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Functional Specialisation in Global Value Chains and the Middle-Income Trap

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Abstract

The emergence of global value chains (GVCs) has opened up the possibility of functional specialisation as a new dimension of the international dimension of labour. Along with the usual gains from trade associated with specialisation according to comparative advantages, the functional specialisation along value chains functions also reinforce technological asymmetries within the world economy. This paper presents empirical evidence on this asymmetry confirming that developing countries serve primarily as 'factory economies' while developed countries take the role of 'headquarter economies' (Baldwin, 2013). The concept of the 'smile curve' suggests that factory economies generate comparatively little value added in their value chain activities. If this is the case, the specialisation as a factory can be expected to act as a drag on economic growth. Our econometric analysis shows that this is indeed true but only beyond a GDP per capita threshold of about USD 14,800. We see this result tightly connected to the notion of a functional middle-income trap. Escaping this growth trap is difficult but by no means impossible and requires countries to adjust their functional specialisation patterns towards more knowledge-intensive value chain functions, especially in the knowledge-intensive pre-production activities.

Keywords: functional specialisation, global value chains, smile curve, economic growth

JEL classification: F60, L23, F20, F43

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1. Introduction

The emergence of global value chains (GVCs) has opened up the possibility of functional specialisation as a new dimension of the international dimension of labour. This geographic fragmentation of the value chain (Jones and Kierzkowski, 1990) implies some form of 'offshoring', that is, the shift of one or more value chain functions to a foreign country. Offshoring can take the form of foreign direct investment (FDI) or contracting with foreign suppliers. In any case, this slicing of the value chain has become a feasible option as progress in information and communication technologies have lowered the co-ordination costs (Baldwin, 2011; Baldwin 2013). Technological progress can be seen as a necessary condition for offshoring and functional specialisation. In order to be realised at a larger scale, however, it also requires the existence of large differences in wage costs between countries which make internationally fragmented production profitable (Arndt and Kierzkowski, 2001) and has been the sufficient condition.

Baldwin and Lopez-Gonzalez (2015) point to a technological asymmetry in this relatively new form of the international division of labour[1]. Guided by capabilities-based comparative advantages, developed countries take the position of 'headquarter economies' that arrange the production networks in the system, while developing countries mainly act as 'factory economies' performing predominantly labour-intensive production-related activities. To confirm this assertion we develop a measure for revealed comparative advantages which captures the functional dimension of specialisation. This measure is labelled relative functional specialisation. It is derived from project-level data on inward greenfield FDI projects which contain information on the functions that the newly established FDI subsidiaries perform. Aggregating the inward greenfield FDI projects result in country-level functional profiles. Hence, a first contribution to the literature of this paper is to derive a GVC-based measure for functional specialisation which allows us to identify factory economies and headquarter economies and the associated technical asymmetries especially within world regions, especially Europe and South East Asia.

Developing countries may benefit from their integration into the global economy in many ways. Apart from the static gains from trade argument, multinational firms managing international production networks may have an incentive to share knowledge and technologies with production partners that are part of this network (Baldwin, 2016) – even though the strength of this channel depends on the type of GVC (Gereffi et al, 2005). The frequency and the extent of augmented technological spill overs within GVCs is a hotly debated issue in the literature (see e.g. Szalavetz, 2017).

The key aspect emphasised in this paper, however, is the fact that global value chains (GVCs) facilitates developing countries' entry into new manufacturing industry. The reason is that with GVCs in place, it suffices to master a segment of the production process instead of having to acquire the entire range of capabilities needed for the production of a product to participate in the joint production of that product (Collier and Venables, 2007). This way, GVCs can initiate or accelerate a structural shift from agriculture to manufacturing. This kind of structural change is emphasised by Bulman et al. (2014) as one of the main challenges that countries which have escaped the so-called middle-income trap (MIT) have successfully mastered. The term middle-income trap denotes the phenomenon whereby a country

[1] Baldwin (2013) also calls this the 'second unbundling'.

becomes entrenched in the lower or upper middle-income range, making it so that only few countries have reached high income status over the past 45 years (Cherif and Hasanov, 2015).

In this paper we emphasise functional specialisation as an additional structural feature influencing countries' growth trajectories and that in many instances the MIT is a 'functional trap'.

In line with various strands in the literature, above all the notion of the 'smile curve' which suggests that the potential for value added capture is comparatively low at the actual production stage occupied by factory economies, we focus on the functional specialisation in production versus specialisation in all other pre- and post-production activities. The ratio between the two yields an index for countries' relative specialisation in production which will be used in the econometric analysis.

Importantly, if the concept of smile curve economics is valid, the specialisation as a factory economy should hamper economic growth exactly because of the comparatively lower value added generation. We add to the literature by embedding the relative production specialisation index of countries into a standard empirical growth model. We consider this as a first attempt to test the *dynamic* implications of the smile curve hypothesis thereby bridging two strands of the literature which are those dealing with functional specialisation and global value chains on the one hand and the vast empirical growth literature, including in particular the phenomenon of the middle income trap on the other hand.

The reminder of the paper is structured as follows. Section 2 positions this paper in the GVC literature and the growth literature addressing the phenomenon of the middle income trap. Section 3 proceeds with the exposition of the theoretical framework, including methodological aspects of the concepts of functional specialisation and some descriptive evidence. Section 4 presents the empirical growth model, the results of which are the subject of Section 5. Section 6 concludes.

2. Related literature

This paper is at the intersection of the GVC literature and the empirical growth literature. Starting with the former, it is interesting to note that much of the existing literature on specialisation along the value chain is derived from inter-industry linkages. Examples include Baldwin et al. (2014) and Baldwin et al. (2015) who 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 changes in the value added contributions of broad sectors (primary, manufacturing, services) to the exports of South East Asian countries between 1985 and 2005. They find that 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 yields a kind of country-level smile curve – or smirk curve[2] - that resembles the firm level smile curve conceptualised by Stan Shih and which will be further discussed in the next section. Note, however, that given the choice of the methodology the link to functional specialisation is rather loose.

The same is true for the approach to functional specialisation by Ye et al. (2015) who base their analysis on the concept of 'upstreamness' (Fally, 2011; Antràs et al., 2012). They rank 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.

An important contribution is that of 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. A key aspect of this paper is that it establishes a direct link between the position of firms along the value chain and their potential to create value added. Methodologically, however, the paper by Rungi and Del Prete (2018) uses firms' primary industry affiliation for identifying their position along the value chain.

While there is some overlap between functions and detailed industries as defined in common industry classifications, this approach negates the idea that functional specialisation adds an additional dimension for international specialisation.

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2 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.

To our knowledge, Timmer et al. (2019) were the first to avoid the mingling of functions and industries. They achieve this by mapping occupations into business functions, such as engineers and related professionals into the function R&D or assemblers into the fabrication stage[3]. 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[4]. 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.

In a companion paper to this one (Stöllinger, 2019), the impact of functional specialisation in production activities derived from inward greenfield FDI on the potential for capturing value added on the industry-country level is estimated. One of the major findings is that specialisation as a factory economy within individual industries leads to lower value added coefficients. The current paper builds on exactly this methodology but shifts to a dynamic analysis by focusing on the impact of functional specialisation patterns of economic growth.

Among the vast empirical growth literature we see this work closely related to papers on the MIT. In a very general sense, the MIT describes a situation where countries somewhere along the lower or upper middle income range experience a decline in their growth rates which prevents them to graduate to the club of high income countries (Felipe et al, 2012; Glawe and Wagner, 2016). The term middle income trap makes its first appearance in a book by the World Bank on the East Asian Renaissance (Gill and Kharas, 2007). The books stresses the insights of New Growth Theory, New Trade Theory and New Economic Geography and their key elements, economies of scale, innovation and agglomeration, for the growth processes of middle income countries. In particular it is emphasised that in order not to run into diminishing returns to scale, countries need at some stage shift from an extensive growth (factor accumulation) to an intensive growth trajectory based on advances in productivity. The latter, in turn, calls for innovation the build up of technological capabilities and skills in addition to the expansion of the capital stock. More precisely, the authors argue that middle income countries face three transformations which are a slow down and eventually a reverse in the diversification of production; a decline in the relative importance of physical investment as a driver of growth and the insufficiency of imitation skills as the advantages of backwardness erodes. All these factors make middle income countries run into the problem of diminishing returns. Therefore these transformations can only be successfully mastered with a qualitative switch towards a growth process that is based on innovation and a skill base (und an underlying education system) that enables workers to shape new products and production processes (Gill and Kharas, 2007, p. 18).

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3 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.

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

A key argument for the existence of such a growth trap in the middle income range is that since the 1960s and 1970s only a handful of middle income countries have reached high-income level status with the exact number depending on the definition of the thresholds[5] (see Wade, 2016). However, the empirical evidence for accumulated growth decelerations in the middle income range is weak at best. Bulman et al. (2017), for example, do not find evidence for a systemic deceleration of convergence processes along the lower or upper middle income range. Likewise, in their literature survey, Im and Rosenblatt (2013) conclude that there is little empirical support for an MIT based on the analysis of transition matrices using various absolute and relative thresholds for the country groups. Focusing on initially fast growing middle income countries, Eichengreen at al. (2012), however, identify a significant growth slowdown – defined as a downshifts in the growth rate by at least 2 percentage points – of rapidly growing economies when their per capita incomes approaches USD 17,000 (in 2005 international dollars). In a follow-up paper by the same authors Eichengreen at al. (2013) using updated data, their analysis points to growth slowdowns at two points of the income distribution, one in the USD 10,000-USD 11,000 range and a second in the USD 15,000 to USD 16,0000.

As pointed out by Felipe et al. (2012) the issue of the MIT boils down to the question of a growth failure (absolute thresholds) or a convergence failure (relative thresholds). There is, however, also a large body of theoretical literature on the mechanisms behind the phenomenon of the MIT. Two of the most important theoretical explanations are structural change and the advantage of backwardness (Glawe and Wagner, 2016). The first argument is based on the idea of a dual economy consisting of a traditional (agricultural) sector with no or low productivity growth and a modern sector (manufacturing) with higher productivity growth as suggested by Lewis (1954) to prevail in many developing countries. Developing countries can therefore benefit from a structural changes bonus (Timmer and Szirmai, 2010) by shifting resources from agriculture to the manufacturing sector. However, as countries grow richer, the dualism in the economy and the relative size of the agricultural sector decline, structural change as a driver of growth is losing steam.

The second argument is built upon Gerschenkron's famous advantages of backwardness. As long as developing countries have the necessary absorptive capacity (Cohen and Levinthal, 1989) to imitate existing technologies and to adapt them to local circumstances, they can increase their growth rate by imitating foreign technologies. The positive impact on the growth rate stems from the fact that imitation is less costly than innovation, so that the import of foreign technologies lifts the growth rate. However, this factor also fades out as countries move closer to the technological frontier. At some stage, typically in the upper-middle income range, countries need to begin the transformation to nurture economic growth via innovation which requires the appropriate skill base.

Investment in R&D, innovation and skills are also the factors shaping countries' comparative advantages and in turn their functional specialisation profiles. This way, the issue of the MIT and the issue of functional specialisation are linked. It should be mentioned, though, that these mechanisms have not been 'discovered' by the MIT literature but have been central elements of the development and growth literature for a long time.

5 The literature distinguishes between absolute and relative thresholds where the former sets the thresholds in terms of real US-Dollars whilethe latter defines the threshold relative to the US, e,g. at 5 and 50 per cent of US-income, or alternatively at specific percentiles of the global income distribution. Using relative thresholds Cherif and Hasanov (2015), for example, find that between 1970 and 2010 only nine middle income countries have transitioned to the high income range (above 46% of US GDP per capita).

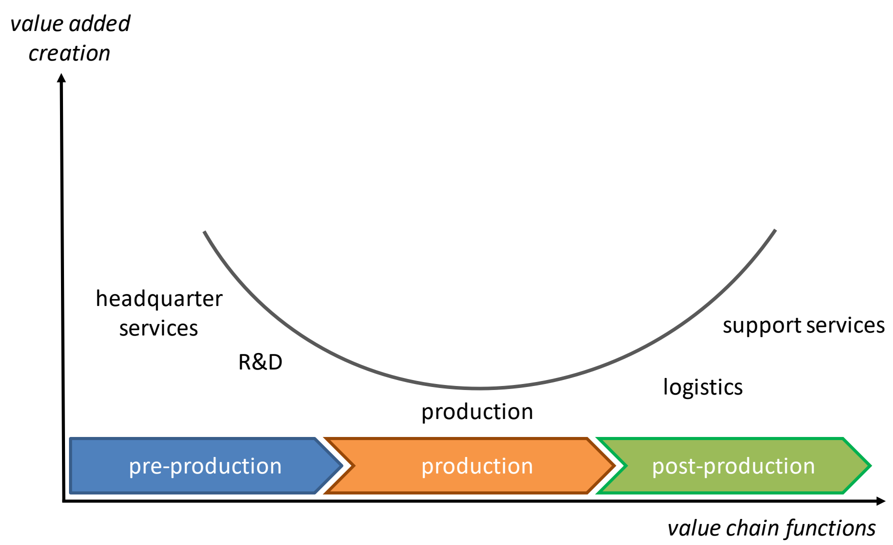
3. Theoretical framework

This section presents a theoretical framework that links the issue of functional specialisation in GVCs with the Middle Income Trap. For this purpose the MIT is considered to reflect too low economic growth as also argued by Felipe at al. (2012). At the same we also consider the qualitative growth aspects highlighted in the literature, especially the fact that the imitation and absorption of foreign technologies will fade out sooner or later and that it has to be replaced with other sources of growth. This reasoning is linked to functional specialisation along value chain functions as countries' functional specialisation patterns are shaped by the underlying factor endowments and capabilities. This aspect shall be discussed first.

3.1. FUNCTIONAL SPECIALISATION AND THE SMILE CURVE

One of the central working hypotheses of this paper is the central prediction of the smile curve. Developed by Stan Shih, the smile curve predicts that along a firm's value chain the potential for capturing value added varies significantly across the individual value chains functions and in particular that the actual production activity is typically associated with comparatively little value added creation. More value added is captured by the knowledge-intensive pre-production function such as headquarter activities or R&D and design and the same is true for a number of post-production services including retail or certain customer support services. A schematic presentation of the smile curve is shown in Figure1.

Figure 1 / The smile curve (schematic representation)



Source: Own elaboration inspired by Mudambi (2008).

Leaving the details of how the functional specialisation patterns of countries are derived for later, it is important to note at this stage that this varying potential for value added capture across value chain functions has increased in importance with the emergence of international production networks and global value chains. As long as all value chain functions of a manufacturing process 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[6] of individual value chain functions this has changed significantly. International production networks imply geographically-dispersed manufacturing processes where the individual value chain functions are being performed in different countries and regions. This opened up the opportunity for functional specialisation as a new dimension of the international dimension of labour which is additional to the specialisation in industries.

It should be mentioned that ‘smile economics’ does not represent a unified theoretical framework (yet). It is rather a concept that summarises a key empirical result emerging from (mainly business literature) studies (e.g. Mudambi, 2008; Shin et al., 2012; Milberg and Winkler, 2013). However, there are economic mechanisms which underpin the predictions of the smile curve. In our view, the most important mechanisms in this respect are competition and comparative advantages.

It is generally accepted that the geographic fragmentation of the value chain (Jones and Kierzkowski, 1990, 2001) was made possible by progress in information and communication technologies which have lowered the coordination costs associated with offshoring (Baldwin, 2011; Baldwin 2013). What made offshoring profitable, though, were the existing differences in wage costs between countries (Jones and Kierzkowski, 1990). Organisational skills necessary for co-ordinating activities as well as the availability of cheap labour are central for the smile curve hypothesis as they shape comparative advantages and further the functional specialisation patterns.

To begin with, a geographically-dispersed value chain requires complex management and controlling expertise to orchestrate the diverse activities within the value chain. It is mainly multinational enterprises (MNEs), so-called lead firms, which assume these management capabilities. Importantly, these management capabilities – needed to fulfil headquarter functions – are difficult to emulate. Property rights and intangible assets such management and organisational capabilities form part of the ownership-specific advantages, which is one of the advantages that firms need for engaging successfully in FDI. (Dunning, 1977; Dunning 1980)[7]. Since the MNEs are predominantly located in developed countries, Robert Wade’s claim that *“Western, especially American, firms occupy the commanding heights of GVCs”* seems highly appropriate (Wade, 2018, p. 539).

In contrast, the main involvement of developing countries in global value chains comes via its abundant pool of unskilled labour. In this context it is worthwhile noting that the emergence of GVCs facilitates the entry of developing countries 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). This way,

6 Offshoring can take the form of vertical FDI or outsourcing to (legally) independent firms which, however, form part of the production network.

7 The other two advantages in the so-called OLI-paradigm are locational advantages and internalisation advantages (Dunning, 1977; Dunning, 1980).

guided by their resource endowments, organisational and technological capabilities, low and middle income countries have *functional* comparative advantages in labour-intensive production activities, including final assembly.

The functional division of labour can be characterised in the following way: in line with their functional comparative advantages, developing countries engage in the value chain function production, while developed countries enjoy comparative advantages in knowledge and intangible assets allowing them to specialise in headquarter functions, R&D and profitable post-production services including retail services. This 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’*. These claims about developing and developed countries’ roles in GVCs will be verified empirically.

In addition to comparative advantages, competition is essential in explaining why the specialisation as a ‘factory economy’ may be sub-optimal, especially when countries catch-up and move closer to the technological frontier[8]. The reason is the growing competitive pressure in (especially basic) manufacturing activities. The strong competition in production activities is essentially the flipside of the GVC-induced refinement in the international division of labour and the fact that it has become easier for developing countries to get a foothold in new manufacturing industries. And it is exactly because assembly and other simple production activities can be performed by a wide array of firms in almost any country (given that basic economic and political framework conditions are in place) that the degree of competition is very high and the potential for value added creation comparatively low[9]. In contrast, the high complexity and knowledge-intensity of headquarter functions or R&D activities shields firms and countries from excessive competition. Given the relatively low 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)[10].

In summary, the logic of the smile curve can be explained by functional comparative advantages in combination with the varying degree of competition across the individual functions along the value chain.

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8 There is in fact ample case study evidence 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)

9 The facilitation of the entry into manufacturing activities led to a ‘commodification’ of manufacturing production. 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. Therefore we see functional division of labour at the global level fitting also in core-periphery frameworks in dependency theory (Prebisch, 1950) and world system analysis popular in history studies (e.g. Wallerstein, 1974; 2004).

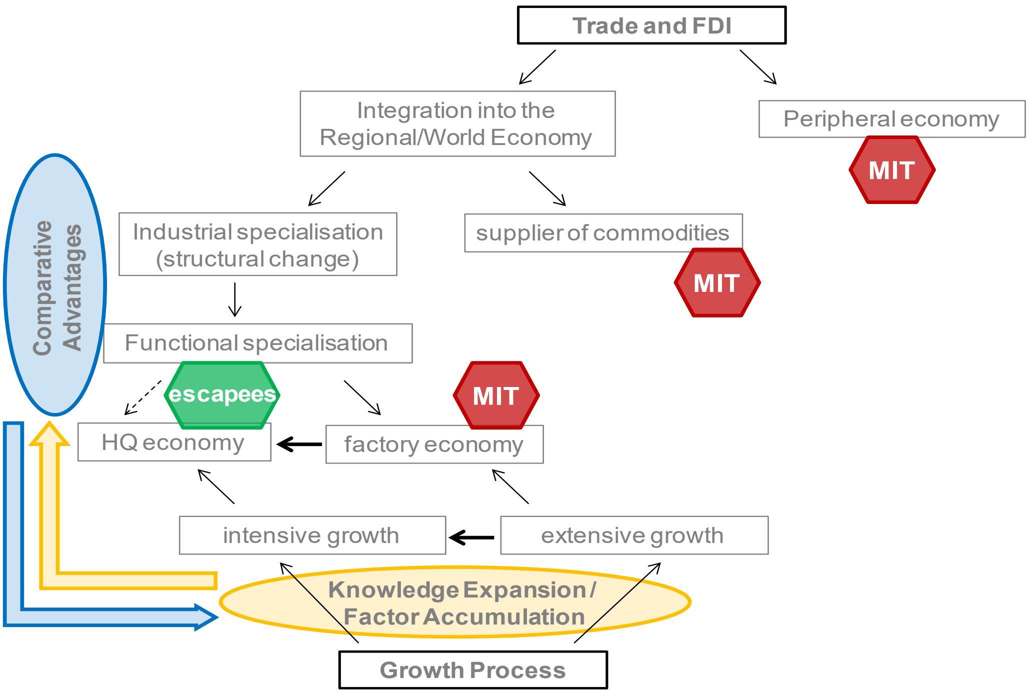
10 From a system theoretical perspective, the economic viability of R&D activities also depends on the quality (respectively the existence of) the National Innovation System (Pavitt, 1995) in which a firm operates.

3.2. THE POSSIBILITY OF A *FUNCTIONAL* MIDDLE INCOME TRAP

Having discussed the implications for value added creation arising from countries' functional specialisations along comparative advantages, we can integrate this into an open economy growth framework. The interdependencies between functional specialisations as factory economies or headquarter economies, to use the expressions by Baldwin and Lopez-Gonzalez (2015), and a possible derailment of countries' growth process and convergence processes are illustrated in Figure 2.

The framework follows Gill and Kharas (2007) by underlining the importance of international trade on the one hand and the accumulation of knowledge and capabilities on the other hand as prerequisites for a sustained growth process beyond the upper middle income stage. More precisely, in line with the insights from international growth theory, it is assumed that integration into the world economy helps developing countries to spur growth. If a country fails to integrate, either by choice or because of its inability to attract FDI and/or obtain export market shares, it runs the risk of remaining a low growth, peripheral country which might constitute a first type of an MIT – or a growth trap more generally, as this may also occur at a low income stage.

Figure 2 / Functional specialisation and the MIT



Note: MIT = Middle Income Trap; HQ = headquarter economy.
Source: own elaboration.

Once an economy opens up to the global economy, it should be able to exploit a structural change bonus by shifting resources towards manufacturing. The increased market size for domestic products allows countries to exploit economies of scale. Otherwise it might end up as a global supplier of commodities which may be the situation experienced by many Latin American countries. Most likely, a country that has successfully tapped into global manufacturing has done so by specialising as a factory economy. In order to avoid a functional growth trap, it needs to adjust its functional specialisation and shift towards the functional specialisation of a headquarter economy. The lower part of the figure should demonstrate that such a functional shift is unlikely to occur, unless the economy also manages to adjust its growth process from an extensive growth to an intensive growth process based on innovation and the expansion of knowledge and skills more generally. Hence, it is at this stage that countries might be caught in what we shall call a functional MIT.

Figure 2 therefore shows that countries may face different types of MITs along their development trajectory. The one this paper is interested in is the functional MIT that occurs when countries which are open and integrated into the world economy are stuck in their functional role as a factory economy. Therefore, the empirical growth model that we develop incorporates both a measure for countries' functional specialisation but also the distance to the technological frontier. The latter is important as we expect that a functional specialisation at a low level of per capita income is not a problem – on the contrary it may initially be growth-enhancing as simple production activities could constitute the only possibility to gain a foothold into global manufacturing activities.

3.3. FUNCTIONAL SPECIALISATION IN GVCS: METHODOLOGICAL ASPECTS AND DESCRIPTIVE EVIDENCE

Data on value chain functions performed by different firms is scarce[11]. This paper therefore proposes a new way of identifying the functional specialisation of countries which is derived from inward FDI. More precisely, it exploits the count of cross-border greenfield investment projects in a specific country as recorded by the fDi Markets crossborder investment monitor database[12]. This rich database contains information on individual cross-border greenfield investment projects[13] by multinational enterprises (MNEs), respectively announcements thereof. Starting in 2003, the database is continuously updated and includes more than 130 countries. For the purpose of this analysis we use the projects recorded for the period 2003-2015[14]. Importantly, the database does not only contain information on the industry of the established greenfield company but also on the value chain function[15] it serves. In fact, this is the essential feature of the database as it allows aggregating the number of projects by country and calculating for each country *i* the relative functional specialisation (*RPS*). This is possible because a large number of the functions (labelled activities) in the fDi Markets database can be mapped directly to the value chain functions of a manufacturing firm. We group these value chain functions into five groups of functions. These groups are *(i)* R&D, *(ii)* headquarter services, *(iii)* production, *(iv)* logistics and retail services and *(v)* after-sales services[16] which are exactly those typically found in schematic representations of the smile curve (see Figure 1).

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[11] The only paper we know of is Timmer et al. (2019) who derive the functional specialisation of countries from job embodiments in international trade combined with a mapping between value chain functions and occupations.

[12] See: https://www.fdimarkets.com/.

[13] The database only records new investment projects referred to as greenfield investments as well as major extensions of existing projects.

[14] We refrain from using the latest data available as some of the projects on record reflect announcements in order avoid including projects which are announced but not realised. According to the information obtained from FDI markets, the database is regularly cleansed of such cases.

[15] In the database the value chain functions are labelled 'activities'.

[16] See Appendix for details of the mappings.

Note that the relative functional specialisation measure is methodologically identical to the concept of revealed comparative advantages in the trade literature but applied to value chain functions of inward FDI projects instead of exports by industries or products. For the calculation of the RPS we use the number of projects by host country and function. Formally, the RFS of country *i* in function *f* is defined as:

$$RFS_i^f = \frac{p_i^f / p_i}{p_{world}^f / p_{world}}$$

where p_i^f is the number of projects serving function *f* in country *i* and p_i is the total number of projects realised in country *i* and analogously for the world. Hence, in analogy to the usual revealed comparative advantages, the RFS is just the share of inward greenfield FDI projects in country *i* serving function *f* (p_i^f) in the total number of inward projects in that country (p_i), relative to the corresponding share at the world level.

Having defined the *RFS*, we can compare the functional specialisation patterns of countries globally. First of all, we shall focus on specific country pairs within the Triad, i.e. the EU, South East Asia and NAFTA, which exemplify the functional division of labour within GVCs (Figure 3).

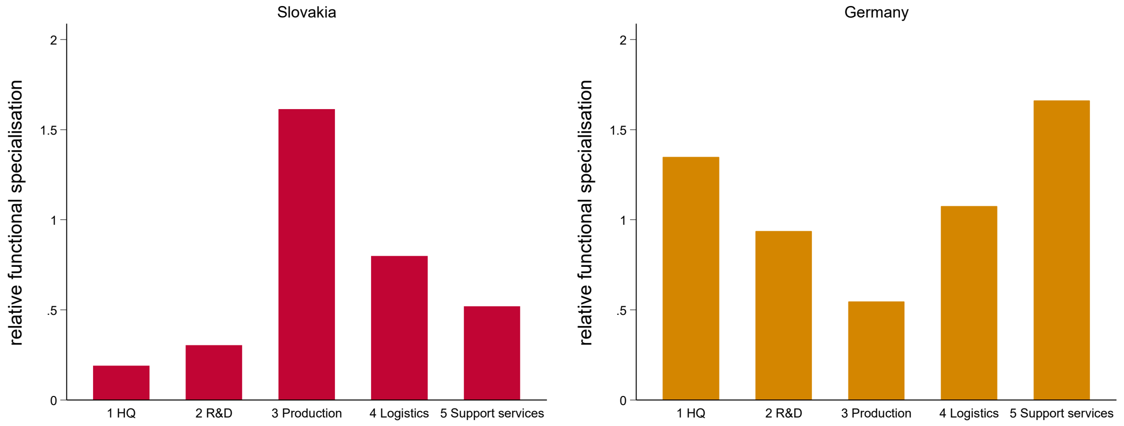
Starting with the EU, Germany and Slovakia are representative for headquarter economies on the one hand and factory economies on the other hand. While it is not entirely surprising that Germany specialises in knowledge-intensive pre-production functions, i.e. R&D and headquarter functions, it is still worth mentioning that Germany, although perceived as Europe's manufacturing powerhouse, does not specialise in actual production activities. Note that this pattern in the data explains indications of origin of the kind *"Designed and developed in Germany"* or *"Engineered in Germany"* that have become common on bicycles, washing machines and countless other products.

These results do by no mean question the role of Germany as leading producer of manufactured goods. Rather, they emphasise the intensity of functional division of labour within the Central European Manufacturing Core[17]. In contrast, Slovakia basically has the opposite functional specialisation to Germany, specialising primarily in production-related activities (see also Szalavetz, 2018). These complementarities between the members of the Central European Manufacturing Core have contributed to their international competitiveness.

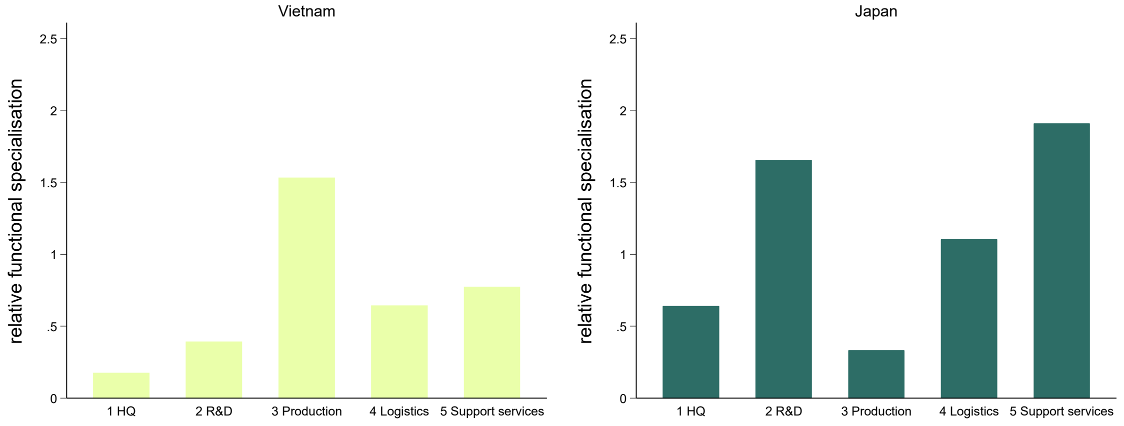
[17] The term Central European Manufacturing Core includes Germany, Austria, Czech Republic, Hungary, Poland and Slovakia and denotes the group of countries which are – relative to other EU Member States – strongly specialised in manufacturing (see Stöllinger, 2016).

Figure 3 / Relative functional specialisation (RFS) of selected country pairs across global regions, 2003-2015

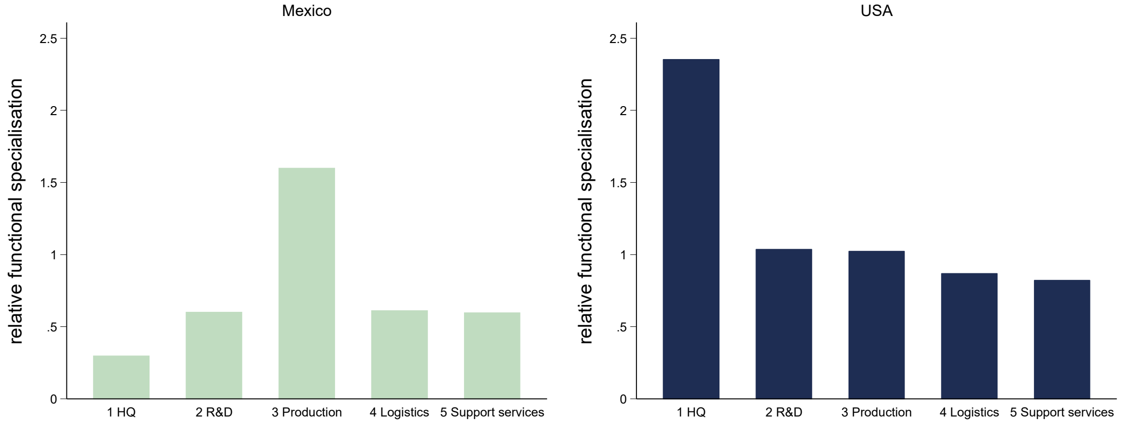
(a) European Union



(b) South East Asia



(c) North America

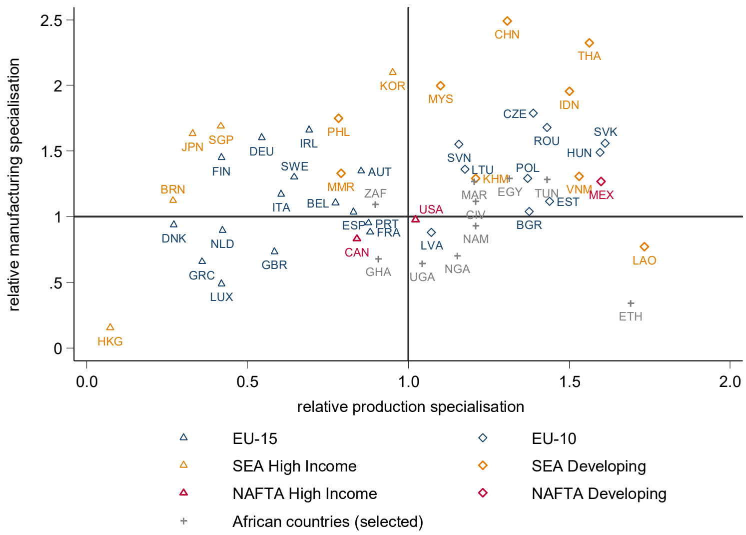


Note: HQ=headquarter functions.
Source: fDi markets database; own calculations.

The general pattern of functional specialisation therefore confirms the existing evidence (often based on case studies) that the actual production activities in Europe's manufacturing sector have been outsourced to a large extent to 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 'headquarter economies'. The examples from South East Asia and North America show that this pattern in the international functional division of labour is not limited to Europe but also observed in other regions with well-developed international production networks. In South East Asia, for example, and in line with the flying geese model (Akamatsu, 1962), Japan – being the first economy in South-East Asia to industrialise and since then the region's primary technology provider – also has the typical profile of a 'headquarter' economy. A similar constellation is found in North America where the US acts of the headquarter economy and Mexico fulfils the role of a factory economy, a fact that is also reflected in the country's maquiladoras.

These functional specialisation as factory and headquarter economies respectively confirm the claim by Baldwin and Lopez-Gonzalez (2015) that this form of the international division of labour implies a technological asymmetry as the *RFS* is clearly positively related to per capita income. Figure 4 provides further evidence on this technological asymmetry between the richer countries and the comparatively less developed countries in the regions which as reflected in their functional profiles. The figure shows the manufacturing share in value added of countries relative to the global average (on the vertical axis) together with the *RFS* of the value chain function production (on the horizontal axis)[18]. Therefore, manufacturing-oriented economies with high manufacturing shares are found in the upper part to the graph, whereas countries specialised as factory economies are found on the right-hand side in the figure.

Figure 4 / Relative manufacturing specialisation versus relative production specialisation worldwide, 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: World Bank, fDi markets database; own calculations.

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

A first interesting observation is that there only few ‘diamond’ symbols found in the left quadrants of the graph. This means that developing countries rarely manage to specialise as headquarter economies. Put differently, once a country develops the necessary capabilities to specialise as a headquarter economy, it is also more likely to become a high-income economy which is in line with the theoretical framework presented in the last section.

A second, European-specific, observation is that the integration into (mainly regional) value chains has led to a convergence in the production structures of the members of the Central European Manufacturing Core (Baker et al., 2015; Stehrer and Stöllinger, (2015). As a result, Germany has a similar share of manufacturing in value added as the Czech Republic, Hungary or Slovakia. As shown earlier, however, their functional profiles, however, are very different. Secondly, even though the United Kingdom and the Netherlands are countries now specialised in services (Baker et al., 2015) (resulting in comparatively smaller manufacturing shares), their functional specialisation in production-related activities is similar to that of Germany. Hence, 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.

A further aspect which is valid globally,is that countries which are tightly integrated into regional value chains tend to have more pronounced functional profiles, meaning that a country has either a very high or a rather low specialisation in the value chain function production. In Figure 4 a pronounced functional specialisation therefore implies that a country is located off the vertical line, either to the left (headquarter economy) or to the right (factory economy). The EU and South East Asia feature a large number of countries that have specialised functionally. In contrast, several African countries remain more marginalised and have difficulties to enter GVCs. This is why several African countries have a functional specialisation in production close to one. Examples include South Africa, Ghana or Uganda. Several of these countries also have a below average share of manufacturing. However, this is not because they have specialised as services economies but rather because they have difficulties developing a competitive manufacturing sector.

The patterns for functional specialisation in GVCs suggested by the FDI data alone are very interesting. With regards to the notion of a potential functional growth trap (or functional MIT), it is however also necessary to investigate the relationship between countries’ functional specialisations and their growth rates. For this a standard empirical growth model is employed and enlarged with an indicator for the functional specialisation.

4. Empirical model

The empirical growth model will make use of the theoretical considerations from section 3. In particular, it will include the possibility that the functional specialisation of countries affects their growth performance. In other words, we will expand an otherwise standard growth model with a measure for functional specialisation. Furthermore, the growth model will also feature a catch-up term to account for the advantage of backwardness, as this has proven to be important.

Regarding the indicator for functional specialisation profiles we shall use the RPS of the five functions shown in the descriptive analysis for selected countries. However, the five RPS values are condensed into one measure. Following the argument of the smile curve, this summary measure is defined as the ration between the RFS of the production-related activities on the one hand and the sum of the RFS for the pre-production and the post-production functions on the other hand.

Labelling this summary measure relative production specialisation index (RPSI), we have:

$$RPSI_i = \frac{RFS_i^{production}}{RFS_i^{pre-production} + RFS_i^{post-production}}$$

The econometric analysis will use this RPSI as the primary indicator for country *i's* functional specialisation, with higher values indicating that the country is more strongly specialised as a factory economy.

Since one might argue that not all post-production services are necessarily very innovation and knowledge-intensive, a second, alternative summary indicator for the specialisation is defined. This alternative indicator is just the ratio between the RFS of production-related activities and the RFS of pre-production functions. Adopting the distinction between 'headquarter' economies and 'factory' economies within global value chains used by Baldwin and Lopez-Gonzalez (2015) we label this indicator the relative factory-headquarter index (*RFQI*). For any country *i*, the *RFQI* is defined as:

$$RFQI_i = \frac{RFS_i^{production}}{RFS_i^{pre-production}}$$

In order to econometrically test the relationship between functional specialisation and economic growth, this *RPSI* (or alternatively the *RFHI*) is included into a panel growth model[19] with 4-year averages as periods. Given that the overall sample period ranges from 2003-2015 and we are working with growth rates, this leaves us with only three periods[20].

The starting point for the empirical growth model is a standard Cobb-Douglas production function. By taking logs and first differences and defining for any variable *X*, $\Delta X_t = \Delta\left(ln\, X_{i,t} - ln\, X_{i,t-1}\right)$, one gets:

[19] At a later stage we will attempt to test this relationship at the industry-country level.

[20] These periods are 2004-2007, 2008-2011 and 2012 to 2015.

(1) $$\Delta\, ln\, Y_{i,t} = \beta^K \cdot \Delta\, ln\, K_{i,t} + \beta^L \cdot \Delta\, ln\, L_{i,t} + \beta^H \cdot \Delta ln\, H_{i,t} + \vartheta \cdot \Delta lnA_{i,t}$$

where $\Delta ln\, Y_{i,t}$ is the log growth rate of country *i* in period *t* and analogously for the physical capital stock *K*, labour *L* and human capital *H*. The latter is measured as the country's average years of schooling.

The term $\Delta lnA_{i,t}$ denotes the log of productivity growth. In line with endogenous growth theory we postulate that productivity growth is driven by the productivity gap to the technologically leading country, which we assume is the US. Following the approach pioneered by Nelson and Phelps (1966), the technology gap is approximated by a country's relative per capita income gap to the technological leader, i.e $GAP_i = \frac{GDPpc_{US} - GDPpc_{i,}}{GAP_{US}}$, where *GDPpc* denotes GDP per capita. Since we also assume that in addition to the technological gap the functional specialisation also matters, we get the following law of motion for productivity:

(2) $$\Delta ln\, A_{i,t} = \alpha + \rho \cdot {RPSI}_{i,t} + \gamma \cdot GAP_{i,t-1} + \xi \cdot \left(GAP_{i,t-1} \times RPSI_{i,t}\right)$$

This specification for the low of motion for productivity assumes that the functional specialisation affects productivity growth directly but also via the catch-up term. The intuition behind this is that productivity growth is negatively affected by the functional specialisation only beyond a certain level of income.

We are well aware of the fact that the various strands of the growth literature suggest different factors as the driving force for productivity growth. For example, one strand of the literature emphasises the (mainly indirect) role of human capital for the growth process through the impact on productivity growth (e.g. Benhabib and Spiegel, 1994). Here we focus on the role of functional specialisation in GVCs, the technology gap and their interrelation. In fact, according to the idea of a functional MIT, it is the interaction between functional specialisation and the technology gap that matters most. After all, it is likely that initially – at a low level of income – countries benefit from linking into GVCs and the specialisation as a factory economy for entering manufacturing processes. Beyond a certain income level, though, being a factory economy may act as a drag on growth. The interaction term provides the necessary flexibility in the regression set-up to give an indication as to where this turning may be found (in terms of per capita income).

There is in fact a rich case study literature on GVCs providing evidence that countries may end up being specialised in unfavourable segments of the value chain with little scope for learning and upgrading (Sturgeon and Memedovic, 2011; Kaplinsky, 2005; Kaplinsky and Farooki, 2010). The implicit assumption of the firm-level concept of the smile curve is that the specialisation in the pure production stage (or even assembly only) would constitute such an unfavourable specialisation – at least if it persists well into the upper middle-income level.

Inserting equations (2) into equations (1) and taking on board country dummies (δ_t) and time dummies (μ_i) as well as the error term ($\varepsilon_{i,t}$) yields the main equation to be estimated:

(1') $$\Delta\left(ln\, Y_{i,t} - ln\, Y_{i,t-1}\right) = \alpha + \beta^K \cdot \Delta\, ln\, K_{i,t} + \beta^L \cdot \Delta\, ln\, L_{i,t} + \beta^H \cdot \Delta ln\, H_{i,t} +$$

$$\rho \cdot RPSI_{i,t} + \gamma \cdot GAP_{i,t-1} + \xi \cdot \left(GAP_{i,t-1} \times RPSI_{i,t}\right) + \delta_t + \mu_i + \varepsilon_{i,t}$$

All data required for this estimation, apart from the RPSI term were taken from the Penn World Tables version 9 (PWT 9) (Feenstra et al., 2015)[21].

In the discussion of the theoretical framework it was highlighted that countries may face various types of growth traps or growth slowdowns during their development process. In order to focus on the possibility of a functional MIT, we limit the sample for the regression to countries that are *(i)* relatively open to FDI or are active FDI investors themselves and *(ii)* countries that are not primarily producers or exporters of oil and primary resources. For the former criterion we define a threshold of 0.1 for the ratio of FDI to gross fixed capital formation (GFCF) based on data from UNCTAD's FDI database as published in their World Investment Report[22] to define a closed economy. This is a rather low threshold but still eliminates countries that remained relatively closed and are therefore unlikely to get caught in a functional MIT. Secondly, we adjust the approach by Bulman et al. (2014) for defining oil exporters and define resource and oil exporters as countries with oil rents exceeding 20% of GDP, resource rents exceeding 30% of GDP or with fuel exports accounting for more than 50%[23]. We exclude these resource and oil exporting countries from the sample.

Finally, we restrict the sample to countries that have more than 50 incoming greenfield FDI projects in either of the three periods. This restriction is necessary because countries with very few greenfield FDI projects may end up with aleatory functional profiles.

Altogether this leaves us with a sample of 167 observations with three time periods. The summary statistics for the sample is shown in Table 1. Note that the minimum for the technology gap is negative because we defined the US as the technological leader and there are some countries in the sample with a higher GDP per capita than that of the US.

Table 1 / Sample overview

Variable	Obs	Mean	Std.Dev.	Min	Max
DlnY	167	0.0453	0.0374	-0.0259	0.1711
RPSI	167	0.6792	0.5757	0.0126	3.8760
FACT	167	2.3048	3.0691	0.0277	26.5063
GAP_{t-1}	167	0.5682	0.2917	-0.1022	0.9807
DlnK	167	0.0757	0.0516	-0.0382	0.2563
DlnL	167	0.0119	0.0200	-0.0731	0.0640
DlnHK	167	0.0076	0.0058	-0.0061	0.0364

21 Data available at: https://www.rug.nl/ggdc/productivity/pwt/. Since the PWT9 data ends in 2014 the log growth rates GDP, physical capital, labour and human capital for the most recent period are calculated for the 3-year period 2012-2014.

22 See: https://unctad.org/en/Pages/DIAE/World%20Investment%20Report/Annex-Tables.aspx

23 For the list of oil and natural resource exporters resulting from this definition see Appendix.

5. Results

The main results of the empirical model are summarised in Table 2. The base model in the first column is the plain growth model including the catch-up term (i.e. the GAP-variable). The results are in line with the expectations that both the production factors contribute positively to the growth rate. The only exception in this case is the growth of human capital for which a negative, though insignificant, coefficient is obtained. This negative coefficient for human capital, however, is not an uncommon result in panel regressions with fixed effects (see Arcand and d'Hombres, 2007). The technology gap yields a positive coefficient, though statistically insignificant. This changes when GDP growth is regressed solely on the gap-variable. In this case (specification 2), the coefficient of the technology gap variable, reflecting the advantages from backwardness, is statistically significant at the 1% level of significance.

Table 2 / Growth regression results, main specification, panel model 2003-2015

Dependent variable: DlnY

	(1) base model	(2) gap model	(3) full model (linear)	(4) full model non-linear
DlnK	0.1511*		0.1543*	0.1571*
	(0.0888)		(0.0872)	(0.0898)
DlnL	0.7221***		0.7107***	0.7112***
	(0.2509)		(0.2252)	(0.2049)
DlnHK	-0.9659		-0.9863	-1.3041
	(0.9845)		(0.9560)	(0.8000)
GAP_{t-1}	0.0867	0.2012***	0.0852	0.0596
	(0.0588)	(0.0672)	(0.0593)	(0.0585)
RPSI			0.0029	-0.0898*
			(0.0124)	(0.0486)
RPSI x GAP_{t-1}				0.1263**
				(0.0613)
Constant	-0.0225	-0.0752**	-0.0237	-0.0016
	(0.0362)	(0.0356)	(0.0368)	(0.0352)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Observations	167	167	167	167
R-squared	0.834	0.759	0.834	0.845
R-squared-adj.	0.713	0.595	0.711	0.726
F-test	25.08	21.44	21.24	17.77

Turning to the model specifications with the RPSI, the main variable of interest, specification 3 delivers a result that is largely identical to the base model, suggesting physical capital and labour growth as the main determinants of economic growth. The RPSI variable is statistically not significant. This changes though as one switches to the non-linear model (specification 4) which includes the interaction term between the initial technology gap and the *RPSI*. The result indicates now that the *RPSI* as such hamper affects growth negatively as indicated by the negative coefficient of the main effect for *RPSI*. However, the interaction term is positive suggesting that countries with a large technology gap may actually gain from a high *RPSI*, i.e. the functional specialisation as a factory economy. Note that this pattern is compatible with the claim derived from the theoretical framework that the overly specialisation in production-related activities becomes a problem only at higher level of incomes (i.e. smaller technology gaps). Using the obtained point estimated for the main effect (-0.0898) and for the interaction term (0.1263) it is possible to identify the turning point where the specialisation as a factory economy becomes a drag on growth. This turning point is found at a technology gap of 0.73 which corresponds to a GDP per capita of USD of around USD 14,800 in the period 2012-2015[24]. Note that this value is well within the income range of countries that the World Bank classifies as upper-middle countries (e.g. Brazil, Bulgaria, Mexico, Thailand or Malaysia)[25]. The result is also well in line with the income levels at which Eichengreen at al. (2012) found growth slowdowns to occur, their estimate being at USD 17,000 in 2005-US-Dollars. Hence, we would argue that our results deliver plausible levels for where to locate a possible functional MIT.

Table 3 / Growth regression results, alternative specification with FACT, panel model 2003-2015

Dependent variable: DlnY

	(1) base model	(2) gap model	(3) full model (linear)	(4) full model non-linear
DlnK	0.1511*		0.1509*	0.1266
	(0.0888)		(0.0843)	(0.0830)
DlnL	0.7221***		0.7231***	0.7314***
	(0.2509)		(0.1870)	(0.1620)
DlnHK	-0.9659		-0.9636	-1.5545**
	(0.9845)		(0.9486)	(0.6698)
GAP_{t-1}	0.0867	0.2012***	0.0867	0.0626
	(0.0588)	(0.0672)	(0.0609)	(0.0549)
RFHI			-0.0000	-0.0535***
			(0.0023)	(0.0157)
RFHI x GAP_{t-1}				0.0695***
				(0.0207)
Constant	-0.0225	-0.0752**	-0.0225	0.0059
	(0.0362)	(0.0356)	(0.0366)	(0.0321)
Country fixed effects	yes	yes	yes	yes
Time fixed effects	yes	yes	yes	yes
Observations	167	167	167	167
R-squared	0.8342	0.7585	0.8342	0.8703
R-squared-adj.	0.713	0.595	0.710	0.771
F-test	25.08	21.44	21.26	23.26

Note: Clustered standard errors in parentheses. ***, **, and * indicate statistical significance at the 1%, 5% and 10% level respectively. All regressions include a constant and time fixed effects. All regressions estimated in STATA with the areg command.
Source: own estimations.

24 The corresponding values for the turning points are USD 14,400 for the first period (2004-2007) and USD 14,300 for the second period (2008-2011).

25 Note that it is not possible to directly compare our estimated turning point with the World Bank's threshold values for their income group classifications as these are defined in terms of current gross national income (GNI).

We perform a robustness check for this pattern which consists of replacing the *RPSI* with the relative factory-headquarter index (*RFHI*) as the indicator for functional specialisation (Table 3). Qualitatively, the results are confirmed. Firstly, the functional specialisation is not found to have a linear effect on economic growth (specification 3) but again in the non-linear model (specification 4) depending on countries' level of development. As one may expect, if one is doubtful about the knowledge-intensive of some of the post-production services that are disregarded in the *RFHI*, the statistical significance of this alternative version is stronger, both for the main effect and for the interaction term compared to the main specification featuring the *RPSI*. We can again calculate the turning point, i.e. the income level where a functional specialisation as a factory economy starts slowing down the growth process. For the (non-linear) *RFHI*-model this turning point is found at around USD 11,500 for the period 2012-2015. This is somewhat lower than in the *RPSI*-model but still in the upper-middle income range where functional growth slowdowns may be expected.

6. Conclusions

This paper suggested a theoretical framework for why functional growth traps or at least slowdowns may occur at a certain level of income. We made use of our recent methodology to identify the functional specialisation patterns of countries which are based on inward greenfield FDI projects. This granular approach to identifying functional specialisation profiles at the country level supports the claim in the literature that within global and regional production networks the most advanced countries specialise as headquarter economies, whereas developing countries typically specialise as factory economies when the integrate into GVCs. Embedding these functional specialisation measures into a growth regression model, we then provide econometric evidence that, depending upon specification, at a level of between about USD 11,500 and USD 14,800, a functional specialisation as a factory economy is associated with lower growth rates. We interpret this as evidence for the possibility of a functional variant of the MIT. In other words, escaping the MIT requires a shift in the functional specialisation towards more knowledge-intensive pre-production and post-production functions. Certainly, such functional upgrading also requires a transformation of the underlying capabilities and in particular the development of an appropriate National Innovation System (NIS). The South East Asian ‘Tiger States’ managed this transformation with the help of active trade and industrial policies[26] and finally graduated from being middle-income to being high-income countries. Nowadays, all these countries have become headquarter economies according to their functional profile. While there is still no agreement on what caused the ‘Asian miracle’, most experts assign a considerable role to active industrial policies, including the deliberate use of export subsidies, exchange rate policy, capital controls and even import protection (e.g. on luxury goods). This would point to the prominent role for a ‘development state’ (Wade, 2018) – in the case of middle-income countries – and an ‘entrepreneurial state’ (Mazzucato, 2013) – for countries close to or beyond the high-income threshold to handle and accompany and guide the economic integration process.

We would also like to emphasise that while we linked our results to the notion of a functional MIT, our main interest is not to discuss whether the fact that only a handful of countries entered the club of advanced countries in the post-World War II era is due to a growth trap in the sense of an equilibrium at a low level of income or a simple growth slowdown somewhere in the middle income range. Rather we wanted to demonstrate that for many countries the incapability of overcoming this ‘glass ceiling’ is linked to their functional specialisation pattern as a factory economy. The technological asymmetry implicit in functional specialisations, may be seen as a parallel to the asymmetry inherent in specialising as a commodity exporter versus specialising as an exporter of advanced manufactures. The logic of specialisation according to comparative advantages suggests that an ever more refined international division of labour may create functional lock-in. Market forces alone are therefore unlikely to induces numerous ‘growth miracles’. Complementing, in some case even superseding, market forces with a mix of targeted innovation policies, trade and industrial policies as well as educational and active labour market policies, while no guarantee for success either, should be considered as tools for the required functional upgrading.

[26] Korea, Singapore, Hong Kong and Taiwan.

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Appendix

Appendix Table A.1 / Mapping of business functions into value chains functions

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

* for chemicals sector only

Appendix Table A.2 / Oil exporters (excluded from the sample), averages for 2003-2015

country	country code	oil rents (% of GDP)	resource rents (% of GDP)	fuel exports (% of total exports)
Angola	AGO	0.359	0.367	0.482
Azerbaijan	AZE	0.277	0.309	0.889
Bahrain	BHR	0.037	0.067	0.660
Brunei	BRN	0.208	0.276	0.831
Congo, Rep.	COG	0.426	0.470	0.377
Algeria	DZA	0.233	0.273	0.970
Ecuador	ECU	0.127	0.131	0.521
Gabon	GAB	0.296	0.328	0.525
Equatorial Guinea	GNQ	0.307	0.339	0.000
Iran	IRN	0.241	0.269	0.530
Iraq	IRQ	0.374	0.376	0.918
Kazakhstan	KAZ	0.176	0.240	0.673
Kuwait	KWT	0.493	0.500	0.823
Mauritania	MRT	0.032	0.307	0.068
Nigeria	NGA	0.131	0.154	0.753
Norway	NOR	0.074	0.096	0.647
Oman	OMN	0.378	0.407	0.817
Qatar	QAT	0.298	0.351	0.831
Russia	RUS	0.105	0.169	0.619
Saudi Arabia	SAU	0.419	0.429	0.886
Sudan	SDN	0.110	0.122	0.588
Turkmenistan	TKM	0.163	0.498	0.051
Trinidad-Tobago	TTO	0.082	0.150	0.631
Venezuela	VEN	0.178	0.189	0.714
Yemen	YEM	0.267	0.276	0.843

Source: World Bank's World Development Indicators (WDI).

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