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1. Introduction

One of the meaningful changes that have emerged in recent times due to the globalization is the so-called Global Value Chains (GVCs), defined as the fragmentation of production processes in several stages being performed in different countries and connected by services links, thus leading to the emergence of borderless production systems of various degrees of complexity. GVCs are typically coordinated by transnational corporations (TNCs), with cross-border trade of production inputs and outputs taking place within their networks of affiliates, including contractual partners in non-equity modes (NEMs) of international production and arm´s-length suppliers. At the country level, GVCs are a proxy for how gross exports include foreign and domestically produced value added. At the industry level, they are a proxy for which industries value chains are segmented (fine-sliced) into distinct tasks and activities that generate trade.

The implications of GVCs are multifold. For less-developed countries in particular, it is an opportunity to have access to new manufacturing processes and technology and, consequently, to increase their production of manufacturing goods[[1]](#footnote-1). With the new reality, trade and investment policies suffered adaptations: developing countries, which had resisted to trade and investment liberalization until the end of the 1980s, started to open in part to facilitate international production sharing. GVC-friendly agreements blossomed, such as Bilateral Investment Treaties, mostly about unilateral concessions to attract investment from developed nations, and the inclusion of specific provisions in new Regional Trade Agreements, such as competition policy, capital movements and assurances for intellectual property (Baldwin and Lopez-Gonzalez, 2014). Most relevant is also the fact that conventional trade statistics may give a misleading perspective of the importance of trade in the case of goods and services requiring the use of imported goods and services to make them, as those inputs are not discounted when export volumes are calculated[[2]](#footnote-2). UNCTAD (2013) concludes in this respect that 28% of the value of world cross-border trade in goods and services in 2010 (about USD 5 trillion) was overstated as a result of multiple counting.

As a response to the fact that traditional statistics of international trade fail to both fully reflect the new reality that globalization created and to overcome the problematic of multiple counting, several organizations recently published important new databases on value-added statistics for international trade, based on international input-output (IO) tables with bilateral trade links[[3]](#footnote-3). The revolutionary character of these new databases comes from the fact that they are based on supply-use relations between industries and across countries so they group goods and services in inputs and final demand according to the use they have in the economy, whereas other methodologies group goods and services in inputs and final demand relying on the standard classification of each product (regardless of the use that the product actually had). This difference is crucial, since most products and services are usually used for both purposes, i.e. as intermediates and as final consumption[[4]](#footnote-4).

Of these new IO databases, the most broadly used by researchers is the World Input-Output Database (WIOD), coordinated by the University of Groningen and launched in 16 April 2012 (see Timmer et al., 2015). It is also the one that will be used in this study. In its first release, it covered 40 countries, mostly Organization for Economic Co-operation and Development (OECD)-effective members and major emerging economies[[5]](#footnote-5) (hereinafter referred to as OE countries), representing nearly 82% of world’s Gross Domestic Output (GDP) in 2011, and 35 sectors.

The contribution of this study to improve knowledge about GVCs is twofold.

First, we will present results obtained with a GVC-participation index for the 40 OE countries and the 35 sectors considered in the WIOD in the last year of the first release of this database (2011). Specific attention will be devoted to the GVC of the “Electronic and optical equipment”, identified as the most internationally fragmented sector in 2011.

Second, we analyze whether a country’s degree of GVC-participation is positively associated with Foreign Direct Investment (FDI) inward stocks. GVCs are typically coordinated by TNCs and, since around the year 2000, global trade and FDI have grown exponentially, reflecting the rapid expansion of international production in TNC-coordinated networks and the inextricably intertwining of investment and trade (UNCTAD, 2013). GVCs are increasingly associated with FDI flows as subsidiaries provide inputs to their parent firms. In this case, trade in intermediates takes the form of intra-firm transactions with production stages located in different countries, i.e. vertical production networks within multinationals. However, the network in which GVCs operate can be much more complex, involving «firms in manufacturing logistics, transportation and other services, as well as customs agents and other public authorities» (Amador and Cabral, 2014, p. 4). UNCTAD (2013) estimates that about 80 per cent of global trade (in terms of gross exports) is linked to the international production networks of TNCs, either as intra-firm trade, or through the NEMs of international production, such as contract manufacturing, licensing and franchising, and arm’s length transactions involving at least one TNC. As a consequence, increasingly the TNCs must decide where to locate their activity taking into consideration the value added activities (or segments) comprised in a GVC (UNCTAD, 2013) and the specific mode adopted by the GVC to internationally fragment production[[6]](#footnote-6). The impact of GVCs on TNCs activity extends to all types of FDI-motivation. For instance, efficiency-seeking FDI, through which firms seek to locate discrete parts of the production in low cost locations, is particularly associated with GVCs. Much of the FDI investment in natural resources and other resource seeking is increasingly driven by TNCs that operate globally. Even in cases of market-seeking purposes (typically horizontal FDI), FDI by TNCs often corresponds to a shift from arm´s-length trade to intra-firm trade (UNCTAD, 2013), in part determined by the increased role of agglomerative spatial economies and local service support facilities (Dunning, 1998) which may belong to a GVC network. Strategic alliances may also prevail in a decision of a firm to opt for the internalization of operations through FDI, dictated by power relations and coordination of potential partners of its international production network, such as to internalize operations aiming to integrate domestic operators in the TNCs’ GVC, often through mergers and acquisitions, or to establish local NEMs and arm´s length relationships. All in all, it is possible that TNCs opt for countries with high levels of GVC-participation as this can facilitate access to global markets and integration in the global economy. Despite the recognition that locational determinants of TNC activities are increasingly specific to GVC segments and GVC modes since at least the turn of the century (Dunning, 1998), the empirical role of a country’s degree of GVC-participation as aninward-FDI driver has been scarcely analyzed in empirical terms. Some studies have focused the expansion of GVCs as a consequence of flows of FDI (UNCTAD, 2013; Lopez-Gonzalez, 2016). However, as pointed out by Amador and Cabral (2014, p. 14), «although it is difficult to set clear borderlines, the flows of FDI and intra-firm trade are mostly a consequence of the expansion of GVCs and not exactly drivers for its expansion».

This paper explores co-movements between a country´s degree of GVC-participation and bilateral FDI inward stocks of OE countries in the 2000s (namely, in the decade from 2002 to 2011) with a pooled regression model, after controlling for other possible FDI determinants. Relatively to similar previous indicators for GVC-participation (Koopman et al., 2011, 2014), we use a measure that enlarges the scope of domestic value-added traded by including intermediate exports absorbed by a direct importer (in addition to domestic value-added exported and returned home or re-exported to third countries).

Considering the beneficial direct and indirect effects that a country may expect from FDI[[7]](#footnote-7), a positive link with GVC-participation suggests that economic policies aiming to promote economic growth should favor the free trade of inputs and other policies aiming to increase firms’ embeddedness into GVCs, such as investment policies, contract enforcement regimes and business facilitation.

The paper is organized as follows. Section 2 reviews the measuring of international fragmentation of production. Section 3 presents the calculations with the proposed factor-content of value-added-related indicator of GVC-participation for each of the OE countries with the first release of the WIOD database. Section 4 gives continuity to section 3 but for the main GVCs per economic sectors. Section 5 presents theoretical and empirical foundations for considering a countries’ degree of GVC-participation as an FDI inward driver and estimates this relation with a pooled regression model for the period 2002-2011, by considering the bilateral relations of the OE countries and other FDI determinants usually found in the literature. Section 6 concludes.

2. Measuring the international fragmentation of production

The indicators used to empirically measure the international fragmentation of production stem from two tributaries of the literature. While the first one pays attention to the importance of international trade in intermediates[[8]](#footnote-8), the second focuses on the import content of exports, the so-called “vertical trade” or Vertical Specialization (VS). The latter is a measure of international fragmentation of production by looking at the imported content of exports and was firstly mentioned by Hummels et al. (2001).

Trade in value-added (TiVA) emerges as an attempt to bring together both branches of literature. On one hand, it broadens the coverage of VS. On the other hand, it aims at disaggregating gross exports into Domestic Value Added (DVA) and Foreign Value Added (FVA). Internationally-linked IO matrices are used to operate this distinction. In addition to initial attempts to measure TiVA by Daudin et al. (2011) and Johnson and Noguera (2012) - the former considering the domestic value added that comes back to the country through intermediates originally exported and re-imported with more processed products, and the latter measuring domestic value-added exported excluding exports of intermediates that return home either via final imports or via intermediate imports -, Koopman et al. (2011) provide a full disaggregation of gross exports in a single conceptual framework that encompasses all previous indicators and branches of literature. These authors propose an accounting framework that breaks up a country’s gross exports into the various value-added components.

We reproduce in Figure 1 a consolidated decomposition of gross exports that brings together Koopman et al. (2011, 2014) and Wang et al. (2017) and clearly identifies the value-added components included in the indicators of Hummels et al. (2001), Daudin et al. (2011) and Johnson and Noguera (2012). First, we decompose the gross exports of a given economy into the two types of value-added referred above (first level of Figure 1): (i) DVA, corresponding to the value of the domestic inputs incorporated in the domestic production processes plus the value-added incorporated from the production factors associated to the production (labor and capital); and (ii) FVA, corresponding to the value-added of the goods and services produced by the country’s trading partners that were imported as inputs and used in the domestic production processes. DVA and FVA correspond to the upstream and the downstream approaches in the internationally-linked IO databases, respectively, although these databases also provide information about the decomposition of the domestic production consumed domestically in addition to the DVA of the domestic production. The second level of Figure 1 decomposes the DVA of gross exports into five other types: (1) exported in final goods; (2) exported in intermediates absorbed by direct importers; (3) exported in intermediates re-exported to third countries; (4) exported in intermediates that return home via final imports; and (5) exported in intermediates that return home via intermediate imports. These five components represent the share of domestic content in a given country’s exports. The internationally-linked IO databases provide for a direct observation of the exports in final goods (1) and exports in intermediates (2)+(3)+(4)+(5), but does not allow to decompose the latter between intermediates absorbed in the foreign economy, intermediates re-exported to third-countries, and intermediates returning home. In Figure 1, (1)+(2) correspond to the domestic direct value-added of a given economy’s gross exports; and (3) corresponds to the domestic indirect value-added of a given economy’s gross exports. Note that (3), (4), and (5) involve value-added that crosses national borders at least twice. These flows are the sources of multiple counting of value added in standard trade statistics.

[Insert Figure 1 here]

Based on the decomposition of gross exports above described, Koopman et al. (2011) built an index to measure a country´s degree of GVC participation that considers both the FVA and (part of) the DVA in gross exports, basically adding the DVA traded with the FVA traded. Indeed, the authors only considered in DVA the intermediates that were re-exported to third countries to facilitate comparison with previous VS-related indicators. Koopman et al. (2014) improved their first proposal by proposing a more elaborated decomposition of gross exports that put additional emphasis in the identification of the double-counting terms (pervasively present in VS indicators) and, in addition, included in the GVC-participation indicator the exported intermediates that return home, both via final imports and via intermediate imports (4 and 5 in Figure 1, respectively).

More recently, Wang et al. (2017) improved the decomposition of gross exports and indexes already provided by Koopman et al. (2011, 2014) basically in order to incorporate the concepts of simple and complex GVCs, defined as those chains in which value-added crosses national borders for production purposes only once or more than once, respectively. Note that, for instance, Koopman et al. (2011, 2014) aimed only at measuring the so-called complex GVCs with regard to the DVA exported in intermediates. The simple GVCs, which are represented by component (2) in Figure 1, were not included in the index proposed by these authors. In the case of the FVA in intermediate goods exports, represented by component (6) in Figure 1, those two GVC types cannot be even disentangled with available data.

In this paper, we use a value-added-related indicator of GVC-participation based on the estimates of the appropriation of value-added by domestic agents in a given economy due to the foreign demand for domestic products and services used as inputs in production processes, i.e. exported DVA (upstream or user’s approach, based in forward industrial linkages), and the appropriation of value-added by foreign agents due to the domestic demand for foreign products and services used as inputs in production processes, i.e. imported FVA (downstream or suppliers’ approach, based on backward industrial linkages). We add both of these traded flows of value-added to capture the “GVC-participation” of a country, being this index normalized by gross exports to allow for comparisons between time periods and/or other countries, as shown in Index 1 below. In relation to the previously-used indicators, we basically include in the GVC-participation index of Koopman et al. (2011) the concept of simple GVCs in the case of the user’s approach.

[Insert Index 1 here]

3. Measuring Global Value Chains for Countries

Table 1 below presents our estimates for GVC-participation of OE countries in 2011[[9]](#footnote-9). In relative terms, Indonesia was the economy with the highest measure of value-added embeddedness in GVCs. Total value-added traded due to participation of Indonesia in GVCs equaled 156.1% of the gross exports of the economy. Taiwan and Finland were the other two countries where trade in value-added represented more than 150% of their gross exports in 2011, with 154.8% and 152.1%, respectively. We conclude that these three economies were, from our set of 40 economies assessed, the most embedded in GVCs. Several other Asian economies emerge in the top ten, namely the PRC, Japan and South Korea. On the opposite side, the Baltic countries and the small European island countries emerged as the economies with the lowest value-added measure of GVC- participation, as the GVC-related trade in value-added represented below 90% of their gross exports. In absolute terms, the PRC and the US, followed by Germany and Japan, observed a higher degree of GVC-participation, with trade in value-added totaling USD 2.99 trillion, USD 2.95 trillion, USD 2.06 trillion, and USD 1.34 trillion in 2011, respectively.

[Insert Table 1 here]

Subtracting the two components of the GVC-participation index (exported DVA and imported FVA in index 1) provides a proxy for the country’s prevailing position (upstream or downstream) in the GVC[[10]](#footnote-10).This concept captures whether a country is predominantly a net exporter or a net importer of value added, i.e. whether the domestic value added incorporated in inputs’ exports (forward linkages) is higher or lower than the foreign value added used in a country’s own exports (backward linkages). A country with a positive balance in net value added traded lies upstream in the GVCs. The more upstream a country is the larger its forward linkage based production is and the shorter its backward linkage based production is. Results for GVC-position of OE countries in 2011 are also shown in Table 1 above.

In relative terms, Russia emerged as the economy with the highest upstream GVC-position. Russian total exports of goods and services used as inputs by other countries represented USD 448.2 billion in 2011, while total imports of foreign goods and services used as inputs in the Russian economy amounted to USD 138.4 billion. Normalized by gross exports, we conclude that Russian net value-added trade from GVC-participation represented 54.0% of its gross exports. These figures were critically influenced, however, by the weight of petroleum and gas in Russian exports, as these two commodities were widely used as inputs in the production processes of other goods and services[[11]](#footnote-11). After Russia, Australia, Germany and Canada were the three most benefited economies in net terms. On the opposite side, we observe that GVC-participation negatively contributed in net value-added to the total output of Greece, India, Cyprus and Portugal, with net losses representing 24.3%, 13.4%, 12.4% and 6.8% of their gross exports, respectively.

4. Measuring Global Value Chains for sectors

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In this section, we make use of the WIOD to estimate and present the most significant GVCs worldwide, per economic sector, using the total trade in value-added due to the participation in GVCs. Results are shown in Table 2 below in absolute terms[[12]](#footnote-12), in 2011, for the 35 sectors included in the WIOD. We note that, globally, “Electrical and optical equipment”, “Basic metals and fabricated metal” and “Mining and quarrying” present the largest values, so we conclude that they constituted the three largest GVCs worldwide in 2011, with USD 2.6 trillion, USD 2.4 trillion and USD 2.0 trillion, respectively.

[Insert Table 2 here]

Due to space restrictions, we selected only the most GVC-embedded sector for a more detailed analysis[[13]](#footnote-13). Table 3 below provides an overview of trade in valued-added within this sector in 2011 per most relevant countries. We observe that the PRC played a pivotal role in this GVC, being the most significant origin and destination of the inputs traded worldwide in this sector, with USD 638.8 billion (representing 24.9% of the total trade in value-added within the sector in that year). Other economies with a significant role in this GVC were Germany (less than a third of the value-added traded by the PRC though, with 7.6%), the US (7.3%), Japan, South Korea, and Taiwan.

[Insert Table 3 here]

In terms of bilateral flows of trade in value added within the GVC of “Electrical and optical equipment” in 2011, Table 4 below shows that the value-added imported by the Rest of the World (RoW) from PRC, the value-added imported by the PRC from the RoW, the value-added exported by the PRC to the RoW, and the value-added imported by the US from the PRC were the largest streams in 2011, with USD 89.7 billion, USD 85.2 billion, USD 81.3 billion, and USD 72.7 billion, respectively. The value-added imported by PRC from Taiwan, South Korea and Japan (with USD 69.8 billion, USD 54.0 billion, and USD 47.1 billion, respectively), and the value-added exported by the PRC to Taiwan (USD 62.5 billion) were also significant. The value-added imported by the RoW from Germany should also be highlighted (USD 30.5 billion). In fact, one could conclude that GVC is, in the case of this sector, a misleading designation, as it is more regional than global[[14]](#footnote-14). In this sector, we observe a predominance of bilateral flows within East Asian countries, namely between the PRC and Taiwan; between the PRC and South Korea; and between the PRC and Japan[[15]](#footnote-15). In addition, based on other studies carried out with traditional international trade databases[[16]](#footnote-16), we admit that the bilateral flows of international trade in inputs between the PRC and the RoW, which are the highest bilateral flows in our sample, include mainly flows of inputs between the PRC and Southeast Asian countries that are not individualized in the WIOD, such as Malaysia, the Philippines, Thailand or Viet Nam. Finally, we also observe significant linkages in international trade of inputs between East Asia (the PRC) on one side, and North America (the US and Mexico) and Europe (Germany) on the other.

5. The association between Global Value Chains and Foreign Direct Investment

As mentioned in section 1, we expect a country’s high degree of participation in GVCs to be a driver of inward FDI stock, as foreign affiliates of TNCs aim to use foreign inputs in their production and/or to supply input exports to other parts of the associated GVC network (which may occur through intra-firm trade, but also through access to strategic NEMs of international production, such as contract manufacturing, licensing and franchising, and arm´s length, within the international network). Nonetheless, a comprehensive theoretical framework encompassing the economic consequences of GVCs is still missing, in general and, more specifically, involving FDI location.

Standard theoretical literature on FDI has modeled the characteristics of firms opting for internalization of operations through FDI, as alternative to NEMs or arm´s length transactions[[17]](#footnote-17). In general, FDI is chosen whenever knowledge flows are complex and the capabilities of potential partners or arm´s length suppliers are low, and the TNC is able to effectively coordinate and integrate affiliate activities. However, with globalization of firms, various forms of cross-border activities have been facilitated and «the way to think about multinational firms has changed passing from a centralized vertical organization to a decentralized more flexible structure» (Franco et al., 2008, p. 9). A TNC may opt for FDI, for instance, as a strategic location to establish some transactions through markets as alternative to intra-firm trade within the GVC-network. Some recent theoretical models already explore some facets of the fact that «firms active in a globalization mode are likely to engage in other globalization modes to take advantage of the globalization effects in reducing costs, expanding outputs, and raising the returns from other global activities» (Tomiura, 2007), such as Zanfei (2000) on the trend of TNCs to establish internal and external networks for innovation, Yeaple (2003) on cross–country dependencies and “complex integrated strategies” of TNCs, Antràs and Chor (2003) on the property-rights theory on the firm’s choice of an organizational form, Antràs and Helpman (2004) on the impact of within-sector heterogeneity in firm productivity on the firm´s globalization decision and Grossman et al. (2005) on the relationship between outsourcing and foreign sourcing on industries with heterogeneous firms that make intensive use of intermediates[[18]](#footnote-18). However, the behavior of many multinational enterprises is “still not well described by existing models of foreign direct investment” (Yeaple, 2003, p.293), the available literature being still quite fragmented, motivated by the particular area of interest in which investigators are involved, with «much confusion in the way the topic is approached, especially to conduct empirical testing of the hypothesis» (Franco et al., 2008, p. 3).

The purpose of this paper is not to evaluate firm-level decisions on globalization modes and location (no inter-country input–output table currently exists to separate production activities between domestic firms and foreign affiliate) but the importance of a macroeconomic context of a country in terms of GVC-participation as a location determinant of inward FDI, given the complexity and diversification of the organizational forms of a GVC-network. The diversified theoretical literature above illustrated on firm´s choice of an organizational form of GVCs, although still in childhood, already gives support to this relation. In empirical terms, there is also some assessment for GVCs as a FDI driver but it is scarce and lacks solid statistical proof. UNCTAD (2013) has shown a strong and increasing positive statistical relationship between FDI inward stock growth in countries and their GVC-participation growth rates for 187 countries in the periods 1990-2000 and 2001-2010. In addition, this study ranked 180 countries by the ratio of FDI inward stock over Gross Domestic Product (GDP) and grouped them in quartiles, in the year of 2010, concluding that the countries with the most FDI relative to the size of their economies have higher GVC-participation (UNCTAD, 2013, p. 16). UNCTAD (2013) also presents evidence of investment-CGVs links for individual countries and regions (box IV, p. 136). For instance, in the USA, in 2010, some two-thirds of both exports and imports of goods can be considered as within the international productions networks of TNCs; 64% of total exports and 62% of total imports in France; and 93% of total exports in Japan.

In this section, we analyze the association between a country’s degree of GVC-participation and the bilateral FDI inward stocks for OE members with a model inspired by the literature on FDI determinants. We will run a pooled-regression model explaining bilateral FDI stocks between countries in the period from 2002 to 2011 which includes the country’s GVC-participation index and explanatory variables usually found in the literature to empirically explain FDI inflows (summarized, for instance, in Chakrabarti, 2001; and Jabri et al., 2013).

The equation to be estimated is presented in Index 1 below. We use the 37 countries of the WIOD database that are also covered by OECD (2015) database[[19]](#footnote-19) for bilateral FDI inward stock.

[Insert Index 2 here]

The variables included in the model are the following:

*Dependent variable*

is the ratio of bilateral FDI inward stock in year t in country i from country j, at current prices, in US dollars, divided by the nominal GDP of country i, in US dollars. t ranges from 2002 to 2011. For the FDI, we make use of the fourth edition of the OECD’s benchmark definition of FDI (OECD, 2008), which includes all sorts of transnational financial flows, productive or speculative, short or long run. FDI data was retrieved from OECD (2015). GDP data was retrieved from World Bank (2015).

*Independent variables*

1. and are the nominal GDP per capita of country i and j, respectively, in US dollars, retrieved from World Bank (2015).
2. and are the nominal GDP of country i and j, respectively, in US dollars, retrieved from World Bank (2015).

According to Chakrabarti (2001, p. 96), market size has, by far, been the single most widely accepted determinant of FDI flows. The market size hypothesis upholds that a large market is necessary for efficient utilization of resources and exploitation of economies of scale in the country of destination, but also for capital accumulation as the source of FDI in the country of origin.

1. and are the sum of imports and exports divided by the nominal GDP of country i and j, respectively, in US dollars. Exports and imports are retrieved from World Bank (2015).

The hypothesis is that a country’s degree of openness to international trade should be a relevant factor in the decision to invest, given that most investment projects are directed towards the tradable sector. However, evidence is mixed regarding the significance of this variable in determining FDI (see, for instance, Chakrabarti, 2001).

In addition, we include in the regression several variables that work as proxies for the transaction costs to invest:

1. is the geodesic weighted distance as the crow flies between country i and country j (weighted using city-level data to assess the geographic distribution of population, in 2004, inside each nation)[[20]](#footnote-20), in kilometers, retrieved from Mayer and Zignago (2011)[[21]](#footnote-21).
2. is a dummy variable indicating whether the two countries are contiguous, i.e. if they share a land border, retrieved from Mayer and Zignago (2011).
3. is a dummy variable indicating whether the two countries share the same official language, retrieved from Mayer and Zignago (2011).
4. is a dummy variable indicating whether the two countries have ever had a colonial link, retrieved from Mayer and Zignago (2011).

The explanatory variables , , and are broadly considered proxies for “trade barriers”. *Ceteris paribus*, one can assume that the higher the distance between two countries, the smaller is the cultural, legal and historical familiarity between them. In the same vein, if two countries share a land border, the same language, or were the colony one of the other, one can assume that the higher is the cultural, legal and historical familiarity between them. This familiarity can be interpreted as an element reducing transaction costs in trade and investment, so stimulating FDI flows between those two countries.

In the case of , its effect can nonetheless be considered ambiguous, as it depends on the prevailing type of FDI (positive for horizontal FDI, aligned with the tariff-jumping motive of FDI; negative for vertical FDI). However, a negative sign is usually obtained in the empirical literature irrespective of the type of FDI, confirming the overall negative effect of distance as a measure of investment costs.

We also include in the regression an explanatory variable to test the sensitivity of FDI bilateral stocks to offshore financial centers:

1. is a dummy variable indicating whether at least one of the two countries is considered to be an offshore financial center[[22]](#footnote-22). A problem with the FDI data used, as mentioned above, is not to differentiate between productive FDI (used in industries, medium and long-term, stable investment) and financial flows (portfolio, short-term, volatile investment). This is what explains that in OECD’s FDI data, Hong Kong, British Virgin Islands, Mauritius and Cyprus are the largest foreign direct investors in PRC, India and Russia. In particular, Hong Kong, the Cayman Islands and the British Virgin Islands account for nearly 70% of PRC’s total outbound FDI (see Garcia-Herrero et al., 2015). The problem is that productive and medium- and long-term investments are certainly less sensitive to offshore financial centers than speculative and short-term investments. Therefore, one would expect this variable to have a significant positive impact on the financial FDI, meaning that offshore financial centers stock high levels of speculative FDI, but it would be expected to be insignificant or just slightly significantly positive for productive FDI if assuming, for instance, the recycling of some part of the stocked financial FDI in productive activities.

Additionally, as already mentioned, we include in the regression the country´s value-added-related GVC-participation index proposed above:

9. and are the value-added measure of GVC- participation for countries i and j in year t-1. These variables are expected to be positively related to the bilateral stock of FDI for economies well inserted into GVCs, as it is the case of most countries considered in this study. We also introduced two set of dummies to capture time- and country-specific effects, namely:

are ten time-specific dummy variables indicating the year t, ranging from 2002 to 2011; and

and are 37 country-specific dummy variables indicating that a given country is origin (i) or destination (j) in that specific bilateral FDI stock. The high number of observations (13,320) allows for the inclusion of such a high number of dummies.

We tested other variables which proved to be statistically insignificant, namely (i) the two partner countries belonging to the same Free Trade Area; (ii) the two partner countries having had a common colonizer, as retrieved from Mayer and Zignago (2011); (iii) the two partner countries having been a colony in the past, also retrieved from Mayer and Zignago (2011); (iv) , defined as the join market size equalling (; (v) one of the countries being subject to main international sanctions; and (vi) the GVC-position of countries i and j (lagged one year), as defined in section 3.

Finally, refers to the disturbance term for the FDI stock from country j in country i at time (year) t.

If we assume that the disturbances are uncorrelated through time and units and, conditioned on the explanatory variables, identically distributed with a zero mean, this is a pooled regression model which can be consistently and efficiently estimated by Ordinary Least Squares (OLS)[[23]](#footnote-23). It is possible that other factors influencing FDI stocks from country j in country i were not included in the right-hand side of our explanatory equation. A part of these missing or unobserved variables can be assumed to be country-specific and year-specific, expressing the heterogeneity between countries but being constant over time, and expressing the heterogeneity between years but being constant for countries, respectively. Accordingly, the disturbance term in Index 2 above can be written as , with the zero mean, constant variance shocks uncorrelated across time and countries, the being the unknown individual effects to be estimated for each year, and and being the unknown individual effects to be estimated for each country.

The individual effects may be either fixed or random. In the latter case, though the must be uncorrelated with the explanatory variables, the errors in Index 3 above will be correlated within countries. However, even when the random effects model is valid, the fixed effects estimator will still produce consistent estimates of the identifiable parameters[[24]](#footnote-24). In any case, we performed a Haussman test, which indicated that both the fixed and the random effects models can be used. Under the fixed effects assumption, Index 2 above was estimated by OLS with country-specific dummies.

We run several pooled OLS regressions by making use of software Stata SE 13 (64 bits). The descriptive statistics and final results obtained, after cleaning statistically insignificant variables, are presented next in Table 5 below.

[Insert Table 5 here]

The model is statistically significant and it explains around 39% of the variations in the stock of FDI between 2002 and 2011. The global model seems to be robust, as F-statistic is marginally zero. We ran the Likelihood-ratio (LR) test for heteroscedasticity and the Chi2-statistic obtained was statistically marginally zero as well; so we conclude that there are no significant problems of this sort in the model.

Explanatory variables generally behave as expected, according to Table 6 below.

[Insert Table 6 here]

Positive correlations between FDI stock, in one hand, and GDP, GDP per capita and openness, in the other hand, are confirmed. Adjacency and common languages between countries, as well as sharing former colonial ties, are positive determinants of FDI stock as well, as expected, as they work as proxies for proximity and familiarity factors that make foreign investors feel comfortable about investment decisions. Distance works on the opposite direction, as a proxy for remoteness factors that discourage foreign investment.

The five remaining variables deserve particular attention.

First, we found the offshore variable to be positive, but significant just at 90% level, which is consistent with the characteristics of the OECD’s data on FDI stock above referred. One should note in this regard that the OECD’s definition of FDI will probably evolve quickly by differentiating types of FDI[[25]](#footnote-25).

Second, the GVC-participation variables are significantly positive. Previous studies usually assumed openness variables (such as exports, imports or the ratio of the sum of exports and imports to GDP) to be positive. We consider the GVC-participation variable as a proxy for openness but a particular one, openness (country embeddedness) to GVCs.

Third, we found that the year dummies included in the model are statistically insignificant from 2002 to 2007, but they are statistically significant and negative from 2008 to 2011, which appears to be related to the global financial crisis that emerged in 2008.

Fourth, there is only one country dummy variable introduced in the model that is statistically significant: the PRC. The explanation for this result is believed to be related to the effect of both offshoring and round-tripping, as described by Garcia-Herrero et al. (2015). On one hand, offshoring understates the role of the PRC in inward FDI in the economies in the sample, since FDI from the PRC to, let’s say, the US does not take into account the outbound flows channeled from the PRC to intermediate offshoring jurisdictions such as Hong Kong, the Cayman Islands or the British Virgin Islands before heading to the US, taking advantage of their relatively lower taxes and significant expertise and avoiding the PRC’s tight capital controls imposed by a fixed exchange rate system and an independent monetary policy. In fact, Haberly and Wójcik (2014) found that around 30 to 50% of global FDI is intermediated through offshore centres, resulting in a significant distortion of FDI assessments. On the other hand, round-tripping, defined as the “channeling by direct investors of local funds to special purpose vehicles abroad with the intent to subsequently return these funds to the local economy in the form of FDI” according to OECD (2008), in order to benefit from preferential terms for foreign investors, both overstates inward and outward FDI in the PRC. In this regard, Geng (2004) estimated the average weight of round-tripping FDI to be 40.1% of outbound FDI flows from the PRC to Hong Kong between 1998 and 2002. Garcia-Herrero et al. (2015) concluded that the adjustment for these two effects decreased outbound FDI stock of the PRC in 2013 from USD 661 billion to USD 490 billion (minus 25%). This is particularly relevant if we also take into account that outbound FDI stock of PRC increased from USD 17.8 billion in 1995 to USD 1.3 trillion in 2016, representing an increase from 0.4% to 4.9% of the world’s outbound FDI stock, according to UNCTAD (2017).

6. Conclusion

Aiming to contribute to research on the current reality given by GVCs in international trade, we took advantage of the potential of the database recently published by the WIOD to measure the degree of participation of OE countries and sectors by joining GVCs in terms of trade in value-added covering simple and complex GVCs and evaluate the contribution of a country´s degree of GVC embeddedness as an inward FDI driver. To capture country’s GVC-participation we used an index based on Koopman et al. (2011, 2014) that enlarges the scope of domestic value-added traded by including intermediate exports absorbed by a direct importer (in addition to domestic value-added exported and returned home or re-exported to third countries), i.e. simple CGVs.

The second purpose for this research was based on a regression to explain bilateral FDI inward stocks of OE countries with the proposed GVC-participation indicator and we observed that the higher the GVC-participation of those countries, the higher the bilateral FDI inward stocks. The estimation performed shows yet the negative impact of the global financial crisis that started in 2008 and the significant role played by PRC in decisions about FDI of the group of countries analyzed.

Several inherent limitations to this study may be pointed out, namely: (i) the narrow number of countries included in the WIOD, despite representing nearly 82% of the world's GDP in 2011, but leaving off the analysis relevant economies that play a significant role in GVCs (namely in East Asia, such as Malaysia, the Philippines, Thailand, or Viet Nam); (ii) the limitations of multicountry input-output tables arising from their statistic characteristics[[26]](#footnote-26); and (iii) the OECD’s broad definition of FDI. A major strand of research that is still underdeveloped is to use firm-level data to examine GVCs; micro-level measurement in analysis of GVCs would meaningfully enlighten the impacts of GVCs[[27]](#footnote-27).

Finally, our work is a preliminary study on the relation between the degree of participation of countries in GVCs and their FDI inward stocks and many questions remain unanswered. For instance, what are the drivers and determinants of location of cross-border activities via investment in GVCs? Is FDI more volatile with GVCs? How do choices about location vary according to the particular parts of the value chain that TNCs choose to locate outside their home countries? What are the prospects for further evolution of GVCs and their role in global investment? How functions the empirical relation between GVCs and FDI assuming, for its part, FDI as a GVC driver? What policies should policy makers adopt to increase GVC participation and FDI-related? A fruitful avenue for further research is ahead.

REFERENCES

Amador, J. & Cabral, S. (2014). “Global Value Chains: a survey of drivers and measures”. *ECB Working Paper*, nº 1739, European Central Bank, published at *Journal of Economic Surveys*, 2016, volume 30, issue 2, 278-301.

Antràs, O. (2003). “Firms, contracts, and trade structure”. *Quarterly Journal of Economic*s, 118, pp. 1375-1418.

Antràs, P. & Chor, D. (2003). “Organizing the Global Value Chain”. *Econometrica*,81 (6), pp. 2127-203.

Antràs, P. & Helpman, E. (2004). “Global sourcing”. *Journal of Political Economy*, 112, pp. 552-580.

Baldwin, R. (2011). “Trade and industrialization after globalization’s second unbundling: how building and joining a supply chain are different and why it matters”. *National Bureau of Economic Research Working Paper Series* number 17,776. Cambridge, MA. US.

Baldwin, R. & Lopez-Gonzalez, J. (2014). “Supply chain trade: a portrait of global patterns and several testable hypotheses”. *The World Economy*, volume 38, issue 11. November, 2015. pp. 1682-1721.

Baltagi, B. (2013). *Econometric Analysis of Panel Data*. 5th edition. John Wiley Sons.

Chakrabarti, A. (2001). “The determinants of Foreign Direct Investment: sensitivity analyses of cross-country regressions”. *Kyklos*, 54 (1), pp. 89-114.

Crespo, N. & Fontoura, M.P. (2007). Determinant factors of FDI spillovers-what do we really know?. *World Development*, 35(3), pp. 410-25.

Daudin, G., Rifflart, C. & Schweisguth, D. (2009). “Who Produces for Whom in the World Economy?”. *The Canadian Journal of Economics*, 44 (4), November. pp. 1403-1437.

Dunning, J. (1998), “Location and the Multinational Enterprise: a Neglected Factor?”, *Journal of International Business Studies*. 29, 1, first quarter: 45-66.

Escaith, H. & Timmer, M. (2012). *Global Value Chains, trade, jobs and environment: the new WIOD database* [online]. Available in: [www.voxeu.org/article/new-world-input-output-database](http://www.voxeu.org/article/new-world-input-output-database).

Franco, C., Rentocchini, F. & Vittucci Marzetti, G. (2008). “Why Do Firms Invest Abroad? An Analysis of the Motives Underlying Foreign Direct Investments”, (December 15, 2008). Available at SSRN: [https://ssrn.com/abstract=1283573](https://ssrn.com/abstract=1283573" \t "_blank), published at *The IUP Journal of International Business Law*, Vol. 9 (2010), Nos. 1 & 2, pp. 42-65.

Garcia-Herrero, A., Xia, L., & Casanova, C. (2015). “Chinese outbound foreign direct investment: How much goes where after round-tripping and offshoring?”. *BBVA Research Working Paper* n. 15/17. Hong Kong. June.

Geng, X. (2004). “People’s Republic of China’s round-tripping FDI: scale, causes and implications”. *Latin American/Caribbean and Asia/Pacific Economics and Business Association research working paper n. 24*. Hong Kong. Inter-American Development Bank and Asian Development Bank. December.

Grossman, G. Helpman, E. & Szeidi, A. (2005). “Complementarities between outsourcing and foreign sourcing”. *American Economic Review*, 95, Papers and Proceedings, pp. 19-24.

Haberly, D., & Wójcik, D. (2014). “Regional blocks and imperial legacies: mapping the global offshore FDI network”. *Journal of Economic Geography*. Vol. 91 (3).

Head, K. & Mayer, T. (2002). “Illusory Border Effects: Distance Mismeasurement Inflates Estimates of Home Bias in Trade”. *CEPII Working Paper Series*, n. 2002-01. Available in: <http://www.cepii.fr/PDF_PUB/wp/2002/wp2002-01.pdf>, retrieved in 24.08.2015.

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

IMF (2000). “Offshore Financial Centers”. *IMF Background Paper*. Available in: <https://www.imf.org/external/np/mae/oshore/2000/eng/back.htm>, retrieved in 28.12.2015.

Jabri, A., Guesmi, K. & Abid, I. (2013). “Determinants of Foreign Direct Investment in MENA region: Panel Co-Integration Analysis”. *The Journal of Applied Business Research*, n. 29 (4).

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

Lopez Gonzalez, J. (2016). “Using Foreign Factors to Enhance Domestic Export Performance: A Focus on Southeast Asia”. *OECD Trade Policy Papers*, No. 191, OECD Publishing, Paris.

Koopman, R., Powers, W., Wang, Z. & Wei, S.J. (2011). “Give credit to where credit is due: tracing value added in global production chains”. *National Bureau of Economic Research Working Paper Series*. Number 16,426. Cambridge, MA. US. September 2010. Revised December 2011.

Koopman, R., Wang, Z. & Wei, S.J. (2014). “Tracing value-added and double counting in gross exports”. *American Economic Review*, 104 (2), pp. 459-494.

Mayer, T. & Zignago, S. (2011). “Notes on CEPII’s distances measures: the GeoDist Database”. *CEPII Working Paper Series*, n. 2011-25. Available in: <http://www.cepii.fr/CEPII/fr/bdd_modele/presentation.asp?id=6>, retrieved in 24.08.2015.

OECD (2008). *OECD benchmark definition of Foreign Direct Investment – 4th edition*. OECD publications, Organization for Economic Co-operation and Development. Paris.Available in: <http://www.oecd.org/daf/inv/investmentstatisticsandanalysis/40193734.pdf>.

OECD (2015). *FDI Statistics* [database]. Available in: <http://stats.oecd.org/index.aspx>, Path followed: Globalization/FDI statistics according to Benchmark Definition, 4th edition (BMD4)/FDI financial flows/FDI financial flows by partner country BMD4, for years 2002 to 2011, retrieved on 28.12.2015.

OECD, WTO & World Bank (2014). *Global value chains: Challenges, opportunities, and implications for policy* [online]. Report prepared for submission to the G20 Trade Ministers meeting held in Sydney, 19 July. Available in: [www.oecd.org/tad/gvc\_report\_g20\_july\_2014.pdf](http://www.oecd.org/tad/gvc_report_g20_july_2014.pdf).

Sanyal, K. & Jones, R. (1982). “The theory of trade in middle products”. The *American Economic Review*, 72 (1), pp. 16-31.

Timmer, M., Dietzenbacher, E., Los, B., Stehrer, R. & De Vries, G. (2015). “An illustrated user guide to the World Input-Output Database: the case of Global Automotive Production”. *Review of International Economics*, 23, pp. 575-605.

Tomiura, E. (2007). “Foreign outsourcing, exporting, and FDI: A productivity comparison at firm level”. *Journal of International Economics*, 72, pp. 113-127.

UNCTAD (2013). *Global Value Chains and Development: Investment and value added trade in the global economy*. United Nations Conference on Trade and Development. New York and Genève.

UNCTAD (2017). *2017* *Country Fact Sheet for the PRC of the* *World Investment Report*. United Nations Conference on Trade and Development. New York and Genève. Available in: *<http://unctad.org/sections/dite_dir/docs/wir2017/wir17_fs_cn_en.pdf>*.

Wang, Z., Wei, S.J., Yu, X., & Zhu, K. (2017). “Measures of participation in global value chains and global business cycles”. *National Bureau of Economic Research Working Paper Series* number 23,222. Cambridge, MA. US.

Wixted, B., Yamano, N. & Webb, C. (2006). “Input-Output analysis in an increasingly globalized world: applications of OECD harmonized international tables”. *OECD Science Technology and Industry Working Paper Series*, number 7-2006. OECD. Paris.

World Bank (2015). *World Database Indicators Statistics* [database]. Available in: <http://data.worldbank.org/indicator>, retrieved in 15.06.2015.

World Bank (2017). *Global Value Chain Development Report: Measuring and Analysing the Impact of GVCs on Economic Development*, International Bank for Reconstruction and Development.

Xing, Y. & Detert, N. (2010). “How the iPhone widens the United States trade deficit with the People’s Republic of PRC”. *Asian Development Bank Institute Working Paper Series*, 257. Tokyo.

Yeaple, S. (2003). “The complex integration strategies of multinational and cross country dependencies in the structure of foreign direct investment”. *Journal of International Economic*s, 60, pp. 293-314.

Yi, A.K.J. (2017). “Dynamics of trade in value-added in ‘Factory Asia’”. *Journal of Contemporary Asia*, volume 47, issue 5.

Zorome, A. (2007), “Concept of Offshore Financial Centers: In Search of an Operational Definition”. *IMF Working Papers* WO/07/87, Washington DC, April.

Zanfei, A. (2000). “Transnational firms and changing organization of innovative activities”. *Cambridge Journal of Economics*, 5, pp. 515-554.

Tables

Table 1

The GVC-participation and GVC-position measures (2011)

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Country | Gross exports  (USD billion)  (A) | Domestic value added exported (USD billion)  (B) | Foreign value added imported (USD billion)  (C) | GVC-participation  (%)  (B+C)/(A) | GVC-position  (%)  (B-C)/(A) |
| Indonesia | 213.0 | 184.8 | 147.6 | 156.1% | 17.5% |
| Taiwan | 338.2 | 298.2 | 225.2 | 154.8% | 21.6% |
| Finland | 106.8 | 89.8 | 72.6 | 152.1% | 16.1% |
| PRC | 2,008.9 | 1,515.3 | 1,476.6 | 148.9% | 1.9% |
| Brazil | 292.5 | 236.3 | 198.7 | 148.7% | 12.9% |
| Czech Rep. | 162.8 | 128.8 | 112.0 | 147.9% | 10.3% |
| Luxembourg | 96.3 | 76.2 | 63.1 | 144.7% | 13.6% |
| Japan | 930.7 | 743.3 | 596.2 | 143.9% | 15.8% |
| Australia | 324.1 | 289.3 | 173.7 | 142.9% | 35.7% |
| South Korea | 678.0 | 519.5 | 443.1 | 142.0% | 11.3% |
| Mexico | 365.6 | 283.1 | 226.8 | 139.5% | 15.4% |
| Poland | 225.3 | 157.8 | 155.2 | 138.9% | 1.2% |
| USA | 2,127.0 | 1,503.3 | 1,450.6 | 138.9% | 2.5% |
| Italy | 616.9 | 419.6 | 423.4 | 136.7% | -0.6% |
| Hungary | 122.3 | 87.1 | 78.0 | 135.0% | 7.4% |
| Canada | 546.6 | 427.9 | 289.9 | 131.3% | 25.2% |
| Sweden | 261.9 | 201.7 | 142.2 | 131.3% | 22.7% |
| Austria | 229.3 | 171.5 | 128.1 | 130.7% | 18.9% |
| Spain | 431.3 | 266.4 | 282.1 | 127.2% | -3.6% |
| Germany | 1,685.0 | 1,248.6 | 813.0 | 122.4% | 25.9% |
| Belgium | 429.0 | 275.0 | 249.4 | 122.2% | 6.0% |
| UK | 796.5 | 542.6 | 416.9 | 120.5% | 15.8% |
| Ireland | 231.6 | 147.4 | 131.4 | 120.4% | 6.9% |
| Romania | 67.9 | 39.3 | 42.4 | 120.3% | -4.6% |
| Turkey | 183.7 | 105.3 | 113.2 | 118.9% | -4.3% |
| France | 823.2 | 501.5 | 460.1 | 116.8% | 5.0% |
| Denmark | 177.7 | 112.1 | 94.0 | 116.0% | 10.2% |
| Greece | 67.6 | 30.7 | 47.1 | 115.1% | -24.3% |
| India | 446.4 | 209.8 | 269.7 | 107.4% | -13.4% |
| Slovakia | 83.3 | 46.9 | 40.9 | 105.4% | 7.2% |
| Bulgaria | 34.0 | 17.5 | 17.9 | 104.1% | -1.2% |
| Netherlands | 691.7 | 384.1 | 324.6 | 102.5% | 8.6% |
| Russia | 573.4 | 448.2 | 138.4 | 102.3% | 54.0% |
| Portugal | 85.7 | 39.7 | 45.5 | 99.4% | -6.8% |
| Slovenia | 36.1 | 18.5 | 15.6 | 94.5% | 8.0% |
| Latvia | 16.4 | 7.8 | 6.4 | 86.6% | 8.5% |
| Lithuania | 32.6 | 13.9 | 12.8 | 81.9% | 3.4% |
| Estonia | 20.1 | 8.7 | 6.7 | 76.6% | 10.0% |
| Cyprus | 14.5 | 3.1 | 4.9 | 55.2% | -12.4% |
| Malta | 15.3 | 4.1 | 3.7 | 51.0% | 2.6% |

Source: Authors’ estimations based on WIOD, first release. Countries are ordered according to its GVC-participation measure, from highest to lowest. GVC-participation adds DVA exported and FVA imported and normalizes its value by gross exports. GVC-position subtracts FVA imported from DVA exported, normalizing its value also by gross exports.

Table 2

The main GVCs in terms of total in value added

(absolute terms, 2011, USD billion)

|  |  |
| --- | --- |
|  | **Total trade in value-added** |
| Coke, refined petroleum and nuclear fuel | 1,846.4 |
| Electrical and optical equipment | 2,561.0 |
| Water transport | 310.7 |
| Chemicals and chemical products | 1,866.4 |
| Basic metals and fabricated metal | 2,412.4 |
| Transport equipment | 1,695.9 |
| Air transport | 229.4 |
| Manufacturing, nec; Recycling | 345.5 |
| Rubber and plastics | 576.4 |
| Mining and quarrying | 1,963.1 |
| Machinery, nec | 1,026.7 |
| Pulp, paper, printing and publishing | 481.4 |
| Wood and products of wood and cork | 168.3 |
| Textiles and textile products | 419.7 |
| Other non-metallic mineral | 289.1 |
| Other supporting and auxiliary transport activities; travel agencies | 261.6 |
| Leather and footwear | 60.6 |
| Inland transport | 529.8 |
| Electricity, gas and water supply | 514.1 |
| Renting of machine and equipment and other business activities | 1,245.8 |
| Food, beverages and tobacco | 736.5 |
| Wholesale trade and commission trade, except of motor vehicles | 789.4 |
| Agriculture, hunting, forestry and fishing | 585.4 |
| Financial intermediation | 717.4 |
| Post and telecommunications | 248.3 |
| Sale, maintenance and repair of motor vehicles, retail sale of fuel | 110.2 |
| Construction | 877.8 |
| Other community, social and personal services | 302.2 |
| Hotels and restaurants | 230.4 |
| Health and social work | 298.0 |
| Public administrations and defense; compulsory social security | 391.0 |
| Retail trade, except of motor vehicles, repair of household goods | 229.9 |
| Education | 101.0 |
| Real estate activities | 169.4 |
| Private households with employed persons | 0.6 |

Source: Authors' estimations based on WIOD, first release. Nec stands for not elsewhere classified. Due to rounding, numbers presented may not add up precisely to the totals provided.

Table 3

GVC of electrical and optical equipment (2011, USD billion) per country

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Country** | **Value-added exported to foreign agents** (A) | **Value-added imported from foreign agents**  (B) | **Country’s total trade in value-added** (C=A+B) | **Share of country’s total trade in value-added in world’s total trade in value added (%)** |
| PRC | 279.5 | 359.2 | 638.8 | 24.9 |
| RoW | 242.5 | 175.3 | 417.8 | 16.3 |
| Germany | 72.6 | 121.1 | 193.7 | 7.6 |
| US | 53.0 | 134.1 | 187.1 | 7.3 |
| Taiwan | 60.7 | 121.9 | 182.6 | 7.1 |
| South Korea | 58.1 | 117.1 | 175.3 | 6.8 |
| Japan | 34.0 | 111.7 | 145.7 | 5.7 |
| Mexico | 47.9 | 37.2 | 85.0 | 3.3 |
| France | 24.9 | 43.0 | 67.9 | 2.7 |
| Italy | 17.1 | 26.6 | 43.7 | 1.7 |
| Czech Rep. | 24.3 | 19.0 | 43.3 | 1.7 |
| (…) | | | | |
| **Total** | 1,088.6 | 1,472.4 | 2,561.0 | 100 |

Source: Authors' estimations based on WIOD, first release. Total values exclude the RoW. Due to rounding, numbers presented may not add up precisely to the totals provided.

Table 4

Main bilateral flows of international trade of inputs within the GVC of electrical and optical equipment (2011, USD billion)

|  |  |  |  |
| --- | --- | --- | --- |
| **Pair of countries (A-B)** | **Value-added exported to foreign agents (from A to B)** | **Value-added imported from foreign agents (from B to A)** | **Total trade in value-added** |
| PRC-RoW | 81.3 | 85.2 | 166.5 |
| RoW-PRC | 53.6 | 89.7 | 143.3 |
| PRC-Taiwan | 62.5 | 69.8 | 132.3 |
| PRC-South Korea | 39.4 | 54.0 | 93.4 |
| US-PRC | 17.0 | 72.7 | 89.7 |
| PRC-Japan | 33.4 | 47.1 | 80.5 |
| RoW-US | 36.6 | 41.9 | 78.5 |
| RoW-Germany | 24.4 | 30.5 | 54.9 |
| PRC-US | 24.2 | 24.5 | 48.6 |
| RoW-Japan | 22.3 | 23.4 | 45.6 |
| South Korea-PRC | 19.1 | 22.1 | 41.3 |
| RoW-South Korea | 16.9 | 22.3 | 39.2 |
| Mexico-PRC | 15.4 | 22.4 | 37.8 |
| RoW-Taiwan | 15.0 | 15.6 | 30.6 |
| Taiwan-RoW | 16.0 | 13.5 | 29.5 |
| PRC-Germany | 7.5 | 17.5 | 25.0 |

Source: Authors' estimations based on WIOD, first release. Total values exclude the RoW. Due to rounding, numbers presented may not add up precisely to the totals provided.

Table 5

Results of a pooled regression model to estimate the determinants of bilateral FDI inward stocks with the country’s GVC-participation index in the period 2002-2011

**-** Descriptive statistics **-**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Variable | Obs | Mean | Std. Dev. | Min | Max |
| FDI/GDPi | 13320 | 0.0281195 | 0.2052440 | 0.00001 | 5.2465738 |
| GDPpci | 27874.25 | 19398.5 | 486.6405 | 113731.7 |
| GDPpcj | 30054.50 | 19005.25 | 486.6405 | 113731.7 |
| GDPi | 1.43e+12 | 2.54e+12 | 4.30e+09 | 1.62e+13 |
| GDPj | 1.36e+12 | 2.63e+12 | 4.30e+09 | 1.62e+13 |
| OPENNESSi | 85.584745 | 53.254789 | 21 | 348 |
| OPENNESSj | 86.565847 | 52.963521 | 21 | 348 |
| DIST | 4672.58 | 4229.13 | 160.9283 | 17981.98 |
| CONTIG | .0755675 | .2598547 | 0 | 1 |
| COMLANG\_OFF | .0635148 | .2326548 | 0 | 1 |
| COLONY | .0512598 | .221254 | 0 | 1 |
| OFFSHORE | .1647465 | .3715846 | 0 | 1 |
| GVCPart(-1)i | 1.1277502 | 0.2380009 | 0.3392831 | 1.556305 |
| GVCPart(-1)j | 1.1277502 | 0.2380009 | 0.3392831 | 1.556305 |
| Y2008 | .1 | 0.300011 | 0 | 1 |
| Y2009 | .1 | 0.300011 | 0 | 1 |
| Y2010 | .1 | 0.300011 | 0 | 1 |
| Y2011 | .1 | 0.300011 | 0 | 1 |
| PRC | .05405405 | .22613282 | 0 | 1 |

- Econometric results-

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Source | SS | df | MS |  | Number of obs = | 13320 |
| Model | 5.0128e+12 | 61 | 3.3765e+09 |  | F(61, 13258) = | 333.89 |
| Residual | 9.4271+12 | 13258 | 8.2186+08 |  | Prob > F = | 0.0000 |
| Total | 1.4439e+13 | 13319 | 1.15951e+09 |  | R-squared = | 0.3625 |
|  |  |  |  |  | Adj R-squared = | 0.3419 |
|  |  |  |  |  | Root MSE = | 21806 |
|  |  |  |  |  | LR Chi2 = | 24989.52 |
|  |  |  |  |  | Prob Chi2 > X = | 0.0000 |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| FDI | Coef. | Std. Err. | T | P>│t│ | [95% Conf. Interval] | |
| CONST | -0.007122 | 0.000576 | -11.11 | 0.000 | -0.0008121 | -0.0006089 |
| GDPpci | 1.44e-07 | 1.08e-08 | 13.87 | 0.000 | 1.22e-07 | 1.66e-07 |
| GDPpcj | 2.02e-07 | 1.09e-08 | 19.13 | 0.000 | 1.79e-07 | 2.25e-07 |
| GDPi | 1.01e-15 | 8.61e-17 | 12.52 | 0.000 | 0.99e-15 | 1.03e-15 |
| GDPj | 2.10e-15 | 8.36e-17 | 29.61 | 0.000 | 2.09e-15 | 2.12e-15 |
| OPENNESSi | 0.000516 | 0.000027 | 27.42 | 0.000 | 0.000467 | 0.000572 |
| OPENNESSj | 0.000554 | 0.000033 | 26.04 | 0.000 | 0.000488 | 0.000620 |
| DIST | -4.47e-07 | 4.68e-08 | -14.78 | 0.000 | -5.37e-07 | -3.41e-07 |
| CONTIG | 0.007673 | 0.000910 | 11.59 | 0.000 | 0.005905 | 0.009489 |
| COMLANG\_OFF | 0.010692 | 0.001424 | 15.01 | 0.000 | 0.009001 | 0.013569 |
| COLONY | 0.008979 | 0.000901 | 12.92 | 0.000 | 0.007093 | 0.010284 |
| OFFSHORE | 0.001103 | 0.000432 | 1.86 | 0.054 | -0.000092 | 0.001989 |
| GVCPart(-1)i | 0.000312 | 0.000075 | 4.09 | 0.000 | 0.000153 | 0.000464 |
| GVCPart(-1)j | 0.000378 | 0.000086 | 4.62 | 0.000 | 0.000281 | 0.000542 |
| Y2008 | -0.001405 | 0.000263 | -5.01 | 0.000 | -0.001987 | -0.000881 |
| Y2009 | -0.001705 | 0.000299 | -5.19 | 0.000 | -0.002341 | -0.001102 |
| Y2010 | -0.000654 | 0.000332 | -2.53 | 0.025 | -0.001205 | -0.000042 |
| Y2011 | -0.000757 | 0.000203 | -3.37 | 0.000 | -0.001026 | -0.000476 |
| PRC | 0.004243 | 0.001562 | 4.21 | 0.000 | 0.001153 | 0.007901 |
|  |  |  |  |  |  |  |

Source: Authors’ estimations by making use of a pooled OLS regression, as explained above.

Table 6

Expected and observed signs for selected variables in the pooled regression model used to estimate the determinants of FDI inward stock\*

|  |  |  |
| --- | --- | --- |
| **Variable** | **Expected sign** | **Observed sign** |
| **GDPpci** | **+** | **+** |
| **GDPpcj** | **+** | **+** |
| **GDPi** | **+** | **+** |
| **GDPj** | **+** | **+** |
| **OPENNESSi** | **+** | **+** |
| **OPENNESSj** | **+** | **+** |
| **DIST** | **-** | **-** |
| **CONTIG** | **+** | **+** |
| **COMLANG\_OFF** | **+** | **+** |
| **COLONY** | **+** | **+** |
| **OFFSHORE** | **+** | **+** |
| **GVCPart(-1)i** | **+** | **+** |
| **GVCPart(-1)j** | **+** | **+** |

\*+ stands for significantly positive; - stands for significantly negative.

Index 1

The GVC-participation index

Source: Authors. i represents country i. j represents country i’s trade partners, ranging from 1 to n. k represents sectors of international trade in intermediates, ranging from 1 to m.

Index 2

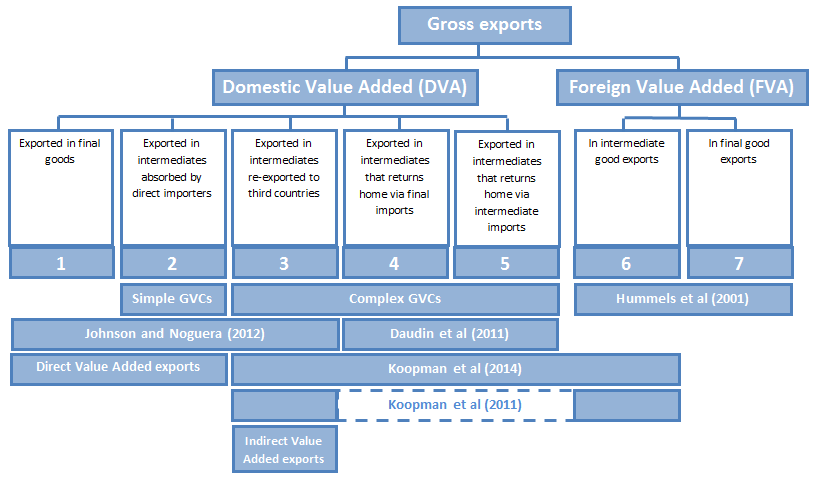
Pooled-Regression Model for bilateral FDI inward stocks

*= α*+β1.+β2.+β3.+β4.+β5.+β6.+  
+β7.+β8.+β9.+β10.+  
+β11.+β12.+β13.+  
+β14-23.*YEAR\_DUMMIES\_2002to2011+*β25-60. *COUNTRY\_DUMMIES+*

Source: Authors.

Figure 1

Decomposition of gross exports



Source: Authors, based on Koopman et al. (2011, 2014) and Wang et al. (2017).

1. In what concerns the geography of production, it is now different, with a clear focus on East Asia and a decrease of the relative weight of the most developed economies. According to Baldwin and Lopez-Gonzalez (2014), from 1990 to 2010, the relative weight of the G7 economies had dropped from 65% to 46% of global manufacturing share, while the weight of the People’s Republic of China (PRC) increased in the same period by 16 percentage points. [↑](#footnote-ref-1)
2. A well-discussed implication of using current trade statistics instead of trade in value added is the study by Xing and Detert (2010) for Apple’s iPhone. The authors concluded that, in 2009, based on the value added approach, the iPhone-related trade deficit of the United States of America (USA) with the PRC remarkably decreases from USD 1.9 billion to merely USD 73 million. [↑](#footnote-ref-2)
3. See UNCTAD (2013, box IV.1, p. 124) for international efforts to map GVCs. [↑](#footnote-ref-3)
4. For a comprehensive explanation of the basic structure of an IO table, also known as supply and use table, see Wixted et al (2006). [↑](#footnote-ref-4)
5. The following OECD members were not included in the first WIOD’s release: Chile, Iceland, Israel, New Zealand, Norway and Switzerland. On the other hand, several non-OECD countries were included in this database, namely the following: Brazil, Bulgaria, Cyprus, India, Indonesia, Lithuania, Malta, the PRC, Romania, Russia, and Taiwan. [↑](#footnote-ref-5)
6. For a typology of GVCs according to typology and modes of organizing value chains, see World Bank (2017, chapter 1). [↑](#footnote-ref-6)
7. With regard to indirect effects, see, for instance, Crespo and Fontoura (2007). [↑](#footnote-ref-7)
8. Analysis initially introduced by Sanyal & Jones (1982). [↑](#footnote-ref-8)
9. Koopman et al. (2011, 2014)’s and Wang et al. (2017)’s results are not broadly comparable to those in our indicator, as they presented results for different years, sectors, and countries. For instance, Koopman et al. (2011, 2014) followed Australia, Brazil, Canada, China, Eastern EU-countries, European Free Trade Association-countries, Hong Kong, India, Indonesia, Japan, Mexico, Malaysia, the Philippines, Russia, Singapore, South Africa, South Korea, Taiwan, Thailand, the US, Viet Nam, and Western EU-countries. [↑](#footnote-ref-9)
10. See Koopman et al. (2011) for a GVC-position index. [↑](#footnote-ref-10)
11. See the examples of Lithuania, Bulgaria, Finland, Italy and Greece, where Russian petroleum and gas were their main foreign input, accounting for 7%, 3%, 2%, 1% and 1% of those countries’ total output, respectively. [↑](#footnote-ref-11)
12. Using gross exports as the denominator, the shares obtained might be very high for sectors with very little direct exports, thus overestimating GVC-participation. For a solution whenever it is necessary to normalize the indicators, see Wang et al. (2017). [↑](#footnote-ref-12)
13. Similar analysis for the remaining sectors is available upon request. [↑](#footnote-ref-13)
14. Baldwin (2011) and OECD et al.(2014) concluded that GVCs are in general not a global phenomenon but located in one of three regions: (Central) Europe, (North) America and, mainly, (East and Southeast) Asia, with no substantial connections between them. [↑](#footnote-ref-14)
15. Other regional value chains were observed in Europe and in North American in other sectors, such as “Transport equipment”. [↑](#footnote-ref-15)
16. See Yi (2017). [↑](#footnote-ref-16)
17. Antràs (2003) was one of the earliest efforts in this direction, aiming to synthesise firm theory under incomplete contracts and international trade theory under imperfect competition. [↑](#footnote-ref-17)
18. See World Bank (2017) for a survey on firm’s choice of an organizational form of GVCs. [↑](#footnote-ref-18)
19. This means that Latvia, Lithuania, and Taiwan, included in the previous section, are excluded in this one. [↑](#footnote-ref-19)
20. «The basic idea, inspired by Head and Mayer (2002), is to calculate distance between two countries based on bilateral distances between the biggest cities of those two countries, those inter-city distances being weighted by the share of the city in the overall country’s population» (Mayer and Zignago, 2011, p. 11). [↑](#footnote-ref-20)
21. The GeoDist Database presents the caveat that Belgium and Luxembourg are considered as one country, so we modified the database to include the geodesic distance between Brussels and Luxembourg. [↑](#footnote-ref-21)
22. The IMF defines offshore centres as “a country or jurisdiction that provides financial services to nonresidents on a scale that is incommensurate with the size of the financing of its domestic economy” (see Zorome, 2007). It is the case of Cyprus, Ireland, Luxembourg and Malta. The IMF’s only official list of “Offshore Financial Centres” dates back to 2000 (IMF, 2000). Since then, the term has had ramifications to more specific concepts, with no consensual list, from tax havens (related to countries with competitive tax regimes), to non-compliant jurisdictions, and to high-risk and non-cooperative jurisdictions (so-called blacklisted jurisdictions). For the purpose of this paper, we consider the above mentioned group of countries (Cyprus, Ireland, Luxembourg and Malta) as tax havens, due to particularly low tax regimes. [↑](#footnote-ref-22)
23. Even if disturbances are uncorrelated through time or units, one could overcome this difficulty by estimating a cluster-robust White’s variance/covariance matrix, as this would correct both for autocorrelation and heteroscedasticity. In such a case, the estimator would not be efficient, but it would be robust. [↑](#footnote-ref-23)
24. See Baltagi (2013). [↑](#footnote-ref-24)
25. See, for instance, the recent first “OECD technical workshop on FDI and GVC” aiming at integrating FDI statistics into the analysis of GVC, held in Paris on October, 19 2015 (<http://www.oecd.org/investment/oecd-technical-worshop-on-foreign-direct-investment-and-global-value-chains-19-october-2015-paris.htm>). [↑](#footnote-ref-25)
26. On the topic, see, for instance, Escaith and Timmer (2012) and World Bank (2017, chapter 1, pp. 23-24). [↑](#footnote-ref-26)
27. For initiatives in this direction being taken in the international statistical community see, for instance, World Bank (2017, p. 28). [↑](#footnote-ref-27)