistical significant at the 1%, 5% and 10% level respectively. RPSI and ln GDP per capita enter the regression in centred form. RPSI are averages over the period 2003-2015. Estimated with STATA.

Based on the OLS point estimates for the main effect and the interaction term, the country-specific marginal effects of RPSI on the value added coefficients can easily be retrieved. They are displayed in Appendix Figure A.4.1. The figure illustrates that for the poorer countries in the sample such as India, Vietnam or Morocco, the specialisation in the value chain function production appears to be beneficial in terms of value added capture. However, many countries that have been described as factory economies due to their functional profile, such as Thailand, Mexico or Slovakia, are beyond the GDP per capita at which a strong specialisation in production activities entails a positive effect on value creation.

Appendix Figure A.4.1 / Marginal effect of RPSI on value added coefficients for countries, full sample



Note: Based on OLS estimations for the full sample – specification 7' in Table A.4.3.

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