

# National Innovation Systems, Openness and Global Value Chains: Towards a taxonomy

Lundvall, Bengt-Åke (3); Fagerberg, Jan (2,3); Srholec, Martin (1,4)

1: CERGE-EI, Charles University, Czech Republic; 2: Center for Technology, Innovation and Culture (TIK), University of Oslo; 3: IKE, Department of Business and Management, Aalborg University; 4: Centre for Innovation, Research and Competence in the Learning Economy (CIRCLE), Lund University

## Abstract

This paper deals with an issue that has attracted considerable interest from scholars and policy-makers, namely the roles of global value chains (GVC) and other aspects of “openness” for economic development. To analyse the issue a comprehensive framework, i.e., one that allows for the inclusion of a range of relevant factors including not only different form of “openness” (e.g. GVC participation) but also technological and social capabilities, is developed. The analysis is based on information from 114 countries, including many least developed nations, over the 1997-2013 period. The paper explores, using descriptive statistics, cluster analysis and econometric methods, the available evidence on the matter. It is shown that for developing countries GVC participation is not the potent driver of growth that for example international organizations tend to assume, and that most of the upgrading that takes place among developing nations occurs in other ways.

Keywords: Global value chains, openness, technological capability, national innovation system, economic development.

JEL codes: F43, O10, O30, O40, O57.

## 1. Introduction

What explains the extent to which countries manage to exploit the worldwide pool of technological knowledge to their advantage? This has been a hotly contested issue in economics and development research for a long time. The so-called Washington Consensus, advocated by the World Bank and other international organizations, predicted that this would be easy as long as the country shied away from tempering with markets and practiced openness to trade and foreign investment. However, empirical research has showed the empirical evidence supporting this proposition to be rather mixed (Fagerberg, Srholec and Verspagen 2010).

It was pointed out by several contributors to the debate that one explanation of this might be that successful exploitation of foreign knowledge crucially depends on the development of national “technological capability” (Kim 1997, Lall 1992) or “absorptive capacity” (Cohen and Levinthal 1990) within the framework of a “national innovation system (NIS)” (Lundvall 1992, Nelson 1993). The emergence of the innovation-system approach has from the early 1990s onward led to a host of new research emphasizing the important role of national capability-building in economic development (Fagerberg and Srholec 2008, Lundvall et al 2009). However, since NISs are increasingly dependent on foreign sources of knowledge, it is also important to assess if, how and in what forms openness matters for economic development.

Another approach, which also emerged during the 1990s, attacks the issue of openness head on by focusing on participation in so-called “global value chains” (GVC) as a way to

promote economic development (Gereffi and Korzeniewicz 1994, Gereffi et al. 2005). It is argued that the combination of the ICT revolution and innovations in transport technology had led to the development of new ways to produce and distribute goods and services globally (Sturgeon 2002), taking the form of global production networks (or value chains) coordinated and led by multinational companies (so-called “lead firms”), and that this has provided enterprises in developing countries with opportunities to upgrade technologically and in terms of functions through participating in such networks (Ernst and Kim 2002, Gereffi and Fernandez-Stark 2011, Gereffi 2014).

Much of the empirical research on GVCs has taken the form of case studies at the level of enterprises, geographical clusters or specific segments of vertically organised business activities. These studies have brought to light many examples of local firms in less developed countries that have been able to upgrade products and processes in an interaction with lead firms in high income countries. Cases in which there have been an upgrading in function, such as moving from being a mere supplier status to having an own brand, have been fewer in number. Moving from case studies to analyses of entire countries (or the global economy as a whole) is a challenging step however, and was for a long time hampered by lack of data on participation in GVC at the national and global level. More recently, international agencies such as UNCTAD, as well as networks of researchers, have created data sets that in a better way than before account for trade in intermediate products. These data may be taken to illustrate the proliferation of GVC (Gereffi et al. 2005), although with respect to the role of GVCs for the ability of poor countries to develop and catch up with the rich part of the world (Kummritz 2015), the lessons coming out of analysing these data are less clear. Nevertheless, these data say nothing about how these chains are governed, e.g., the role of multinational companies in coordination the activities of the chain and distribution of the rewards from

these activities. In fact, the increasing trade in intermediates that these data reveal (Cattaneo et al 2010) may be related to quite different forms of integration into the global economy from, say, pure market relationships between independent firms to more hierarchical arrangements controlled by multinationals, possibly with different implications for economic development.

In this paper we argue that arriving at conclusive evidence on the matter requires a comprehensive framework that allows for the inclusion of a range of relevant factors, including not only different forms of “openness” but also differences in “absorptive capacity”, e.g., the development of the national innovation system, and other relevant factors. In section 2 we discuss how different forms of capability building and “openness” to foreign sources of knowledge, including participation in GVCs, interact in the process of economic development. Based on the conclusions reached there the subsequent section 3 delves more deeply into the measurement of the various factors, including participation in GVCs, and explores the relationship with economic development. It is shown that although many of these variables are correlated with economic development, there is also a lot of diversity in how countries at roughly similar levels of development link up with the global economy. Section 4 of the paper delves further into the nature of this diversity with the help of a cluster analysis, leading to the identification of six categories of countries, characterized by different combinations (and forms) of openness, capability-building and other factors. In section 5 we consider the question to what extent it matters for a country’s economic performance which category it belongs to and, in particular, if it adopts a form of integration characterized by high participation in GVC. The final section is concerned with the lessons from the study and the implications for policy.

## 2. The roles of knowledge, openness and GVC in economic development

The role of “openness” in long term development has attracted attention for years. A sizeable empirical literature has developed but has failed to develop robust knowledge on the matter (Fagerberg, Srholec and Verspagen 2010). This may of course have to do with weaknesses in data or methods, for example data on developing countries’ participation in GVCs have only recently become available. However, it may also have to do with theoretical shortcomings, notably the lack of a sufficiently comprehensive theoretical framework that allows for the inclusion of both different forms of openness and other relevant factors.

Traditionally, economists saw economic development as resulting from increases in the factors of production, i.e., capital, labour and natural resources that a country possesses. However, when researchers started to research the reasons behind the large differences in levels of economic development globally, they soon realized that very little of the observed differences could be explained in this way (Abramovitz 1956, Solow 1956). Today it is generally acknowledged among economists that the primary source of differences in levels of economic development is differences in the command of knowledge (for an overview see Fagerberg, Srholec and Verspagen 2010). Moreover, it is increasingly recognized that much economically useful knowledge is difficult and costly to identify, access, acquire and exploit and that, for most if not all nations, foreign knowledge-bases are much larger than domestic ones. Hence the ability to tap into these foreign knowledge-bases becomes of utmost importance for the economic development of a nation.

Several different mechanisms may be identified. Much knowledge, scientific knowledge for example, is in principle free, but that does not mean that it is easy to access and exploit.

Above all it requires a high quality national education system, and a public and private R&D system that makes it possible to link up advanced global research networks (Wagner and Leydesdorff 2005). Some advanced knowledge is proprietary and enterprises and governments can obtain access by paying for it (licensing for instance). Still, successfully exploiting the knowledge continues to be demanding and requires domestic engineering and design capabilities to succeed. Knowledge may be also embodied in people, e.g, skilled workers and experts moving across national borders (Saxenian 2006). Foreign direct investments (FDI) is another potential channel of knowledge transfer that may generate positive spillovers to other domestic firms. Studies of such spillovers demonstrate that the main beneficiaries are enterprises with in house capabilities and regions with a reasonably strong knowledge base (Bell and Marin 2004, Fagerberg, Srholec and Verspagen 2010). Finally, participation in international trade may increase domestic actors' awareness of promising products, services or technologies, and feedbacks from foreign users and competitors also stimulate upgrading of products and processes. Moreover, when an economy opens up for trade it exposes the existing enterprises to a stronger transformation pressure which, dependent on a sufficiently well- developed local knowledge infrastructure (i.e. NIS), may lead to technological upgrading among domestic firms.

Participation in GVCs is a particular form of openness to trade in which knowledge transfer takes place in a highly organized manner under the supervision of so-called "lead firms" governing the activities of the chain (Gereffi, Humphrey, and Sturgeon 2005). Studies by GVC scholars have analysed how specific major multinational firms have organised production chains and how they have influenced formally independent firms operating as

their preferred suppliers (Gereffi and Fernandez-Stark 2011). The dominance of the main firm may be rooted in market control for a final product – such as when Walmart procures blue jeans from formally independent suppliers in Mexico (Gereffi 1999). Alternatively dominance may be rooted in technological capabilities – such as when Apple procures electronic components from formally independent producers in China (Linden et al 2009). Often the case studies have revealed long term relationships and illustrated that the dominant firm under certain circumstances and to a certain degree will contribute to upgrading in the supplier firms (Gereffi 1999). For example Walmart needs good quality products adapted to market needs and Apple needs high quality components that are designed so that they fit into final products, including new product generations.

But there may be limits for the willingness of dominant firms to share knowledge and build capabilities among suppliers. A crucial issue is about branding and market access. Walmart does not want the Mexican suppliers to become independent producers of a competing brand and Apple will only share technological knowledge that is not at the core of the business. Actually we would expect the dominant firm to take all kinds of precaution to avoid that the supplier becomes a competitor (Humphrey and Schmitz 2000). The most important reason for engaging suppliers in low income countries is to reduce cost (and to use market and technology control to extract rents).

While high and middle income countries with a strong industrial base and knowledge infrastructure may be in a position to benefit from participation in GVCs (or trade in intermediate products),<sup>1</sup> it is not obvious that this holds to the same extent for low income countries with a weak industrial base and a weak knowledge infrastructure. Arguably, enterprises from such countries may be expected to be weak players in GVC dominated by

multinational oligopolies. Hence, it cannot be excluded that a major part of the economic value created goes to other parts of the value chain with more leverage. Nor is it obvious that the local economy in which the enterprise is located benefits. For example, a potential downside for the national economy might be that an enterprise joining a GVC, although advanced by local standards, decouples from interacting with domestic firms and thus undermines the potential for building dynamic national or regional clusters.<sup>2</sup> Furthermore, if the selected enterprise, while upgrading products and processes, remains locked into narrow functions, the implications for the national economy may not be as favourable as policy makers would have wished, at least not in the longer run. Several studies indicate that a strong local base is a prerequisite for benefitting from joining GVCs (Giuliani, Pietrobelli and Rabellotti 2005, Fu, Pietrobelli and Soete 2011).

Moreover, it is important to take into account that not all transactions in organized markets take place in GVC led by multinationals. In fact, much of the trade in intermediate goods takes place between enterprises located in high income countries and within supranational regions (Europe, Asia and Africa) rather between continents and sometimes regional trade agreements explain this kind of trade (Sturgeon 2001). For example, as will be illustrated by our empirical analysis, the process of European integration has been accompanied by a dramatic increase in this kind of trade. Such trade may involve long term relationships between unequal partners. But it may also involve interaction between equal partners, and suppliers may well be in a strong position.

It is clear from the discussion that knowledge - and openness to foreign sources of knowledge – are essential for economic development. However, it is also evident that there are several different channels for acquiring knowledge, and that the ability to successfully exploit these

depends on domestic capability-building. Therefore, to get a better grasp on the role that openness plays in economic development, a broad framework including not only various sources of openness but also domestic capability-building and other relevant factors is required.

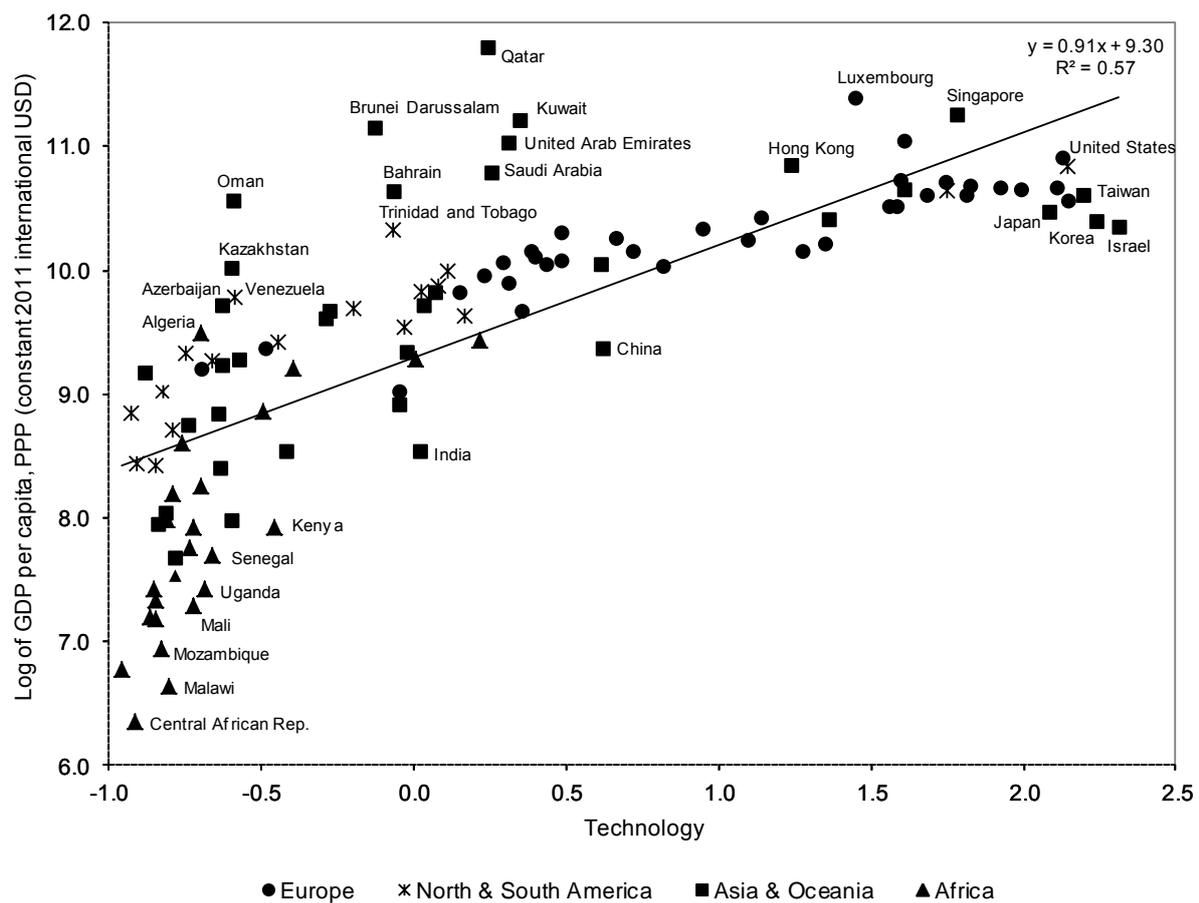
### **3. A preview of the data**

This section is concerned with the empirical operationalisation of the factors discussed above, i.e., capabilities and openness, as well as their relationships with economic development given by GDP per capita. All of the variables are measured in two points in time: initial and final periods, which refer to data from the nearest available year to 1997 and 2013, and used in logs to limit the influence of outliers.<sup>3</sup> Although the selected indicators have broad coverage, in some cases there were missing values that had to be dealt with.<sup>4</sup> Moreover, firms in large countries naturally engage more with domestic customers, suppliers and investors than do firms in smaller economies. To correct for this bias the openness indicators have been adjusted for differences in country size.<sup>5</sup> Further details on definitions and sources can be found in Appendix A1.

As concerns technological capabilities, we take into account three different indicators that together give a broad view on where a country stands on this dimension. These indicators reflect the quality of a country's science base, invention and investments in R&D, which are weighed together in a composite measure using factor analysis (see Appendix A3 for details). Figure 1 plots the resulting measure of technological capability against GDP per capita. The correlation and regression line between the two variables is also reported. As would be

expected GDP per capita is an increasing function of technological capability. All poor countries generally have very low levels of technological capability. Furthermore, as can be observed from the figure, resource-rich countries, and smaller economies that serve as financial or trade hubs, tend in some cases to have far higher GDP per capita than their levels of technological capability would indicate.

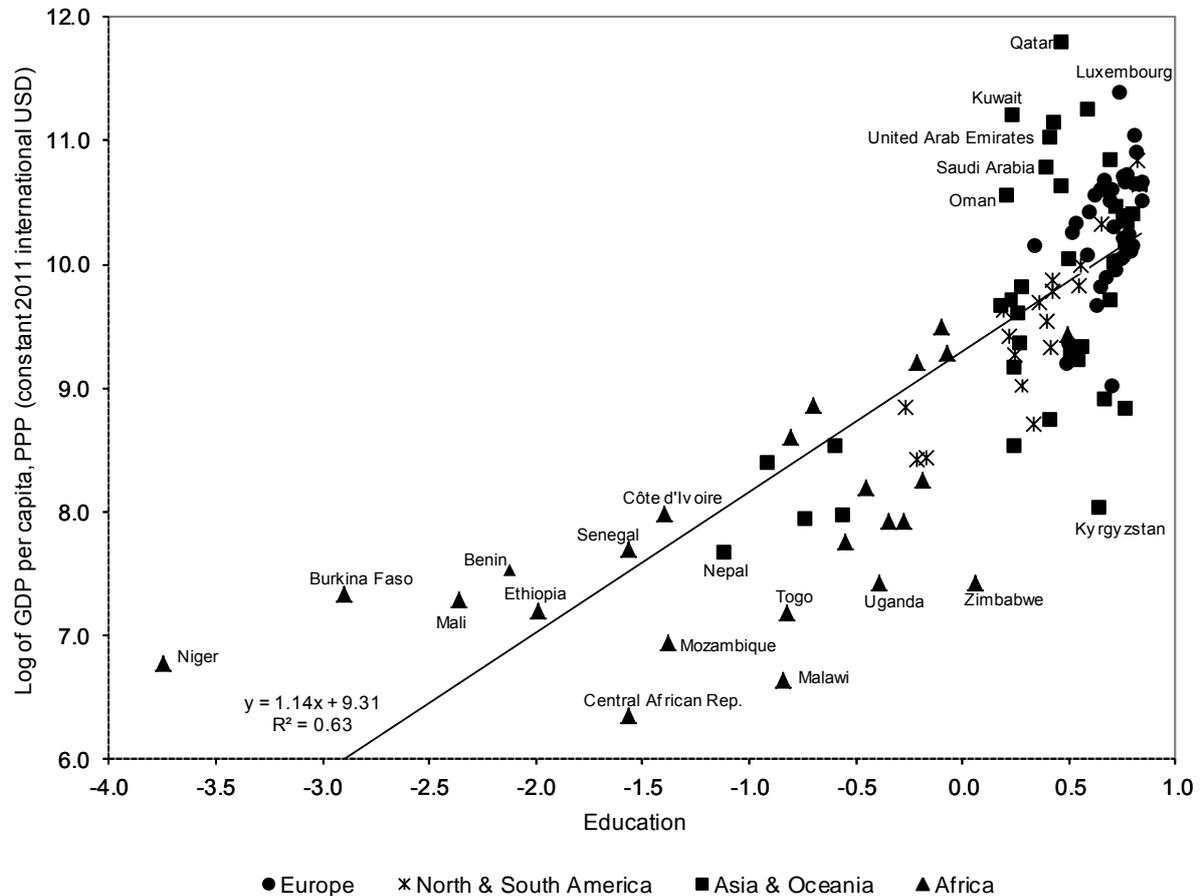
**Figure 1: GDP per capita and technology, final period (2013)**



In addition to technological capability we also take into account the level of education, as reflected in adult literacy and mean years of schooling. As before these two indices are weighed together using factor analysis (see Appendix A3 for details). Figure 2, which again

plots the resulting measure of education against GDP per capita, confirms that there is a strong positive relationship. In fact, one feature that all developed countries appear to have in common is a very high levels of education.

**Figure 2: GDP per capita and education, final period (2013)**

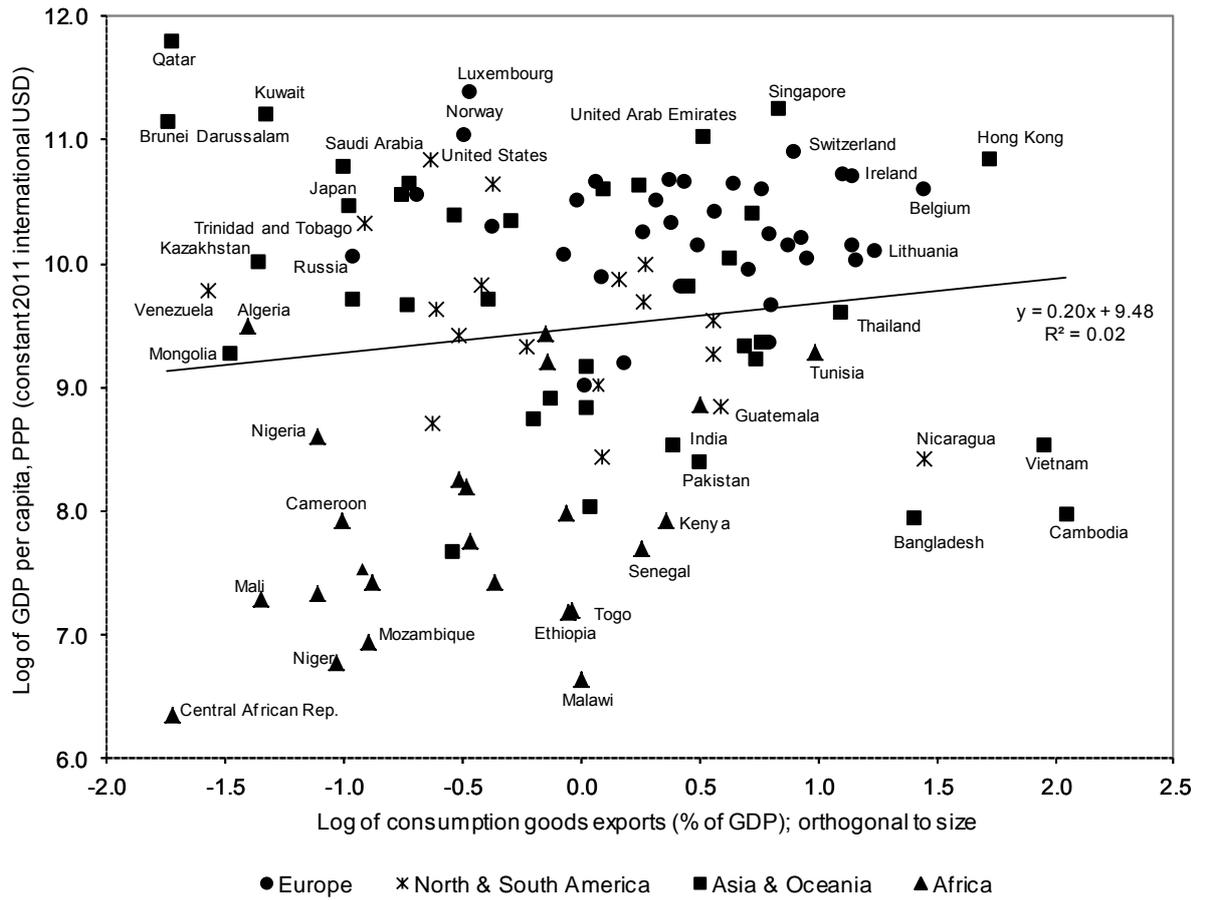


With respect to openness, we were able to take into account three different channels: i) Openness to trade (exports and imports); ii) Participation in GVC (upstream and downstream); and iii) Foreign direct investments (outward and inward). Due to lack of suitable data for a sufficiently large number of countries were not able to include migration of skilled personnel. Nor do we have measures for the diffusion of non-embodied technology.<sup>6</sup>

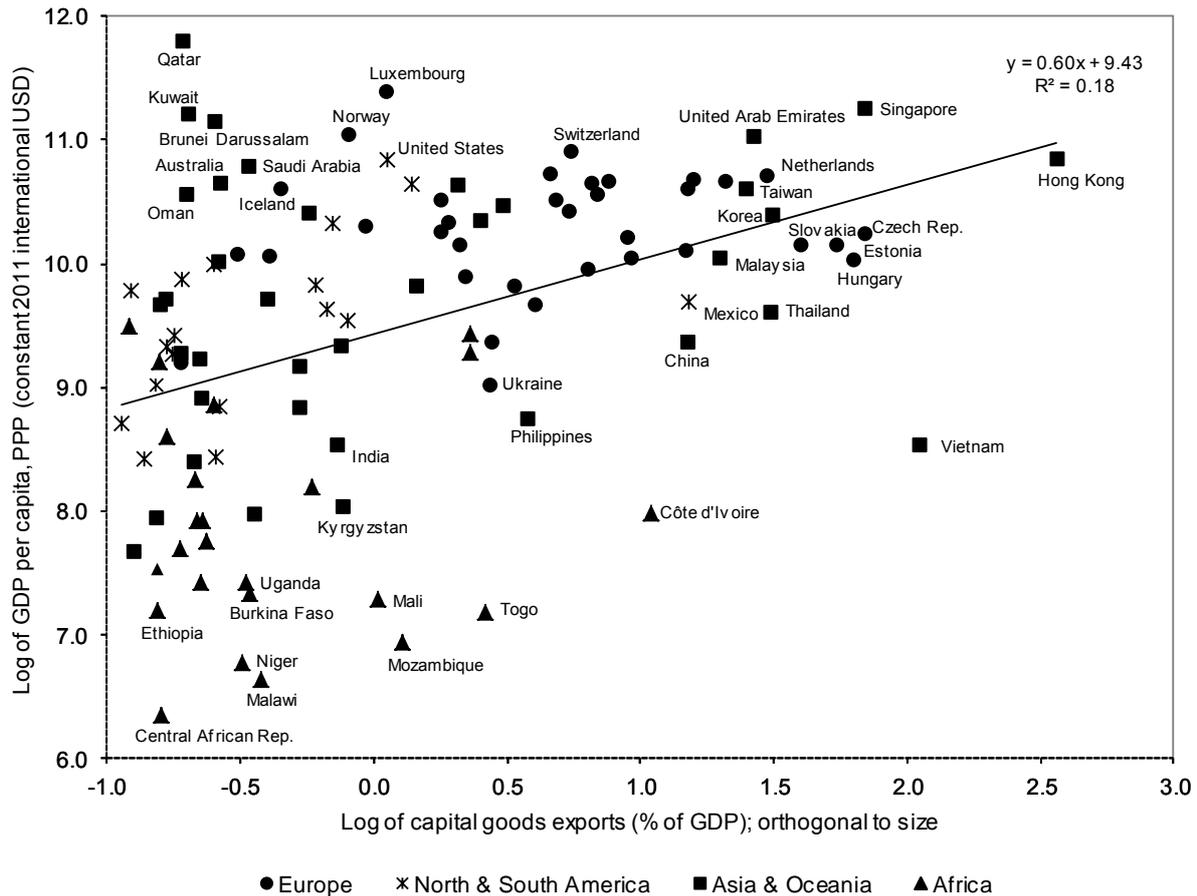
However, as pointed out above, we would expect differences in the ability to acquire and implement such knowledge to depend on absorptive capacity, for which technological capability and level of education appear as relevant measures.

Figures 3-4 plot exports of final consumption and capital goods as percentage of GDP, respectively, against GDP per capita.<sup>7</sup> In the case of exports of consumption goods the explanatory power of the regression is extremely low. Thus, there does not appear to be a straightforward relationship between the two variables. There is more support in the data for a positive relationship between exports of capital goods and economic development, particularly for advanced economies. For many countries, however, the role of capital goods exports in the economy seems to be low quite independent of what GDP per capita is.

**Figure 3: GDP per capita and exports of consumption goods, final period (2013)**



**Figure 4: GDP per capita and exports of capital goods, final period (2013)**

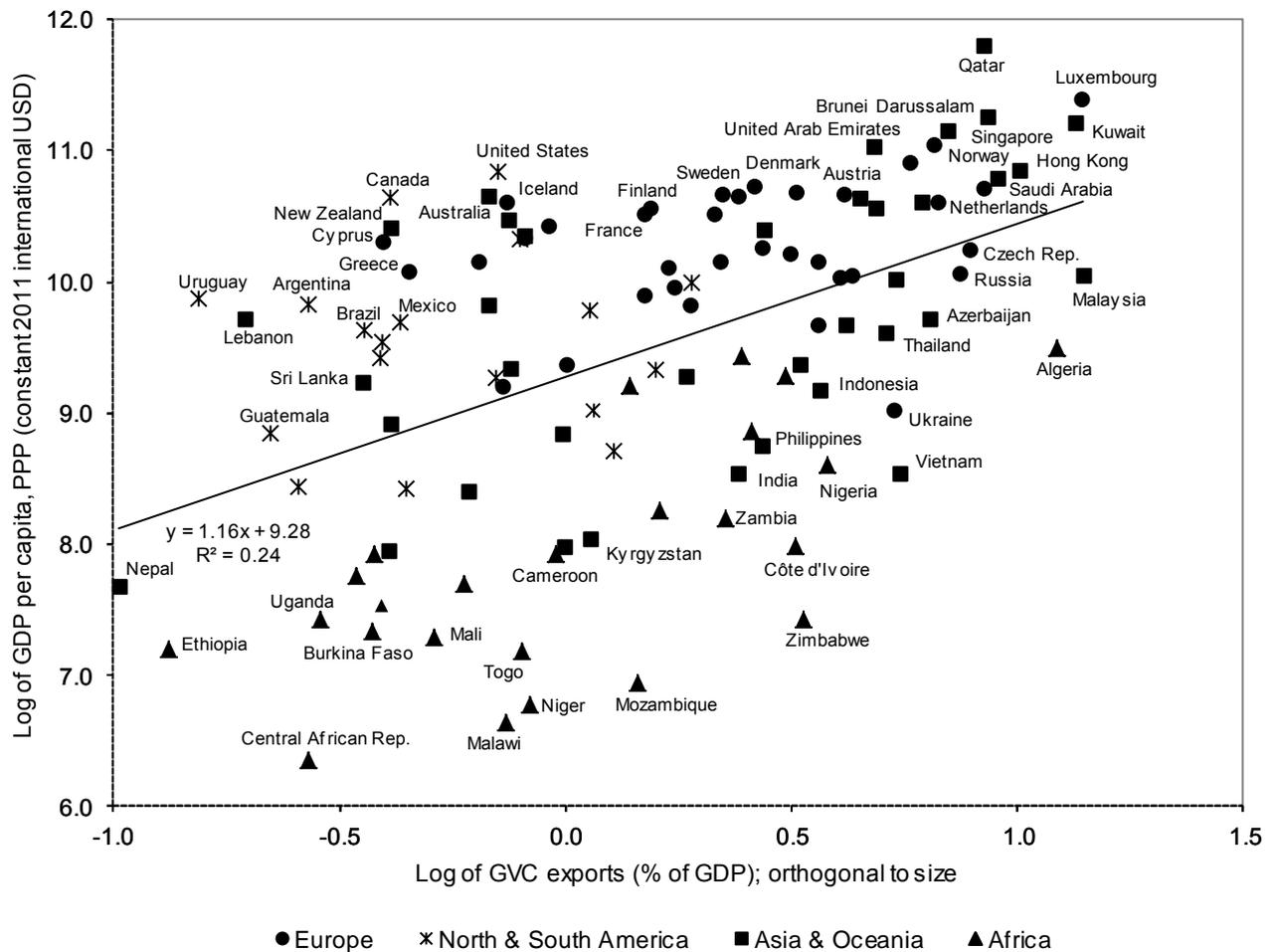


At the centre of our interest is the measure for participation in GVCs. Until recently trade statistics were only available in terms of gross exports and imports, hence reflecting sales, not value added. UNCTAD jointly with OECD and WTO has recently put great effort to trace how intermediate products move between countries along GVCs using detailed data on international transactions recorded in input-output tables resulting in the UNCTAD-Eora GVC Database (Eora 2016). The data allows for the calculation of two different measures of GCV participation. The first – what we call GVC imports - refers to the extent to which a country’s exports contains inputs (or value added) produced in other countries (for example assembly of foreign-produced parts for exports). The other – GVC exports – reflects the share

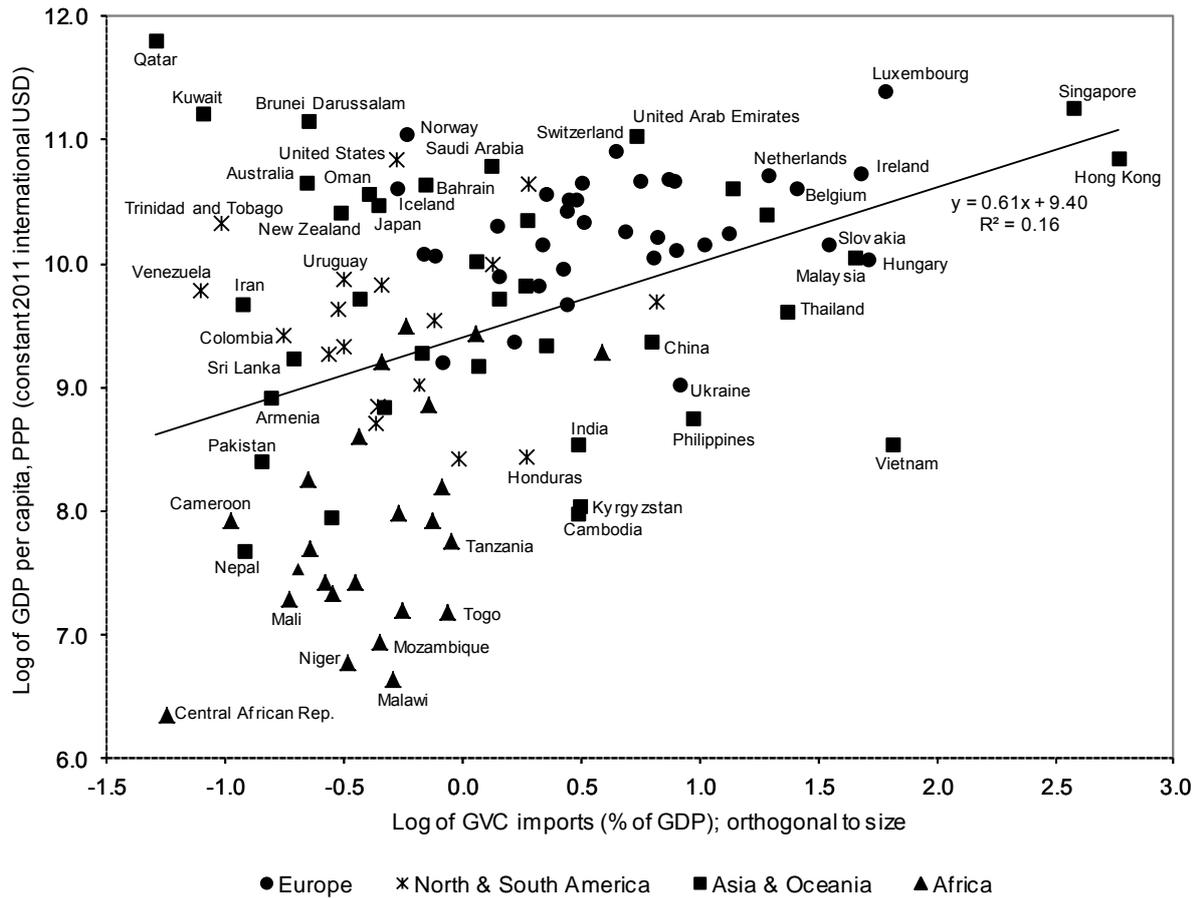
of a country's exports that consist of goods for further processing and export by other countries (raw materials and intermediate products for instance).<sup>8</sup>

Figures 5-6 plot GVC participation against GDP per capita. The figures reveal that both measures are correlated with economic development. Hence, rich economies tend to have high GVC participation and vice versa. However, there is also a lot of variation across countries along this dimension.

**Figure 5: GDP per capita and GVC exports, final period (2013)**

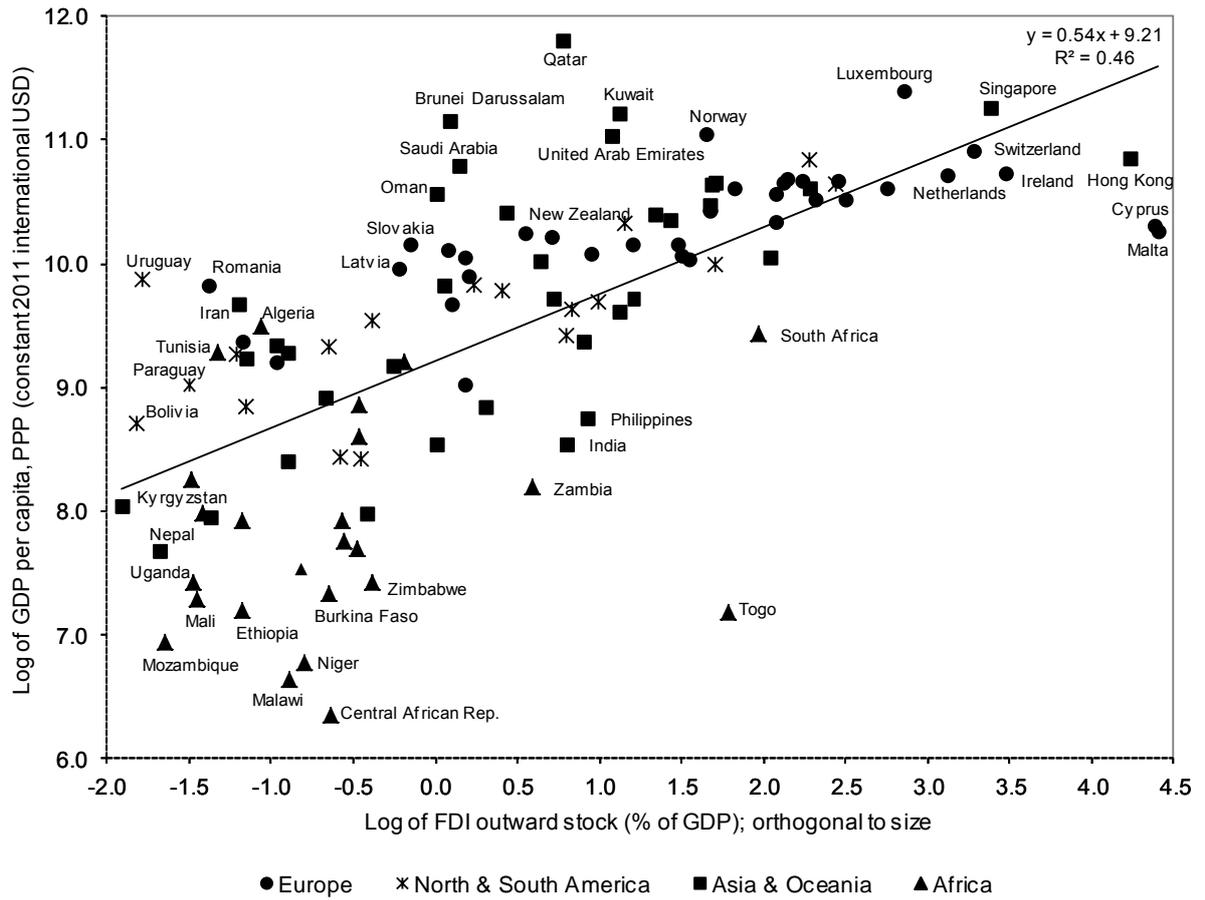


**Figure 6: GDP per capita and GVC imports, final period (2013)**

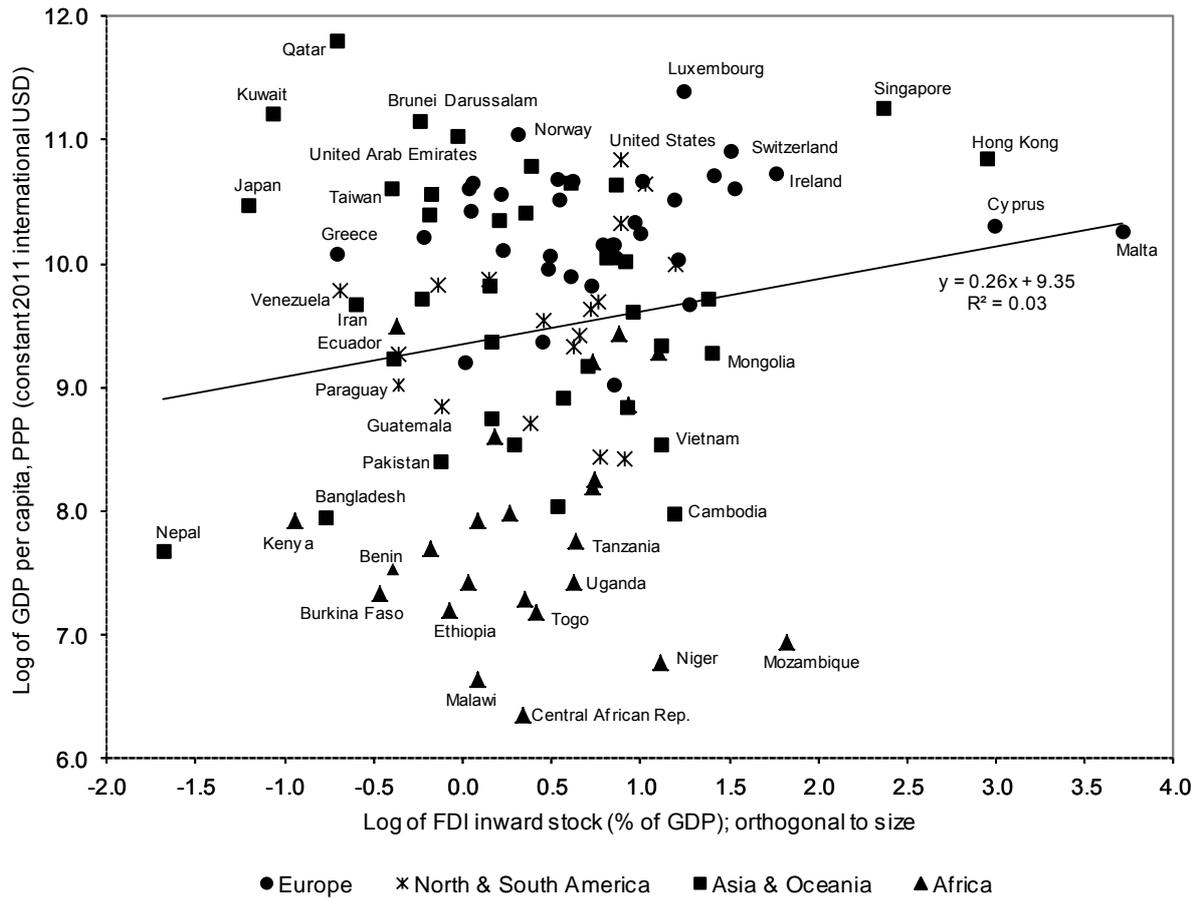


Figures 7-8 illustrates the relationship between foreign direct investment and economic development. With respect to outward FDI (Figure 7) there is a clear positive relationship between the two variables, i.e., rich countries export capital, poor countries don't. One might perhaps have expected the poor part of the world to be the main recipient of the rich countries' capital export but this is not the case. In fact, as Figure 8 shows, inward foreign direct investment takes is hardly correlated with the level of economic development.

**Figure 7: GDP per capita and FDI outward, final period (2013)**



**Figure 8: GDP per capita and FDI inward, final period (2013)**



In short, this section shows that many of the indicators presented are related to economic development in one way or another. Thus, as a country moves up the development ladder the way it is embedded into the global economy, the channels for knowledge transfer and its national innovation system tend to change. Nevertheless, there is also a lot of variation in how countries at roughly the same level of economic development position themselves on the various dimensions taken into account here. Hence, it is not obvious that there is one single model that all countries have to pass through - or converge towards - in the process of development.

## 4. In search of a taxonomy

To explore the possibility of different pathways to economic development, including different forms of integration with the global economy, a cluster analysis will be undertaken. The variables included in the analysis are those already presented in the previous section with a few additions:

- National innovation system: Technology and Education,
- Trade openness: Exports and imports of consumption and capital goods, respectively, four variables altogether,
- GVC participation: GVC exports and GVC imports,
- FDI: Outward and inward stock,
- Natural resource rents,
- Agriculture,
- Manufacturing.

A hierarchical cluster analysis on a combined dataset of observations from the initial and final year was conducted. Six clusters were retained. The main characteristics of these clusters, ranked from left to right in terms of level of economic development, are laid out in Table 1. For more details on the clustering procedure, including dendrogram, see Appendix A4 and A5.

**Table 1: A Taxonomy of openness and economic development (cluster analysis)**

	<b>Least Developed</b>	<b>Emerging</b>	<b>Natural Resource Exporters</b>	<b>Assemblers</b>	<b>Globalized</b>	<b>Advanced</b>
<b>Technology</b>	Very low	Very Low	Low	Low	High	Very high
<b>Education</b>	Very low	Medium	Medium	Medium-high	Very high	Very high
<b>GVC exports</b>	Very low	Low	High	Medium	Very high	Medium
<b>GVC imports</b>	Very low	Low	Low	High	Very high	Medium
<b>Trade openness</b>	Very low	Medium	Very low	High	Very high	Medium
<b>FDI outward</b>	Very low	Very low	Medium	Low	Very high	Very high
<b>FDI inward</b>	Very low	Medium	Low	Medium	Very high	Medium
<b>Natural resources</b>	High	Medium	Very high	Low	Very low	Very low
<b>Agriculture</b>	Very high	High	Low	Medium	Very low	Very low
<b>Manufacturing</b>	Very low	Medium	Very low	Very high	Medium-high	Medium
<b>Number of countries</b>	18(8)	33(32)	13(17)	24(19)	6(15)	20(23)

Note. Numbers of countries in the initial and final year (the latter in brackets).

The **least developed countries** are agricultural economies characterized by very low technological capabilities and, in particular, levels of education. They are hardly integrated into the global economy at with all openness indicators being very low. The group of **emerging economies** is also characterized by low technological capabilities but the level of education – and hence absorptive capacity - is much higher than in the previous group. Although agriculture plays an important role in these countries as well, they have also developed a presence in manufacturing. They are also more open when it comes to trade and inward FDI but are not much into GVCs. As the label suggests, the group of **natural resource exporters** is characterized by abundance of natural resources, which they export for further processing in other countries, hence a high level of GVC exports. Otherwise their degree of integration in the global economy is relatively low, except for some outward FDI. Capabilities are medium to low. The latter also applies to the group of **assemblers**, which distinguishes itself from the groups described so far by being more open to trade, more deeply involved in GVC and more specialized in manufacturing industry. By relying to a large extent on GVC imports from other countries, which are further processed, assembled into final products and (re)exported, they resemble the type of economies that tend to be in focus in the GVC literature. The group of **globalized** countries is as the label indicates characterized by very high openness on all dimensions taken into account here, including GVC participation. However, the countries in this category generally have more well developed technological capabilities and, in particular, levels of education. Finally, there is the group of **advanced** countries, which particularly excel when it comes to technological capability and education, but with more modest levels of openness, apart from outward FDI. Overall, the results indicate that there is a lot of diversity among countries when it comes to how they search, acquire and exploit knowledge and the roles that various sources of openness play.

Table 2 shows the distribution of countries by the clusters. The horizontal dimension (row) reports the country's position in the initial year, while the vertical dimension (column) contains its position in the final year. This makes it possible to track moves between clusters over time. Most of the countries - close to three fourth of the sample - remain in the same category. i.e., they stay on the diagonal. Among those that do move there are only three instances which involve more than three countries. The largest of these concerns 8 countries (7 of which are in Sub-Saharan Africa) that move from the "least developed" cluster, in which GVC plays little or no role, to another cluster, "emerging", for which the same applies. Hence, these countries are upgrading but not through GVC participation. Another case involves 6 countries that move from "emerging" to "natural resource exporters", probably a reflection of the boom in the demand for natural resources during the last decade or so, which made the possessions of these countries much more valuable. The final case contains 6 countries, 5 of which are central and eastern European, that move between two groups in which GVC plays a very important role. This is an interesting development but has little to do with how developing countries fare. Thus, it is difficult to avoid the conclusion that as far as developing countries are concerned, GVC participation plays a rather limited role.

**Table 2: Classification of countries by clusters in the initial and final period**

		Classification by clusters in the final period (2013)					
		(1)	(2)	(3)	(4)	(5)	(6)
		Least Developed	Emerging	Natural resources exporters	Assemblers	Globalized	Advanced
Classification by clusters in the initial period (1997)	(1)	Benin Burkina Faso Central African Republic Mali Nepal Niger Pakistan Senegal	Bangladesh Cote d'Ivoire Ethiopia Malawi Mozambique Tanzania Togo Uganda		India Morocco		
	(2)		Albania Argentina Armenia Bolivia Brazil Cambodia Colombia Ecuador Georgia Ghana Greece Guatemala Honduras Kenya Kyrgyzstan Lebanon Mongolia Nicaragua Paraguay Peru Sri Lanka Uruguay Zambia	Azerbaijan Chile Kazakhstan Nigeria South Africa Trinidad and Tobago	Costa Rica Macedonia	Vietnam	Cyprus
	(3)			Algeria Bahrain Brunei Darussalam Cameroon Iran Kuwait Oman Qatar Russia Saudi Arabia Venezuela	Egypt	United Arab Emirates	
	(4)		Zimbabwe		Bulgaria China Croatia Indonesia Jordan Latvia Lithuania Mexico Philippines Poland Romania Tunisia Turkey Ukraine	Czech Rep. Estonia Hungary Slovakia Slovenia Thailand	Malta Portugal Spain
	(5)					Belgium Hong Kong Malaysia Netherlands Singapore	Ireland
	(6)					Austria Germany	Australia Canada Denmark Finland France Iceland Israel Italy Japan Korea Luxembourg New Zealand Norway Sweden Switzerland Taiwan United Kingdom United States

This is not to say that the proliferation of GVCs isn't an important phenomenon, it is just that it with a only few exceptions seems to be most important for economies that are already quite developed. Both the descriptive evidence of the previous section, and the cluster analysis presented above, point in this direction. However, as noted, the results of the cluster analysis point to a major development, and that is the emergence of a quite large group of highly globalized countries. Going back to starting point for our analysis a few decades ago this group had only a few members consisting of highly internationalized countries that functioned as global business hubs (e.g., Singapore and Hong Kong). Now membership in this group has more than doubled, the major reason for which is the addition of seven European countries: Germany; Austria; and five previously socialist countries in Central and Eastern Europe. Arguably, this reflects the integration of these countries into the capitalist economy of the west from the early 1990s onwards, with German multinationals in the driving seat. This is of course a very interesting phenomenon, but it is currently not clear what the lessons from this are for the prospects of the global economy in general and developing countries in particular.

## **5. Does it matter?**

It should be clear by now that there is more than one way to acquire foreign knowledge and integrate with the global economy, and that participation in GVC plays a more prominent role in some of these than in others. However does it matter which group a country belongs to, and is there evidence of gains related from moving from one category to another? This is what we are going to consider in what follows.

To analyse this issue we will employ a so-called conditional growth regression (Cornwall 1976, Barro 1991):

$$(1) y = a_0 + a_1Y_{-1} + a_2C + a_3F,$$

where  $y$  is the annual percentage growth rate of GDP per capita (approximated by log difference),  $Y_{-1}$  is the initial level of GDP per capita (in logs),  $C$  is a set of dummy variables reflecting cluster membership (and changes in these) and  $F$  represents other exogenous factors that may be controlled for to reduce the possible omitted variable bias. The control variables taken into account here reflect differences in geography, disease ecology, and nature (see Appendix Table A1 for details on their definitions and sources). The sample includes 114 countries between 1997 and 2013.

The results are reported in Table 3. The first column in the table reports results for a model with only the initial cluster dummies. In the second column dummies for shifts into new clusters are added. The third column repeats this regression with control variables included. Note that in the case of the least developed countries no cluster dummy was included, hence this is the base category (reflected in the constant term).

The inclusion of the initial level of GDP per capita (in logs) among the explanatory factors reflects the classical “catch-up” or “latecomer” hypothesis advanced by economic historians such as Gershenkron (1962) and Abramovitz (1986), i.e., that low income countries far from the technology frontier have a larger scope from benefitting from international knowledge spillovers than countries close to the frontier. Thus, the estimated impact of this variable should be expected to be negative (i.e., slower growth for countries close to the frontier), which is also confirmed by the estimations (Table 3).

As concerns the effects of (initial) cluster membership, the results in the two first columns suggest that countries in the least developed cluster grow significantly slower than most other countries. This holds particularly when compared with countries in the emerging, assemblers, globalized and advanced clusters (which are estimated to grow about 2-3 % faster per year than the least developed countries). The estimate of the dummy for being part of the natural resources exporters group is also positive but not significant at conventional levels. When control variables reflecting exogenous differences in geography, disease ecology and nature are added the numerical values and significance levels of the estimates for the effects of cluster membership drop. In fact, the estimated differences in growth vis-à-vis the least developed countries remain significant for just two clusters (globalized and advanced). The interpretation is that the model in this case attributes the relatively poor growth performance of many developing countries to a large extent to such exogenous factors rather than cluster membership per se.

With respect to the effect of moving into another cluster, this turns out to be significantly positive for the move into the “natural resource exporters” group (all of which moved from the “emerging” cluster), but with one possible exception (which does not concern developing countries) not for moves into other clusters<sup>9</sup>. Thus, apart from the possible payoffs from tapping into (new) natural resource rents, there does not seem to be particular benefits to growth for developing countries that become more deeply involved in GVCs. Moreover, as noted earlier, the growth premium from moving into the natural resources exporters group primarily reflects the booming demand (and rising prices) for natural resources, especially oil and gas, throughout the period, and may well turn out to be of a transitory nature (for example the initial membership in the “natural resource exporters” groups does not provide much growth advantage).

**Table 3: Explaining growth of GDP per capita: Regression results, OLS, 1997-2013**

	(1)	(2)	(3)
Constant	8.88*** (3.94)	9.76*** (4.36)	16.27*** (6.41)
Initial level of GDP per capita	-0.94*** (3.10)	-1.03*** (3.69)	-1.54*** (5.74)
<u>Initial cluster dummies:</u>			
Emerging	2.61*** (3.48)	2.07** (2.14)	1.29 (1.33)
Natural resource exporters	1.53 (1.43)	1.47 (1.20)	0.97 (0.88)
Assemblers	2.64** (2.55)	2.73** (2.12)	1.77 (1.47)
Globalized	3.01*** (2.72)	3.19** (2.56)	3.17** (2.60)
Advanced	2.47** (2.26)	2.54** (2.06)	1.92* (1.70)
<u>Change cluster dummies:</u>			
To emerging	..	-0.82 (0.57)	-1.15 (0.87)
To natural resource exporters	..	2.15** (1.97)	2.07** (2.26)
To assemblers	..	1.29* (1.80)	0.42 (0.61)
To globalized	..	-0.01 (0.02)	0.17 (0.35)
To advanced	..	-0.68 (1.62)	-0.70* (1.92)
<u>Control variables:</u>			
Malaria ecology	..	..	-0.10*** (3.10)
Tropics and subtropics	..	..	-0.75* (1.84)
Natural disasters	..	..	-0.17** (2.13)
F-test	6.22	5.53	7.26
R <sup>2</sup>	0.29	0.37	0.49
Number of observations	114	114	114

Note: The dependent variable is annual percentage growth rate of GDP per capita (PPP, constant 2011 international USD) approximated by log difference. Absolute value of robust t-statistics in parentheses. \*, \*\*, \*\*\* denote significance at the 10, 5 and 1 per cent levels.

## 6. Conclusions

The importance of “openness” for economic development has been a hotly debated topic in applied international economics and development studies. In the 1980s international organizations such as IMF and the World Bank forged the so-called Washington Consensus which emphasized openness to trade and FDI and a hands-off approach with respect to markets as essential ingredients for development. The consensus soon started to crack however, as research indicated that the empirical support for the underlying assumptions were far from robust. In fact, a fair reading of the evidence suggests during the last half century very few countries globally succeeded in making the transition from low to high income, and that the policy approach adopted in these countries differed fundamentally from the Washington Consensus (Rodrik 1994, Chang 2002, Fagerberg and Godinho 2004).

However, from the 1990s onwards a sizeable literature has emerged on the increasing role played by GVC, coordinated by multinational companies, in the world economy, and the possibilities that participation in such chains may entail for developing countries. The very same international organizations that were behind the now defunct Washington Consensus now actively promote participation in such chains as a way forward for development. The question arises if this is just the Washington Consensus in new tapping, or if it represents a decisive new turn in the process of global economic development with significant new opportunities for low-income countries to escape the poverty trap. This paper has attempted to throw new light on the issue, using a framework that also takes into account other factors that may be importance for development, and data for a broad range of countries including a

fair number of developing countries. Arguably, having a broad framework and country coverage is essential for producing reliable evidence on the matter.

It is certainly true, as argued in the relevant literature, that participation in GVC has increased steadily over the last decades. However, the results presented in this paper show that it is primarily in developed countries that this has been the case. In fact, the propensity to participate in GVC is much higher there than in the developing part of the world. This does not mean that GVC participation cannot be conducive to the latter. But as pointed out in section 2, such positive effects cannot be taken for granted, because it cannot be excluded that most of the benefits go to the multinationals that coordinate the chains, and that spillovers in the developing country, being pecuniary or technological in nature, are minimal (and possibly less than they would have been had the human and other resources from the developing country been devoted to something else). Gereffi, a pioneer in research on GVC, sums this up well: “Globalization’s benefits will continue to be unevenly distributed, with its gains going to those with more education, skills, wealth, and power.” (Gereffi & Fernandez-Stark 2011, p. 37).

The results presented in this paper suggest that for developing countries increased participation in GVC is not the potent driver of growth that international organizations such as the World Bank tend to assume. In fact, most of the upgrading that takes place among developing nations occurs in other ways. There are not many other studies that the results presented here can be compared to but it is noteworthy that Kummritz (2015), using different methods and a smaller sample, finds that low-income countries do not benefit economically from participating in GVC. Thus it appears that the evidence behind policy recommendations

urging low income countries to engage in GVC controlled by foreign multinationals may not stand up to scrutiny.<sup>10</sup>

This does not mean that the analysis undertaken here is lacking with respect to implications for policy. The results presented here confirm, in line with other research (Fagerberg and Srholec 2008, 2017), that there is a strong link between technological capability and economic development and that well developed social capabilities, e.g., a well-developed education system, contributes to this virtuous dynamics. So placing emphasis on improving such factors, i.e., developing the national innovation system, seems to be the right direction to go.

## References

- Abramovitz, M. (1956) Resource and Output Trends in the United States Since 1870. *American Economic Review*, 46(2), 5-23.
- Abramovitz, M. (1986) Catching Up, Forging Ahead, and Falling Behind. *Journal of Economic History*, 46, 386-406.
- Barro, R. J. (1991) Economic Growth in a Cross Section of Countries. *Quarterly Journal of Economics*, 106, 407-443.
- Barro, R. J. and Lee, J-W. (2010) A New Data Set of Educational Attainment in the World, 1950-2010. NBER Working Paper No. 15902, download on 21 November 2012, v. 1.2, 09/11.
- Bell, M. and Marin, A (2004), 'Where do FDI-related technology spillovers come from in emerging economies? An exploration in Argentina in the 1990s', *European Journal of Development Research*, 16, pp. 653-686.
- Cattaneo, O., Gereffi, G., and Staritz, C. (2010), Global value chains in a postcrisis world: a development perspective. *World Bank*.
- Chang, H-J (2002), *Kicking Away the Ladder – Development Strategy in Historical Perspective*, Anthem Press, London.
- Cohen, W. M. and Levinthal, D. A. (1990) Absorptive Capacity: A New Perspective on Learning and Innovation. *Administrative Science Quarterly*, 35(1), 128-152.
- Cornwall, J. (1976) Diffusion, Convergence and Kaldor's Law. *Economic Journal*, 85, 307-314.
- Eora (2016) The UNCTAD-Eora GVC Database. <http://www.worldmrio.com>.
- Ernst, D. and Kim, L. (2002) Global production networks, knowledge diffusion, and local capability formation. *Research Policy*, 31(8):1417–1429.

- Fagerberg, J. and Godinho, M. M. (2004) Innovation and Catching-up, in Fagerberg, J., Mowery D., and Nelson, R. (eds.) *The Oxford Handbook of Innovation*, Oxford University Press, Oxford.
- Fagerberg, J. and Srholec, M. (2008) National innovation systems, capabilities and economic development. *Research Policy*, 37, 1417-1435.
- Fagerberg, J., Srholec, M. and Verspagen, B. (2010) Innovation and economic development. In Hall, B. and Rosenberg, N., eds., *Handbook of the economics of innovation*, North Holland, 833-872.
- Fagerberg, J. and Srholec, M. (2017) Capabilities, Economic Development, Sustainability. *Cambridge Journal of Economics*, forthcoming..
- Fagerberg, J. and B. Verspagen (2015). One Europe or Several? Causes and Consequences of the European Stagnation, in Fagerberg, J., S. Laestadius and B. R. Martin (2015) *The Triple Challenge for Europe: Economic Development, Climate Change and Governance*, Oxford University Press, p 33-59.
- Foster-McGregor, N., Kaulich, F. and Stehrer, R. (2015) *Global Value Chains in Africa*. UNU-MERIT Working Paper Series #2015-024.
- Fu, X., Pietrobelli, C., and Soete, L. (2011), ‘The role of foreign technology and indigenous innovation in the emerging economies: Technological change and catching-up’, *World Development*, 39, pp. 1204–1212.
- Gallup, J. L., Sachs, J. D., and Mellinger, A. (1998). *Geography and Economic Development*. NBER Working Paper No. 6849.
- Gereffi, G. (1999), ‘International Trade and Industrial Upgrading in the Apparel Commodity Chain’, *Journal of International Economics*, 48: 37–70.
- Gereffi, G. and Korzeniewicz, M. (1994), *Commodity Chains and Global Capitalism*, (ABC-CLIO).

- Gereffi, G., Humphrey, G.J. and Sturgeon, T. (2005), 'The governance of global value chains', *Review of International Political Economy*, 12.
- Gereffi, G., Fernandez-Stark, K. (2011) Global value chain analysis: a primer. Center on Globalization, Governance & Competitiveness (CGGC), Duke University.
- Gereffi, G. (2014) Global value chains in a post-Washington Consensus world. *Review of International Political Economy*, 21, 9-37.
- Giuliani, E., Pietrobelli, C. and Rabellotti, R. (2005), 'Upgrading in global value chains: Lessons from Latin American clusters', *World Development*, 33.
- Humphrey, J. and Schmitz, H. (2000), 'Governance and upgrading: linking industrial cluster and global value chain research', *IDS Working Paper*, No. 120, Institute of Development Studies, University of Sussex, Brighton.
- Kim, L. (1997), *Imitation to Innovation: The Dynamics of Korea's Technological Learning*, Harvard Business School Press, Boston, Massachusetts.
- Kiszewski, A., Mellinger, A., Spielman, A., and Malaney, P. (2004) A global index of the stability of malaria transmission. *American Journal of Tropical Medicine and Hygiene*, 70, 486-498.
- Kummritz, V. (2015) Global Value Chains: Benefitting the Domestic Economy? CTEI Working Papers, CTEI-2014-05.
- Lall, S. (1992), 'Technological capabilities and industrialization', *World Development*, Vol. 20, (2) 165-186.
- Lee, K. (2013), *Schumpeterian Analysis of Economic Catch-up. Knowledge, Path-Creation, and the Middle-Income Trap*. Cambridge: Cambridge University Press.
- Linden, G., Kraemer, K.L. and Dedrick, J. (2009), 'Who Captures Value in a Global Innovation Network? The Case of Apple's iPod'. *Communications of the ACM* 52(3), 140-144.

- Lundvall, B.-Å. (ed.), (1992), *National Innovation Systems: Towards a Theory of Innovation and Interactive Learning*. London, Pinter Publishers.
- Lundvall, B.-Å., Joseph, K.J., Chaminade, C. and Vang, J. (ed.), (2009) Handbook of innovation systems and developing countries. Building domestic capabilities in a global context, Cheltenham, Edward Elgar,
- Nelson, R., eds. (1993) *National Innovation Systems: A Comparative Analysis*. New York: Oxford University Press.
- OECD (2016) OECD.Stat. Paris: OECD.
- Rodrik, D. (1994), 'King Kong Meets Godzilla: The World Bank and the East Asian Miracle', in Albert Fishlow, et al., *Miracle or Design? Lessons from the East Asian Experience*, Vol. 11, Overseas Development Council, pp. 13-38
- Saxenian, A. (2006) *The New Argonauts: Regional Advantage in the Global Economy*. Cambridge, MA: Harvard University Press.
- SCImago (2016) SCImago Journal & Country Rank. Scopus database, Elsevier, <http://www.scimagojr.com/countryrank.php>
- Schmitz, H. (1995), 'Small shoemakers and Fordist giants: tale of a supercluster', *World Development*, 23: 9–28.
- Schmitz, H. (1999), 'Global competition and local cooperation: success and failure in the Sinos Valley, Brazil', *World Development*.
- Solow, R. M. (1956) A Contribution to the Theory of Economic Growth. *Quarterly Journal of Economics*, 70 (1), 65-94.
- Sturgeon, T (2001), 'How do we define value chains and production networks?', *IDS Bulletin* 32 9–18.
- Sturgeon, T J. (2002), 'Modular production networks: a new American model of industrial organization', *Industrial and Corporate Change*, 11.

- UN (2016) UN Comtrade Database. United Nations, New York, <http://comtrade.un.org/data>.
- UNCTAD (2013) Global Value Chains and Development: Investment and Value Added Trade in the Global Economy. UNCTAD, Geneva, [http://unctad.org/en/PublicationsLibrary/diae2013d1\\_en.pdf](http://unctad.org/en/PublicationsLibrary/diae2013d1_en.pdf).
- UNCTAD (2016) UNCTAD Statistics on-line. UNCTAD, Geneva, <http://unctad.org/en/Pages/Statistics.aspx>.
- UNDP (2015) Human Development Report 2015. United Nations Development Programme. New York, [http://hdr.undp.org/sites/default/files/2015\\_human\\_development\\_report.pdf](http://hdr.undp.org/sites/default/files/2015_human_development_report.pdf).
- UNESCO (2014) On-line Data Centre. Geneva: UNESCO Institute for Statistics, <http://www.uis.unesco.org/Pages/default.aspx>.
- Université catholique de Louvain 2014. EM-DAT: The OFDA/CRED International Disaster Database. Brussels, [www.emdat.be](http://www.emdat.be).
- USPTO (2016) Extended Year Set - Patents By Country, State, and Year Utility Patents (December 2015). U.S. Patent and Trademark Office, [http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst\\_utlh.htm](http://www.uspto.gov/web/offices/ac/ido/oeip/taf/cst_utlh.htm).
- Wagner, C.S and Leydesdorff, L. (2005) Network structure, self-organization, and the growth of international collaboration in science. *Research Policy*, 34, 1608–1618
- World Bank (2016) World Development Indicators 2015, World Bank, last updated on 17. 2. 2016.

## Appendix A1: Definitions and sources of the variables

<i>Indicator &amp; definition</i>	<i>Scaling</i>	<i>Source</i>	<i>Estimated observations</i>
<b>GDP per capita:</b> Gross domestic product converted to constant 2011 international dollars using purchasing power parity rates.	USD per capita	World Bank (2016)	0
<b>Scientific and engineering articles:</b> Counts of citable documents recorded in SCImago Journal & Country Rank (based on information contained in the Scopus database).	per mil. people	SCImago (2016)	0
<b>USPTO patent applications:</b> Counts of applications for utility patents filed in the United States Patent and Trademark Office (USPTO) classified by country of residence of the first named inventor.	per mil. people	USPTO (2016)	0
<b>R&amp;D expenditures:</b> Intramural expenditure on research and experimental development (R&D) performed on the national territory.	% of GDP	UNESCO (2016), OECD (2016), Castellacci and Natera, (2011) and national sources	34
<b>Adult literacy:</b> People aged 15 and over who can read, understand and write a short, simple statement on their everyday life.	%	UNDP (2016) and World Bank (2016)	2
<b>Mean years of schooling:</b> Average number of years of education received by people ages 25 and older, converted from education attainment levels using official durations of each level.	years	UNDP (2016)	0
<b>GVC exports:</b> Domestic value-added accounted in the gross exports of a country that is supplied to other countries' exports derived from input-output tables.	% of GDP	Foster-McGregor, et al. (2015)	0
<b>GVC imports:</b> Imported inputs (produced in other countries) accounted in the gross exports of a country derived from input-output tables.	% of GDP	Foster-McGregor, et al. (2015)	0
<b>Consumption goods exports:</b> Exports of consumption goods (BEC, rev. 3 categories 112, 122, 522 and 6) derived from trade in goods statistics.	% of GDP	United Nations (2017)	0
<b>Consumption goods imports:</b> Imports of consumption goods (BEC, rev. 3 categories 112, 122, 522 and 6) derived from trade in goods statistics.	% of GDP	United Nations (2017)	0
<b>Capital goods exports:</b> Exports of capital goods (BEC, rev. 3 categories 41 and 521) derived from trade in goods statistics.	% of GDP	United Nations (2017)	0
<b>Capital goods imports:</b> Imports of capital goods (BEC, rev. 3 categories 41 and	% of GDP	United Nations (2017)	0

521) derived from trade in goods statistics.			
<b>FDI inward:</b> The value of capital and reserves (including retained profits) attributable to foreign parent enterprises with lasting management interest, plus the net indebtedness of foreign affiliates to the parent enterprises.	% of GDP	UNCTAD (2016)	0
<b>FDI outward:</b> The value of capital and reserves (including retained profits) attributable to domestic parent in enterprises abroad with lasting management interest, plus the net indebtedness of foreign affiliates to the parent enterprises.	% of GDP	UNCTAD (2016)	8
<b>Natural resources rents:</b> The sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents.	% of GDP	World Bank (2016)	0
<b>Agriculture:</b> Agriculture corresponds to ISIC divisions 1-5 and includes forestry, hunting, and fishing, as well as cultivation of crops and livestock production.	% of GDP	World Bank (2016)	0
<b>Manufacturing:</b> Manufacturing refers to industries belonging to ISIC divisions 15-37.	% of GDP	World Bank (2016)	4
<b>Population:</b> All residents regardless of legal status or citizenship--except for refugees not permanently settled in the country of asylum, who are generally considered part of the population of their country of origin.	people	World Bank (2016)	0
<b>Malaria ecology:</b> Stability of malaria transmission given by biologic characteristics of vector mosquitoes.	index	Kiszewski et al. (2004)	0
<b>Tropics and subtropics:</b> Proportion of land area in tropical or subtropical ecozone based on Holdridge life zones.	share	Gallup et al. (1998)	0
<b>Natural disasters:</b> Log of people killed in natural disasters (earthquake, volcano, storm, drought, flood, extreme temperature, wildfire, landslide and epidemic) per total population.	per mil. people	Université catholique de Louvain (2014)	0

**Appendix A2: Adjusting openness variables for size differences between countries (OLS)**

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	GVC exports	GVC imports	Consumption goods exports	Consumption goods imports	Capital goods exports	Capital goods imports	FDI inward	FDI outward
Constant	4.50*** (12.52)	6.18*** (11.36)	2.98*** (5.35)	5.82*** (19.92)	1.30*** (2.66)	3.64*** (12.43)	6.32*** (7.92)	4.08*** (3.80)
Log of population	-0.15*** (6.73)	-0.25*** (7.78)	-0.08** (2.39)	-0.25*** (13.97)	-0.02 (0.73)	-0.12*** (6.60)	-0.19*** (4.12)	-0.14** (2.17)
F-test	45.31	60.54	5.72	195.16	0.54	46.59	16.94	4.72
R <sup>2</sup>	0.16	0.20	0.02	0.46	0.00	0.15	0.09	0.02
Number of observations	228	228	228	228	228	228	228	228

Note: Based on pooled data in 114 countries in 1997 and 2013, hence 228 observations in total. Absolute value of robust t-statistics in parentheses. \*, \*\*, \*\*\* denote significance at the 10, 5 and 1 per cent levels.

### Appendix A3: Constructing capability variables with the help of factor analysis

Table A2.1: Technology: Results of the factor analysis

	Factor loadings
Scientific and engineering articles (per capita)	0.86
USPTO patent applications (per capita)	0.95
R&D expenditures (of GDP)	0.89

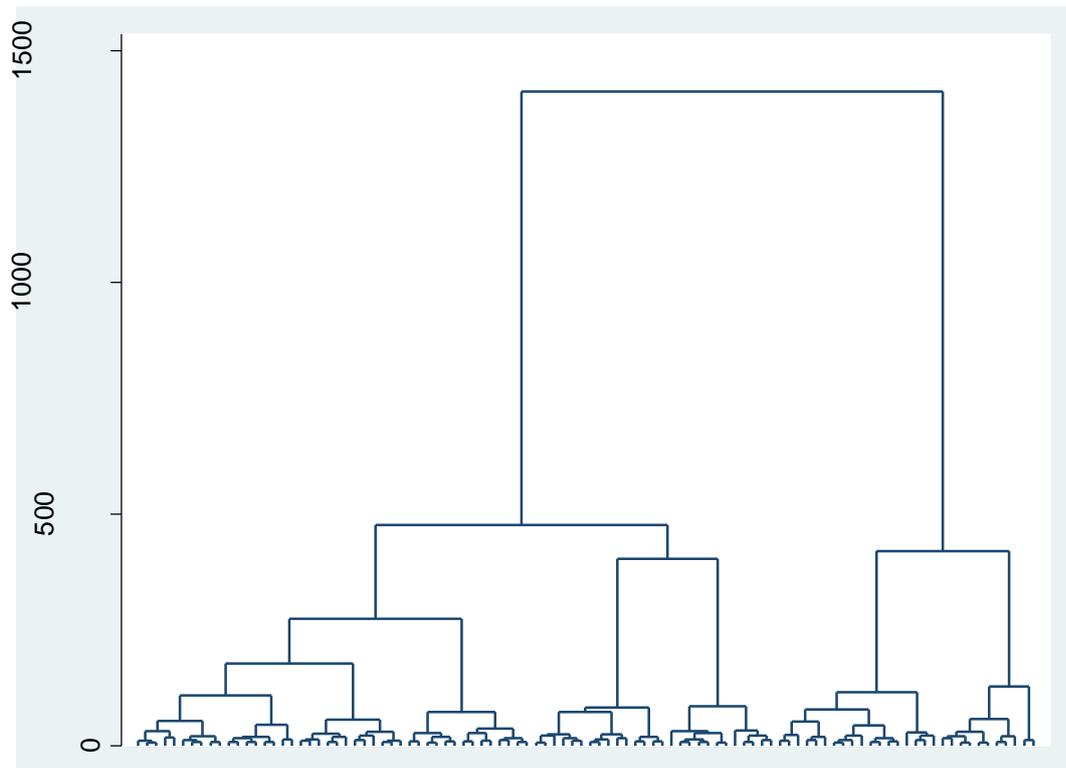
Note: The extraction method is principal factors; based on pooled data in 114 countries in 1997 and 2013, hence 228 observations in total; 0.78 proportion of eigenvalues accounted for using the trace of the correlation matrix as the divisor.

Table A2.2: Education: Results of the factor analysis

	Factor loadings
Adult literacy (% of adult population)	0.92
Mean years of schooling (years)	0.92

Note: The extraction method is principal factors; based on pooled data in 114 countries in 1997 and 2013, hence 228 observations in total; 0.81 proportion of eigenvalues accounted for using the trace of the correlation matrix as the divisor.

## Appendix A4: Dendrogram



Note: Hierarchical clustering method using Ward's linkage with squared Euclidean dissimilarity measure; based on pooled data in 114 countries in 1997 and 2013, hence 228 observations in total.

### Appendix A5: Cluster group averages of the underlying indicators

	Techno- logy	Edu- cation	GVC exports	GVC imports	Consum- ption goods exports	Consum- ption goods imports	Capital goods exports	Capital goods imports	FDI inward	FDI outward	Natural resource rents	Agri- culture	Manu- facturing
Least Developed	-0.9	-2.2	-0.9	-0.9	-0.6	-0.3	-0.8	-0.7	-0.7	-0.8	0.5	1.4	-0.7
Emerging	-0.7	0.0	-0.6	-0.5	0.0	0.0	-0.6	0.1	0.0	-0.6	0.2	0.6	-0.2
Natural resources producers	-0.4	0.1	0.8	-0.7	-1.2	-0.7	-0.7	-0.6	-0.3	0.0	1.5	-0.6	-0.5
Assemblers	-0.2	0.3	0.2	0.6	0.6	0.1	0.4	0.3	0.0	-0.4	-0.3	0.0	0.8
Globalized	1.0	0.6	1.3	1.9	1.3	1.3	2.0	1.6	1.0	1.2	-0.7	-0.9	0.3
Advanced	1.6	0.7	0.1	0.3	0.0	-0.2	0.6	-0.4	0.2	1.2	-0.9	-0.9	0.2
Total sample	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0

---

<sup>1</sup> Enterprises in countries such as Korea, Singapore and China have entered into international interactions as suppliers to multinationals in electronics and used the experience to move from being dependent suppliers to developing their own brands and ending as important multinational enterprises (Lee 2013).

<sup>2</sup> The well-documented case of shoe-making in Sinos Valley, Brazil illustrates this problem (Schmitz 1995 and Schmitz 1999).

<sup>3</sup> If necessary unity was added to avoid logs of zero. Unity was also added to variables with values very close to zero to avoid generating outliers with high negative values.

<sup>4</sup> Missing data were estimated with the help of the other indicators included in the cluster analysis using the impute procedure in Stata 11.2 (see the Stata 11.2 Manual for details). The number of observations (in both periods) estimated by this procedure is given in the last column of the Appendix A1 table.

<sup>5</sup> The variable in question is regressed against the population size and the residuals of this regression are used as measure of this particular source of openness. Hence, the part of the variation that can be seen as reflecting differences in country size is filtered out. The estimates are presented in the Appendix A2 table.

<sup>6</sup> With respect to payments for proprietary knowledge, this is a part of services trade, and therefore included in the GVC-measures used in this paper. Including such payments as a separate openness variable would therefore introduce an element of double-counting, which is why we refrained from doing so.

<sup>7</sup> Similar variables were also calculated for imports but for the sake of space we do not include the graphs here. These are available from the authors on request.

<sup>8</sup> Foster-McGregor, et al. (2015) is the source for the GVC indicators used in this paper.

<sup>9</sup> This concerns three Southern-European countries that moved into the advanced cluster. The estimated effect is negative, significant at the 10 % level, but only when control factors are included. Thus the evidence of a significant effect is not very strong. Moreover, it may be noted that these three countries suffered extensively from the financial crisis and the way it was handled by the European Union (see Fagerberg and Verspagen 2015 for a discussion). Hence, one possibility is that the estimate picks up the effect of this.

<sup>10</sup> It should be noted that the GVC measure used here comes out national accounting exercises, and does as such not discriminate between different types of governance in such chains (Gereffi et al 2005), an issue that may merit more research.