LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

Department of Economics

*Enrique Martínez-Galán & Maria Paula Fontoura*

# Foreign Direct Investment determinants revisited in the context of Global Value Chains

WP15/2016/DE/UECE

WORKING PAPERS

ISSN 2183-1815

U LISBOA
UNIVERSIDADE DE LISBOA

**Foreign Direct Investment determinants revisited in the context of Global Value Chains**

*Enrique Martínez-Galán* *

* ISEG (Lisbon School of Economics and Management), Universidade de Lisboa, CESA (Centre for African, Asian and Latin American Studies), UECE (Research Unit on Complexity and Economics) and GPEARI - Office for Economic Policy and International Affairs at the Portuguese Finance Ministry

*Maria Paula Fontoura* **

** ISEG (Lisbon School of Economics and Management), Universidade de Lisboa, and UECE (Research Unit on Complexity and Economics)

**Corresponding Author**:
*Enrique Martínez-Galán**
e.galan@gpeari.min-financas.pt
+351963945904

The authors acknowledge the financial support from national funds by FCT (Fundação para a Ciência e a Tecnologia) under grant SFRH/BD/71528/2010 and the strategic project UID/ECO/00436/2013**.**

**Abstract**

In this paper, we aim at contributing to the new field of research that intends to bring up-to-date the tools and statistics currently used to look to the current reality given by Global Value Chains (GVC) in international trade and Foreign Direct Investment (FDI). Namely, we make use of the most recent data published by the World Input-Output Database to suggest indicators to measure the participation and net gains of countries by being a part of GVC; and use those indicators in a pooled-regression model to estimate determinants of FDI stocks in Organization for Economic Co-operation and Development (OECD)-member countries. We conclude that one of the measures proposed proves to be statistically significant in explaining the bilateral stock of FDI in OECD countries, meaning that the higher the transnational income generated between two given countries by GVC, taken as a proxy to the participation of those countries in GVC, the higher one could expect the FDI entering those countries to be. The regression also shows the negative impact of the global financial crisis that started in 2009 in the world's bilateral FDI stocks and, additionally, the particular and significant role played by the People's Republic of China in determining these stocks.

*Keywords*: International fragmentation of production, Globalization, Global Value Chains, Foreign Direct Investment, Pooled-regression model

*Journal of Economic Literature* (JEL) *Classification System*: C33, C67, F14, F21, and F60.

**Introduction**

This paper globally aims at adding empirical contributes on one of the meaningful changes that had emerged in recent times due to the globalization, namely the so-called Global Value Chains (GVC), defined as worldwide production processes where fragmented production blocks are connected by service links.

This globalization posed a new reality and new challenges that needs to be addressed by policy makers and researchers. Before 1985, successful industrialization meant building a domestic supply chain. Today, in the face of the regional dispersion of productions stages, industrialisers join supply chains and grow rapidly because off shored production brings elements that normally take decades to develop domestically. As main consequences, trade in intermediate goods has come to dominate world merchandise trade, trade politics changed, geography of manufacturing is now different, and it becomes clear that traditional trade statistics and measure fail to properly reflect the current complexity of international trade.

First, international fragmentation of production has become increasingly prominent since the 1990s and the associated cross-border trade in intermediate goods has come to dominate world merchandise trade (see Arndt and Kierzkowski 2001; Cheng and Kierzkowski 2001). Empirical data show that, already in 2005, trade in intermediates accounted for about 60% of the USD 20 trillion annual global trade (56% in the case of goods and 73% in the case of services) (Mirodout et al. 2009)[1].

Second, trade politics changed, as pointed out by Lamy (2010). Developing countries, which had resisted to trade and investment liberalization until the end of the 1980s, started to open, mostly to facilitate international production sharing. Baldwin and Lopez-Gonzalez (2013) show that tariffs were slashed unilaterally in all regions, particularly on intermediates; that pro-supply chain agreements blossomed, such as Bilateral Investment Treaties (BIT) (mostly about unilateral concessions to attract investment from developed nations); and that the number of deep provisions in new Regional Trade Agreements (RTA) (referring to provisions that are pro-supply-chain, such as competition policy, capital movements, and assurances for intellectual property) increased significantly in the first decade of the 21st century. As a consequence, annual FDI flows increased from around USD 200 billion in 1988 to USD 2 trillion in 2007.

Third, geography of manufacturing is now different, as showed by Baldwin and Lopez-Gonzalez (2013). A major revolution was observed in the relative weigh of the largest manufacturers. In 1970, US, Germany and Japan alone accounted for 52% of global manufacturing share. From 1990 to 2010, the relative weigh of the G7 economies had dropped from 65% to 46% of global manufacturing share (18 percentage points). People's Republic of China (PRC)'s weigh increased in the same period by 16 percentage points. Only six other nations saw their world shares rise by more than half percentage point between 1970 and 2010: India, Indonesia, South Korea, Thailand, Turkey and Poland. Additionally, the shift in manufacturing followed a strong geographical dimension, with a clear focus on East Asia. In fact, in PRC and South Korea, the world's largest exporters of electronic goods in 2009, the foreign content of exports of these products was about 40%, according to Organisation for Economic Co-operation and Development (OECD) and World Trade Organisation (WTO) (2013). Finally, a revolutionary aspect is that this supply chain trade happens between high-tech and low-wage nations, meaning North-South production sharing[2].

Fourth, traditional trade statistics and measure fail to properly reflect the current complexity of international trade. With the globalization of production, awareness grew that conventional trade statistics may give a misleading perspective of the importance of trade and that «what you see is not what you get» (Maurer and Degain, 2010). Traditional measures of trade flows exaggerate the volume of total exports and imports because they involve double counting. UNCTAD (2013) concludes in this regard that 28% of the value of world cross-border trade in goods and services in 2010 (or about USD 5 trillion) was overstated as a result of double and triple counting. Many goods require the use of other imported goods and materials to make them, but those inputs are not discounted when export volumes are calculated. Following OECD and WTO (2013), let's suppose a world with three countries: A, B and C. Country A exports USD 100 of goods produced entirely within A to country B, which further processes them before exporting them to country C where they are consumed. B adds value of USD 10 to the goods and so exports USD 110 to C. Conventional measures of trade show total global exports and imports of USD 210, but only USD 110 of

[1] Other empirical studies also produced similar results. Feenstra (1998) robustly concluded for several indicators that OECD countries generally observed between the 1970s and the 1990s an increase in the utilization of imported inputs and a reduction in domestic inputs. Yi (2003) concluded that at least half of the increase in international trade observed since the 60s can be explained by vertical specialization. Yeats (2001) and Hummels et al. (2001) concluded that vertical specialization was responsible for nearly 30% of global trade in manufactures in 1995. Jones et al. (2005) and Athukorala and Yamashita (2006) showed that de dynamism and growth rates observed in parts and components has persistently out passed the one observed in final goods for the last decades.

[2] Meng et al, (2010) show for OECD and emerging economies, from 1995 and 2005, a positive correlation between the exporting orientation of a giving country and its dependence on imported intermediate goods.

value-added has been generated in their production. Conventional measures also show that C has a trade deficit of USD 110 with B, and no trade at all with A, despite the fact that A is the major beneficiary of C's consumption. If we would track trade flows in value-added instead, C's deficit with B reduces to USD 10 and it now runs a deficit of USD 100 with A. A well-discussed empirical study of what we mean is the study by Xing and Detert (2010) on the trade in value added of Apple's iPhone.

And fifth, the link between investment and trade becomes stronger. UNCTAD (2013) estimates that value chains administered by multinational enterprises account for 80% of global trade, showing that global investment and trade are thoroughly entwined through international production networks.

To overcome that fact that old statistics of international trade fail to fully reflect that new reality that globalization created - from "made in one country" to "made in the world"; from "trade in goods" to "trade in tasks"; and from "value of trade" to "trade in value added"- , recently several organizations published important new databases on value-added statistics for international trade, based on international input-output (IO) tables with bilateral trade links[3]. The revolutionary character of these new databases comes from the fact that 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 standard classification of each product (regardless of the way the product was actually used). This difference is crucial, since most kinds of products and services are usually used for both purposes, i.e. as intermediates and as a final consumption.

We point out the World Input-Output Database (WIOD), coordinated by the University of Groningen, launched on April 16, 2012 (see Timmer et al. 2015), covering 40 countries[4] and 35 sectors. This new public data source offers unique opportunities to study the effects of fragmentation on a range of socioeconomic and environmental issues. The core of the database is a set of harmonized supply and use tables, alongside with data on international trade in goods and services. These two sets of data have been integrated into sets of intercountry (world) IO tables, which are complemented by extensive satellite accounts with environmental and socio-economic indicators, such as industry-level data of capital stock, investment, wages and employment by skill type. Other IO databases have been published following WIOD. A comparative listing of those databases is presented in Table 1 below. We make use of WIOD in our study as it has been the database most widely used by researchers so far.

TABLE 1

COMPARATIVE LISTING OF SCOPE AND REACH OF THE INTERNATIONALLY-LINKED IO DATABASES PUBLISHED AS PER 30 JUNE 2016

| Project | Institution | Data sources | Countries | Sectors | Years | Comments |
|---|---|---|---|---|---|---|
| World Input-Output Database (WIOD) | Consortium of 11 institutions led by Groningen University, EU funded | National Supply-Use tables | 40 | 35 | 1995 to 2011 | Based on official National Accounts statistics; uses end-use classification to allocate flows across partner countries; includes data on socioeconomic and environmental issues |
| Inter-Country-IO model | OECD-WTO, under the Made in the World Initiative (MIWI) | National IO tables | 56 | 18 | 1995, 2000, 2005, 2008, and 2009 | Based on national I-O tables harmonized by the OECD |
| Asian International IO tables | IDE-JETRO | National accounts and firm surveys | 10 | 76 | 1975, 1980, 1985, 1990, 1995, 2000, 2005 | US-Asia tables also bilateral tables, including PRC-Japan |
| Global Trade Analysis Project | Purdue University | Contributions from individual researchers and organizations | 129 | 57 | 2004, 2007 | Unofficial dataset; includes data on areas such as energy volumes, land use, carbon dioxide |

[3] For a comprehensive explanation of the basic structure of an IO table, also known as supply and use table, see Wixted et al. (2006).

[4] Namely Austria, Australia, Belgium, Bulgaria, Brazil, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Latvia, Lithuania, Luxembourg, Mexico, Malta, the Netherlands, Poland, Portugal, PRC, Romania, Russia, Slovakia, Slovenia, South Korea, Spain, Sweden, Taiwan, Turkey, United Kingdom, and United States.

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | | | | emissions and international migration |
| Eora multi-region IO Database | Several Australian researchers, under funding by the Australian Research Council | National supply-use and IO data; plus data from Eurostat and United Nations | 187 | 25-500, depending on the country | 1990 to 2012 | Still under improvement. |

Source: Authors.

Contributing to this new field of research, we will make use of the most recent data published by the WIOD to suggest two indicators of measuring the participation and the net gains of countries joining GVC in terms of income (section 2). Second, we will build in section 3 a pooled-regression model explaining bilateral FDI stock between countries. In this model, we will make use of explanatory variables usually found in the literature to empirically explain FDI flows and also the two income-related indexes proposed in section 2, which introduce the GCV-related character of the model. Lastly, section 4 concludes.

## 2. Measuring the impact of Global Value Chains for countries

In this section, we will use the WIOD database coordinated by the University of Groningen to build two indicators that help measuring the impact of GVC for the 40 countries considered in this database, both of them related to income appropriation. Namely, we propose an "Income measure of country embeddedness in GVC (GVC income country embeddedness, in short) and an "Income measure of net country gains from participating in GVC" (GVC income country net gains, in short) and apply them to the 40 selected economies. Then, we compare these new proposed measures to those previously suggested in the literature.

### 2.1. The GVC income country embeddedness measure

The first measure proposed adds the appropriation of a given economy's income by foreign agents and that given economy's appropriation of income due to demand by foreign agents.

EMBINCO (see Index 1 below) is the income measure of country embeddedness of participating in GVC, where i refers to a given country i, GAININCO refers to the sum of the income of other countries appropriated by country i due to the demand for country i's products and services used as inputs in the production processes of foreign agents (in USD), LOSTINCO refers to the sum of the country i's income appropriated by all n foreign agents due to the use by country i of foreign inputs in its production processes (in USD) and OUTPUT refers to the total value of the domestic production of country i at basic prices.

INDEX 1

THE INCOME MEASURE OF COUNTRY EMBEDDEDNESS

$$EMBINCO_i = \frac{\sum_{j=1}^{n} GAININCO_{i,j} + \sum_{j=1}^{n} LOSTINCO_{i,j}}{OUTPUT_i}$$

The results are as it follows (see Table 2 below). Luxembourg is the economy (within the set of 40 countries assessed here) more relatively embedded in GVC. The income transferred to and from Luxembourg due to its participation in GVCs equals almost 87% of the total output of the economy (at prices[5]). Other countries where that transfer represents at least half of their domestic output are Ireland (58%) and Hungary (53%).

TABLE 2

THE INCOME MEASURE OF COUNTRY EMBEDDEDNESS OF PARTICIPATING IN GLOBAL VALUE CHAINS (2011)

| Country | OUTPUT (USD billion) | GAININCO (A) (USD billion) | LOSTINCO (B) (USD billion) | (A+B) (USD billion) | EMBINCO (%) |
|---|---|---|---|---|---|
| **Luxembourg** | 160.6 | 76.2 | 63.1 | 139.3 | **86.7%** |

[5] The basic price is the amount receivable by the producer exclusive of taxes payable on products and inclusive of subsidies receivable on products (the equivalent for imported products is the c.i.f. - cost, insurance and freight - value, that is, the value at the border of the importing country) - definition by the Data Helpdesk of the World Bank, in https://datahelpdesk.worldbank.org/knowledgebase/articles/114947-what-is-the-difference-between-purchaser-prices-p).

| | | | | | |
|---|---|---|---|---|---|
| **Ireland** | 477.1 | 147.4 | 131.4 | 278.8 | **58.4%** |
| **Hungary** | 309.4 | 87.1 | 78.0 | 165.1 | **53.4%** |
| **Taiwan** | 1,052.8 | 298.2 | 225.2 | 523.4 | **49.7%** |
| **Belgium** | 1,113.9 | 275.0 | 249.4 | 524.4 | **47.1%** |
| **Czech Rep.** | 532.2 | 128.8 | 112.0 | 240.8 | **45.2%** |
| **Malta** | 17.7 | 4.1 | 3.7 | 7.8 | **44.1%** |
| **Netherlands** | 1,659.0 | 384.1 | 324.6 | 708.7 | **42.7%** |
| **Slovakia** | 214.4 | 46.9 | 40.9 | 87.7 | **41.0%** |
| **Austria** | 811.2 | 171.5 | 128.1 | 299.6 | **36.9%** |
| **Lithuania** | 73.5 | 13.9 | 12.8 | 26.7 | **36.3%** |
| **Estonia** | 43.2 | 8.7 | 6.7 | 15.4 | **35.6%** |
| **Slovenia** | 97.4 | 18.5 | 15.6 | 34.1 | **35.0%** |
| **Denmark** | 600.4 | 112.1 | 94.0 | 206.1 | **34.3%** |
| **South Korea** | 2,877.4 | 519.5 | 443.1 | 962.6 | **33.5%** |
| **Sweden** | 1,036.3 | 201.7 | 142.2 | 343.9 | **33.2%** |
| **Finland** | 530.1 | 89.8 | 72.6 | 162.4 | **30.6%** |
| **Germany** | 6,773.1 | 1,248.6 | 813.0 | 2,061.6 | **30.4%** |
| **Bulgaria** | 116.9 | 17.5 | 17.9 | 35.4 | **30.3%** |
| **Poland** | 1,049.9 | 157.8 | 155.2 | 313.0 | **29.8%** |
| **Mexico** | 1,954.5 | 283.1 | 226.8 | 509.9 | **26.1%** |
| **Latvia** | 55.4 | 7.8 | 6.4 | 14.2 | **25.6%** |
| **Romania** | 361.1 | 39.3 | 42.4 | 81.7 | **22.6%** |
| **Canada** | 3,184.5 | 427.9 | 289.9 | 717.8 | **22.5%** |
| **UK** | 4,419.1 | 542.6 | 416.9 | 959.5 | **21.7%** |
| **Cyprus** | 39.4 | 3.1 | 4.9 | 8.0 | **20.3%** |
| **Indonesia** | 1,658.8 | 184.8 | 147.6 | 332.4 | **20.0%** |
| **Italy** | 4,278.9 | 419.6 | 423.4 | 843.0 | **19.7%** |
| **Portugal** | 439.5 | 39.7 | 45.5 | 85.2 | **19.4%** |
| **France** | 5,070.1 | 501.5 | 460.1 | 961.6 | **19.0%** |
| **Spain** | 2,905.0 | 266.4 | 282.1 | 548.5 | **18.9%** |
| **Russia** | 3,262.7 | 448.2 | 138.4 | 586.6 | **18.0%** |
| **Greece** | 453.2 | 30.7 | 47.1 | 77.8 | **17.2%** |
| **Australia** | 2,844.6 | 289.3 | 173.7 | 463.0 | **16.3%** |
| **Turkey** | 1,418.5 | 105.3 | 113.2 | 218.5 | **15.4%** |
| **PRC** | 22,271.0 | 1,515.3 | 1,476.6 | 2,991.9 | **13.4%** |
| **India** | 3,609.8 | 209.8 | 269.7 | 479.5 | **13.3%** |
| **Japan** | 11,333.4 | 743.3 | 596.2 | 1,339.5 | **11.8%** |
| **US** | 26,918.1 | 1,503.3 | 1,450.6 | 2,953.9 | **11.0%** |
| **Brazil** | 4,001.1 | 236.3 | 198.7 | 435.0 | **10.9%** |

Source: Authors estimations based on WIOD, retrieved in January 2014.

On the opposite side of the spectrum, Brazil and USA emerge as the least relatively embedded economies in GVCs, as the transfers of income in which they are involved due to their participation in these chains merely represent 11% of their domestic output.

### 2.2. The GVC income country net gains measure

The second measure proposed just subtracts the appropriation of a given economy's income by foreign agents to that given economy's appropriation of income due to demand by foreign agents.

GOODINCO(see Index 2 below) is the income measure of country net gains from participating in GVC, where i refers to a given country i, GAININCO refers to the sum of the income of other countries appropriated by country i due to the demand for country i's products and services to be used as inputs in the production processes of foreign agents (in US dollars), LOSTINCO refers to the sum of the country i's income appropriated by all n foreign agents due to the use by country i of foreign inputs in its production processes (in US dollars), and OUTPUT refers to the total value of the domestic production of country i at basic prices.

INDEX 2

THE INCOME MEASURE OF GOODNESS

$$GOODINCO_i = \frac{\sum_{j=1}^{n} GAININCO_{i,j} - \sum_{j=1}^{n} LOSTINCO_{i,j}}{OUTPUT_i}$$

The results are shown in Table 3 below. Russia appears as the economy (of the set of 40 countries assessed here) with higher gains obtained from participating in GVCs. In 2011, total exports of goods and services used as inputs by other countries represented USD 448 billion, while total imports of goods and services used as inputs in the Russian economy amounted to USD 138 billion. Annual gain sums USD 310 billion therefore. This finding is critically influenced however by the weight of Petroleum and Gas in the Russian exports, as these two commodities are widely used as inputs in the production processes of goods and services of its main trade partners (Russian petroleum and gas was the main input in the economy in Lithuania, Bulgaria, Finland, Italy and Greece in 2011, accounting for 7%, 3%, 2%, 1% and 1% of those countries' total output, respectively). Apart from Russia, Luxembourg and Taiwan are the most benefited economy in relative terms, i.e. according to GOODINCO. In absolute terms, i.e. considering the difference between GAININCO and LOSTINCO, Germany shows up as the most benefited country. The difference between the foreign output appropriated by German agents and the German output appropriated by foreign agents amounted to USD 435 billion in 2011. On the opposite side of the spectrum, Greece and India emerge as the less benefiting countries in relative and absolute terms, respectively. The foreign output appropriated by Indian agents was USD 60 billion lower than the Indian output appropriated by foreign agents in 2011. That difference amounted to 4.6% of total domestic output in the case of Greece.

One should bear in mind that this analysis does not take into consideration other impacts of belonging to GVCs, such as gains from technology transfer, efficiency in the allocation of resources or the final impact in the country's trade balance.

TABLE 3

THE INCOME MEASURE OF COUNTRY NET GAINS FROM PARTICIPATING IN GLOBAL VALUE CHAINS (2011)

| Country | OUTPUT (USD billion) | GAININCO (A) (USD billion) | LOSTINCO (B) (USD billion) | (A-B) (USD billion) | GOODINCO (%) |
|---|---|---|---|---|---|
| **Russia** | 3,262.7 | 448.2 | 138.4 | 309.8 | **9.5%** |
| **Luxembourg** | 160.6 | 76.2 | 63.1 | 13.1 | **8.2%** |
| **Taiwan** | 1,052.8 | 298.2 | 225.2 | 73.0 | **6.9%** |
| **Germany** | 6,773.1 | 1,248.6 | 813.0 | 435.6 | **6.4%** |
| **Sweden** | 1,036.3 | 201.7 | 142.2 | 59.5 | **5.7%** |
| **Austria** | 811.2 | 171.5 | 128.1 | 43.4 | **5.4%** |
| **Estonia** | 43.2 | 8.7 | 6.7 | 2.0 | **4.6%** |
| **Canada** | 3,184.5 | 427.9 | 289.9 | 138.0 | **4.3%** |
| **Australia** | 2,844.6 | 289.3 | 173.7 | 115.6 | **4.1%** |
| **Netherlands** | 1,659.0 | 384.1 | 324.6 | 59.5 | **3.6%** |
| **Ireland** | 477.1 | 147.4 | 131.4 | 16.0 | **3.4%** |
| **Finland** | 530.1 | 89.8 | 72.6 | 17.2 | **3.2%** |
| **Czech Rep.** | 532.2 | 128.8 | 112.0 | 16.8 | **3.2%** |
| **Denmark** | 600.4 | 112.1 | 94.0 | 18.1 | **3.0%** |
| **Slovenia** | 97.4 | 18.5 | 15.6 | 2.9 | **3.0%** |
| **Hungary** | 309.4 | 87.1 | 78.0 | 9.1 | **2.9%** |
| **Mexico** | 1,954.5 | 283.1 | 226.8 | 56.3 | **2.9%** |
| **UK** | 4,419.1 | 542.6 | 416.9 | 125.7 | **2.8%** |
| **Slovakia** | 214.4 | 46.9 | 40.9 | 6.0 | **2.8%** |
| **South Korea** | 2,877.4 | 519.5 | 443.1 | 76.4 | **2.7%** |
| **Latvia** | 55.4 | 7.8 | 6.4 | 1.4 | **2.5%** |
| **Belgium** | 1,113.9 | 275.0 | 249.4 | 25.6 | **2.3%** |
| **Malta** | 17.7 | 4.1 | 3.7 | 0.4 | **2.3%** |
| **Indonesia** | 1,658.8 | 184.8 | 147.6 | 37.2 | **2.2%** |
| **Lithuania** | 73.5 | 13.9 | 12.8 | 1.1 | **1.5%** |
| **Japan** | 11,333.4 | 743.3 | 596.2 | 147.1 | **1.3%** |
| **Brazil** | 4,001.1 | 236.3 | 198.7 | 37.6 | **0.9%** |
| **France** | 5,070.1 | 501.5 | 460.1 | 41.4 | **0.8%** |
| **Poland** | 1,049.9 | 157.8 | 155.2 | 2.6 | **0.2%** |
| **US** | 26,918.1 | 1,503.3 | 1,450.6 | 52.7 | **0.2%** |
| **PRC** | 22,271.0 | 1,515.3 | 1,476.6 | 38.7 | **0.2%** |
| **Italy** | 4,278.9 | 419.6 | 423.4 | -3.8 | **-0.1%** |
| **Bulgaria** | 116.9 | 17.5 | 17.9 | -0.4 | **-0.3%** |
| **Spain** | 2,905.0 | 266.4 | 282.1 | -15.7 | **-0.5%** |
| **Turkey** | 1,418.5 | 105.3 | 113.2 | -7.9 | **-0.6%** |
| **Romania** | 361.1 | 39.3 | 42.4 | -3.1 | **-0.9%** |
| **Portugal** | 439.5 | 39.7 | 45.5 | -5.8 | **-1.3%** |
| **India** | 3,609.8 | 209.8 | 269.7 | -59.9 | **-1.7%** |
| **Greece** | 453.2 | 30.7 | 47.1 | -16.4 | **-3.6%** |
| **Cyprus** | 39.4 | 3.1 | 4.9 | -1.8 | **-4.6%** |

Source: Authors estimations based on WIOD, retrieved in January 2014.

Of course this same indicator could be replicated for pairs of countries. For this estimation, we substitute the total output (OUTPUT) for the sum of income existing domestically due to foreign demand (sum of A), aiming just at having a change in scale that avoids ending up with too small numbers. As a case in point, let's just take the Portuguese case (see Table 4 below). Clearly, Portuguese income benefits the most from demand for inputs originated in Sweden, United States, and France, while it losses the most due to domestic demand for foreign inputs produced in Brazil, the Netherlands and, particularly, Spain.

TABLE 4
THE DISAGGREGATED INCOME MEASURE OF COUNTRY NET GAINS FROM PARTICIPATING IN GLOBAL VALUE CHAINS FOR PORTUGAL (2009)

| Country | GAININCO (A) (USD billion) | LOSTINCO (B) (USD billion) | (A-B) (USD billion) | GOODINCO (%) |
|---|---|---|---|---|
| **France** | 3.77 | 2.38 | 1.39 | **3.5%** |
| **US** | 2.95 | 2.11 | 0.84 | **2.1%** |
| **Sweden** | 0.54 | 0.28 | 0.27 | **0.7%** |
| **Poland** | 0.36 | 0.19 | 0.17 | **0.4%** |
| **Turkey** | 0.26 | 0.10 | 0.16 | **0.4%** |
| **Czech Rep.** | 0.31 | 0.17 | 0.15 | **0.4%** |
| **Ireland** | 0.53 | 0.41 | 0.12 | **0.3%** |
| **Austria** | 0.46 | 0.34 | 0.11 | **0.3%** |
| **Romania** | 0.16 | 0.06 | 0.10 | **0.3%** |
| **Australia** | 0.10 | 0.03 | 0.07 | **0.2%** |
| **Finland** | 0.18 | 0.12 | 0.05 | **0.1%** |
| **Greece** | 0.10 | 0.05 | 0.05 | **0.1%** |
| **Hungary** | 0.11 | 0.09 | 0.03 | **0.1%** |
| **Mexico** | 0.33 | 0.31 | 0.02 | **0.0%** |
| **Slovenia** | 0.03 | 0.01 | 0.02 | **0.0%** |
| **Slovakia** | 0.07 | 0.06 | 0.02 | **0.0%** |
| **Cyprus** | 0.02 | 0.00 | 0.01 | **0.0%** |
| **Latvia** | 0.01 | 0.00 | 0.01 | **0.0%** |
| **Estonia** | 0.01 | 0.00 | 0.01 | **0.0%** |
| **Canada** | 0.31 | 0.30 | 0.00 | **0.0%** |
| **Malta** | 0.01 | 0.01 | -0.01 | **0.0%** |
| **Japan** | 0.19 | 0.20 | -0.01 | **0.0%** |
| **Denmark** | 0.16 | 0.17 | -0.02 | **0.0%** |
| **Lithuania** | 0.01 | 0.03 | -0.02 | **0.0%** |
| **Taiwan** | 0.04 | 0.07 | -0.03 | **-0.1%** |
| **Bulgaria** | 0.03 | 0.07 | -0.04 | **-0.1%** |
| **Belgium** | 1.23 | 1.29 | -0.06 | **-0.2%** |
| **Indonesia** | 0.02 | 0.11 | -0.08 | **-0.2%** |
| **Germany** | 4.35 | 4.44 | -0.09 | **-0.2%** |
| **Luxembourg** | 0.06 | 0.22 | -0.16 | **-0.4%** |
| **UK** | 1.71 | 1.89 | -0.18 | **-0.5%** |
| **India** | 0.08 | 0.27 | -0.19 | **-0.5%** |
| **South Korea** | 0.04 | 0.24 | -0.20 | **-0.5%** |
| **Russia** | 0.19 | 0.41 | -0.22 | **-0.5%** |
| **Rest of the World** | 7.69 | 7.97 | -0.28 | **-0.7%** |
| **PRC** | 0.69 | 1.04 | -0.35 | **-0.9%** |
| **Italy** | 1.43 | 2.02 | -0.58 | **-1.5%** |
| **Brazil** | 1.62 | 2.29 | -0.66 | **-1.7%** |
| **Netherlands** | 0.98 | 1.71 | -0.73 | **-1.8%** |
| **Spain** | 8.72 | 14.04 | -5.32 | **-13.3%** |
| **Total** | 39.84 | 45.46 | -5.6 | **-** |

Source: Authors estimations based on WIOD, retrieved in January 2014.

## 2.3. Comparing the proposed indicators with those previously suggested in the literature

We will now compare the main innovative aspects of the indexes proposed in the previous sections with the most commonly used indicators found in the literature so far, namely Feenstra and Hanson (1996)'s and Feenstra (1998)'s index of international outsourcing; Hummels et al. (1998)'s and Hummels et al. (2001)'s index of vertical specialization; Guerrieri and Caffarelli (2004)'s index of revealed comparative advantages for intermediate goods; Baldone et al. (2007)'s index of relative propensity revealed to

internationally fragmented production; Amador and Cabral (2009)'s index of relative vertical specialization; Dullien (2010)'s index of relative importance of international trade of parts and components; Meng et al. (2010, 2011)'s index of re-exported imported intermediate goods; Ferrarini (2011)'s network trade index between a pair of countries; and Yamano et al. (2011)'s indexes of import content of exports, of re-exported exports in intermediates and of a given country's exports embedded in its trade partners' exports.

Firstly, while the indexes proposed in this paper put two approaches (downstream and upstream) together, the indexes found in literature merely cover a downstream approach . While the downstream approach (also known as supplier's approach) provides us with a partial idea of how embedded in GVC is a given economy by telling us how much foreign production is incorporated as inputs into its production, the upstream approach (also known as user's approach) provides us with the other partial information missing to get the full picture of how embedded in GVC is a given economy by telling us how much the production of that given economy is used as inputs in the production processes of other countries. Secondly, the measures that we present are based on the actual use of the goods and services as inputs in the production process and not in its classification as intermediate or final goods or services, as it is the case of previous indexes Thirdly, we estimate income transfers between countries to assess GVC participation, instead of typically assessing it by means of trade flows. These three innovative aspects of the proposed indicators directly derivate from the utilization of internationally-linked IO databases.

## 3. The Link Between Global Value Chains and the Investment of Countries

In this section, we test the impact of the two income-related indexes proposed in a pooled regression model that analyses the bilateral FDI stocks between 37 OECD members of the WIOD database coordinated by the University of Groningen that are also covered by OECD (2014)'s database of outward bilateral FDI stock[6].

A vast empirical literature has been developed determining the forces attracting FDI, most of them making use of cross-country regressions to search for empirical linkages between FDI and a variety of economic variables. For instance, this literature shows that for most variables, observed effect is ambiguous, as summarized by Chakrabarti (2001) and complemented by Onyeiwu (2003) and Jabri et al. (2013).

We will run a pooled-regression model explaining bilateral FDI stock between countries in the period ranging 2002 to 2012. In this model, we will make use of explanatory variables usually found in the literature to empirically explain FDI flows plus the two income-related indexes EMBINCO and GOODINCO (see Index 3 below).

INDEX 3

POOLED-REGRESSION MODEL FOR BILATERAL FDI STOCK

$$FDI_{i,j}^{t} = \alpha + \beta_1 . GDPpc_i^t + \beta_2 . GDPpc_j^t + \beta_3 . GDP_i^t + \beta_4 . GDP_j^t +$$
$$+ \beta_5 . OPENESS_i^t + \beta_6 . OPENNESS_j^t + \beta_7 . DIST_{i,j} + \beta_8 . CONTIG_{i,j} + \beta_9 . COMLANG\_OFF_{i,j} +$$
$$+ \beta_{10} . COLONY_{i,j} + \beta_{11} . OFFSHORE_{i,j} + \beta_{12} . EMBINCO_{i,j}^t + \beta_{13} . GOODINCO_{i,j}^t +$$
$$+ \beta_{14\text{-}25} . YEAR\_DUMMIES\_2002to2012 + \beta_{26\text{-}216} . COUNTRY\_DUMMIES + e_{i,j}^t$$

The variables included in the model are the following:

*Dependent variable*

$FDI_{i,j}^{t}$ is the outward bilateral FDI stock in year t from country j to country i, current prices, in million US dollars; t ranges from 2002 to 2012; j is the reporting country and i is the partner country. The number of observations is 10,968 (non-negative, non-zero and non-confidential observations). It makes use of the third edition of the OECD's benchmark definition of FDI, which includes all sorts of transnational

[6] The 37 countries covered by the WIOD that are also covered by (2014) are Austria, Australia, Belgium, Bulgaria, Brazil, Canada, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, India, Indonesia, Ireland, Italy, Japan, Luxembourg, Mexico, Malta, the Netherlands, Poland, Portugal, PRC, Romania, Russia, Slovakia, Slovenia, South Korea, Spain, Sweden, Turkey, United Kingdom, and United States. Latvia, Lithuania, and Taiwan are not included in this study, as OECD (2014) does not present data for them.

financial flows, productive or speculative, short or long run and data was retrieved on 10 October 2015 from OECD (2015).

*Independent variables*

1. $GDPpc_j^t$ and $GDPpc_i^t$ are the nominal GDP per capita of country j and i, respectively, current prices, in US dollars, retrieved from World Bank (2015a), complemented for selected countries with Bureau of Economic Analysis (2015) and Kurshnir (2015).

2. $GDP_j^t$ and $GDP_i^t$ are the nominal GDP of country j and i, respectively, current prices, in US dollars, retrieved from World Bank (2015a), complemented for selected countries with Bureau of Economic Analysis (2015) and Kurshnir (2015).

According to Chakrabarti (2001, p. 96), market size has, by far, been the single most widely accepted as a significant 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: as the market-size grows to some critical value, FDI will start to increase thereafter with its further expansion.» This hypothesis has been rather popular and a variable representing market size has appeared as an explanatory variable in nearly all empirical studies on the determinants of FDI. Those empirical studies use as main explanatory variables GDP, GNP, and, mostly, GDP or GNP per capita.

3. $OPENNESS_i^t$ and $OPENNESS_j^t$ are the sum of imports and exports divided by the nominal GDP of country i and j, respectively, current prices, in US dollars. Exports are imports are retrieved from World Bank (2015b) and complemented with The Observatory of Economic Complexity (2016).

Chakrabarti (2001, p. 99) explains that, for openness, «there is mixed evidence regarding the significance of openness measured by the ratio of exports plus imports to GDP in determining FDI». The hypothesis is that a country's degree of openness to international trade should be a relevant factor in the decision, given that most investment projects are directed towards the tradable sector. Authors report ambiguous results though. We will produce our own empirical evidence in this regard.

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

4. $DIST_{i,j}$ 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)[7], in kilometers, retrieved on 24 August 2015 from Mayer and Zignago (2011)[8].

5. $CONTIG_{i,j}$ is a dummy variable indicating whether the two countries are contiguous, i.e. if they share a land border, retrieved on 24 August 2015 from Mayer and Zignago (2011).

6. $COMLANG\_OFF_{i,j}$ is a dummy variable indicating whether the two countries share the same official language, retrieved on 24 August 2015 from Mayer and Zignago (2011).

7. $COLONY_{i,j}$ is a dummy variable indicating whether the two countries have ever had a colonial link, retrieved on 24 August 2015 from Mayer and Zignago (2011).

The explanatory variables $DIST_{i,j}$, $CONTIG_{i,j}$, $COMLANG\_OFF_{i,j}$, and $COLONY_{i,j}$ are broadly considered proxies for "trade barriers". *Ceteris paribus*, the higher the distance between the two countries involved in the bilateral FDI stock, one can assume that the smaller is the cultural, legal, and historical familiarity between the two countries. In the same vein, if the two countries share a land border, the same language, or used to be the colony one of the other, one could assume that the higher is the cultural, legal, and historical familiarity between the two countries. This familiarity could be interpreted as an element reducing transaction costs in trade and investment, so easing FDI flows between those two countries.

In the case of $DIST_{i,j}$, 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 trade costs. This negative effect is also valid as a proxy of investment costs, since restrictions on FDI discourage all foreign investors, implying an expected negative coefficient regardless of the FDI type.

[7] «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», in Mayer and Zignago (2011, p. 11).

[8] 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.

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

8. $OFFSHORE_{i,j}$ is a dummy variable indicating whether at least one of the two countries is considered to be an offshore financial center, following IMF (2015)[9]. One should expect this variable to be positively related to the bilateral stocks of FDI between countries, since the OECD's definition of FDI not only includes productive and medium- and long-term investments, but also speculative and short-term investments, the latter being sensitive and positively related to offshore financial centers.

Additionally, as already mentioned, we also include in the regression the two income-related GVC indexes proposed:

9. $EMBINCO_{i,j}^{t}$ is the income measure of country embeddedness of participating in GVC as defined in the previous section. One could expect this variable to be positively related to the bilateral stock of FDI between countries. In fact, the higher the participation of a given country in GVC, the higher one could expect the FDI entering that country to be, since FDI are at the origin of the implementation of the production stages in locations where the pay-off of the utility function of a given firm, considered interested in joining a GVC, is higher.

10. $GOODINCO_{i,j}^{t}$ is the income measure of country net gains from participating in GVC as defined in the previous section. The inclusion of this explanatory variable will allow us to test if the degree of favorable or unfavorable participation in GVC of a given country, measured in terms of income transfer, is statistically related to the investment decisions made by firms at the micro-level. If significant, one could expect this explanatory variable to be negatively related to the bilateral stock of FDI between countries. The rationale is that the investment decisions made by firms at the micro-level would be deterred at some degree by the existence of sizeable imbalances in terms of net transfers of income due to GVC participation, which could be interpreted as a proxy for future macroeconomic adjustments in that economy.

Note that correlation between EMBINCO and GOODINCO for the set of data analyzed was 27.4%.

We also introduced two set of dummies to capture time- and country-specific effects, namely:

11. $YEAR\_DUMMIES\_2002to2012^{t}$ are 11 time-specific dummy variables indicating the year t, ranging from 2002 to 2012; and

12. $COUNTRY\_DUMMIES_{i}$ and $COUNTRY\_DUMMIES_{j}$ 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 (10,968) allows for the inclusion of such a high number of dummies.

We also tested other variables not included in Chakrabarti (2001)'s stock taking of explanatory variables of FDI, namely (i) the two partner countries belonging to the same Free Trade Area; (ii) the two partner countries having had a common colonizer, retrieved on 24 August 2015 from Mayer and Zignago (2011); (iii) the two partner countries having being a colony in the past, also retrieved on 24 August 2015 from Mayer and Zignago (2011); (iv) $TGDP_{i,j}^{t}$, defined as the join market size equalling ($GDP_{i}^{t} + GDP_{j}^{t}$); and (v) one of the countries being subject to main international sanctions. They were found to be statistically insignificant though.

Finally, $e_{i,j}^{t}$ refers to the disturbance term for the FDI stock from country j to 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)[10]. It is possible that other factors influencing FDI stocks from country j to country i are 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. In such a case, the disturbance term $e_{i,j}^{t}$ in Index 3 below can be written as $e_{i,j}^{t} = \alpha_{i} + \alpha_{j} + \mu^{t} + \upsilon_{i,j}^{t}$, with the $\upsilon_{i,j}^{t}$ zero mean, constant variance shocks uncorrelated across time and countries, the $\mu^{t}$ being the unknown individual effects to be estimated for each year, and $\alpha_{i}$ and $\alpha_{j}$ being the unknown individual effects to be estimated for each country.

[9] Namely Cyprus, Ireland, Luxembourg and Malta.

[10] *Cf.* Flôres et al. (2007). 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.

The individual effects may be either fixed or random. In the latter case, though the $\alpha_i$ must be uncorrelated with the explanatory variables, the errors in Index 5 above will be correlated within sectors. However, even when the random effects model is valid, the fixed effects estimator will still produce consistent estimates of the identifiable parameters[11]. Under the fixed effects assumption, Index 3 above can be estimated by OLS with country-specific dummies.

We run several pooled OLS regressions by making use of software Stata SE 13 (64 bits). The final results obtained, after cleaning statistically insignificant variables are presented next (Table 6).

TABLE 6

RESULTS OF A POOLED REGRESSION MODEL TO ESTIMATE THE DETERMINANTS OF BILATERAL FDI STOCK WITH THE GVC-RELATED INDICATORS

**- Descriptive statistics -**

| Variable | Obs | Mean | Std. Dev. | Min | Max |
|---|---|---|---|---|---|
| FDI | 10968 | 11211.72 | 37388.52 | .001 | 645098 |
| GDPpcj | | 30412.48 | 19210.02 | 486.6405 | 113731.7 |
| GDPpci | | 28273.65 | 19596.4 | 486.6405 | 113731.7 |
| GDPj | | 1.46e+12 | 2.68e+12 | 4.30e+09 | 1.62e+13 |
| GDPi | | 1.39e+12 | 2.60e+12 | 4.30e+09 | 1.62e+13 |
| OPENNESSi | | 89.718404 | 53.318816 | 21 | 348 |
| OPENNESSj | | 89.718404 | 53.318816 | 21 | 348 |
| DIST | | 4682.915 | 4233.475 | 160.9283 | 17981.98 |
| CONTIG | | .071663 | .2579409 | 0 | 1 |
| COMLANG_OFF | | .0619985 | .2411639 | 0 | 1 |
| COLONY | | .0511488 | .2203112 | 0 | 1 |
| OFFSHORE | | .1651167 | .3713028 | 0 | 1 |
| Y2009 | | .097283 | .2963563 | 0 | 1 |
| Y2010 | | .0982859 | .2977144 | 0 | 1 |
| Y2011 | | .098833 | .2984512 | 0 | 1 |
| Y2012 | | .0970095 | .2559842 | 0 | 1 |
| PRC | | .0428519 | .2025394 | 0 | 1 |
| EMBINCO | | .408573 | 7.945184 | 9.59e-06 | 240.3026 |
| GOODINCO | | .1998905 | 4.801704 | -1.688337 | 146.4376 |

**- Econometric results-**

| Source | SS | df | MS |
|---|---|---|---|
| Model | 6.0868e+12 | 17 | 3.5805e+11 |
| Residual | 9.2440+12 | 10950 | 844201779 |
| Total | 1.5331e+13 | 10967 | 1.3979e+09 |

| | |
|---|---|
| Number of obs = | 10968 |
| F(17, 10950) = | 424.12 |
| Prob > F = | 0.0000 |
| R-squared = | 0.4971 |
| Adj R-squared = | 0.4964 |
| Root MSE = | 29055 |
| LR $Chi^2$ = | 33493.48 |
| Prob $Chi^2$ > X = | 0.0000 |

| FDI | Coef. | Std. Err. | t | P>\|t\| | [95% Conf. | Interval] |
|---|---|---|---|---|---|---|
| CONST | -12623.24 | 790.1637 | -15.98 | 0.000 | -14203.57 | -11042.91 |
| GDPpcj | 0.2956113 | 0.015863 | 18.64 | 0.000 | .2638853 | .3273373 |
| GDPpci | 0.207731 | 0.0156834 | 13.25 | 0.000 | .1763642 | .2390978 |
| GDPj | 2.65e-09 | 1.21e-10 | 21.81 | 0.000 | 2.41e-09 | 2.89e-09 |
| GDPi | 2.03e-09 | 1.27e-10 | 15.99 | 0.000 | 1.78e-09 | 2.28e-09 |
| OPENNESSi | 976.4987 | 26.4325 | 36.24 | 0.000 | 923.6337 | 1029.364 |
| OPENNESSj | 815.9832 | 20.3251 | 31.32 | 0.000 | 775.333 | 856.6334 |
| DIST | -.6380666 | 0.0769138 | -8.30 | 0.000 | -.7918942 | -.484239 |
| CONTIG | 11951.41 | 1632.534 | 7.32 | 0.000 | 8686.342 | 15216.48 |
| COMLANG_OFF | 28825.74 | 1768.424 | 16.30 | 0.000 | 25288.89 | 32362.59 |

[11] See Baltagi (2013).

| | | | | | | |
|---|---|---|---|---|---|---|
| **COLONY** | **14769.5** | **1419.055** | **10.41** | **0.000** | **11931.4** | **17607.61** |
| **OFFSHORE** | **1588.21** | **840.8849** | **1.89** | **0.059** | **-93.5598** | **3269.9798** |
| **EMBINCO** | **5.21e-06** | **9.51e-07** | **5.48** | **0.000** | **3.38e-06** | **7.11e-06** |
| GOODINCO | -6.49e-07 | 8.20e-07 | -0.79 | 0.429 | -2.29e-06 | 9.91e-07 |
| **Y2009** | **-2103.569** | **404.809** | **-5.20** | **0.000** | **-2913.187** | **-1293.951** |
| **Y2010** | **-1686.141** | **404.3867** | **-4.17** | **0.000** | **-2494.9144** | **-877.3676** |
| **Y2011** | **-951.7249** | **424.9599** | **-2.24** | **0.025** | **-1801.6447** | **-101.8051** |
| **Y2012** | **-1573.918** | **426.0642** | **-3.69** | **0.000** | **-2426.0464** | **-721.7896** |
| **PRC** | **6611.089** | **2617.354** | **3.58** | **0.000** | **1376.381** | **11845.797** |

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

The model is statistically significant and it explains around 50% of the variations in the stock of FDI between 2002 and 2012. The global model seems to be robust, as F-statistic is marginally zero. After having performed a Haussman test, which indicated that both the fixed effects and the random effect models can be used, we also run the Likelihood-ratio (LR) test for heteroscedasticity. The $Chi^2$-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 7 below.

TABLE 7

EXPECTED SIGNALS FOR SELECTED VARIABLES IN THE POOLED REGRESSION MODEL USED TO ESTIMATE THE DETERMINANTS OF FDI STOCK

| Variable | Expected sign | Observed sign |
|---|---|---|
| **GDPpcj** | + | + |
| **GDPpci** | + | + |
| **GDPj** | + | + |
| **GDPi** | + | + |
| **OPENNESSi** | + | + |
| **OPENNESSj** | + | + |
| **DIST** | - | - |
| **CONTIG** | + | + |
| **COMLANG_OFF** | + | + |
| **CONLANG_ETHNC** | + | + |
| **COLONY** | + | + |
| **OFFSHORE** | + | + |
| **EMBINCO** | + | + |
| **GOODINCO** | - | **NS** |

Source: + stands for significantly positive. - stands for significantly negative. NS stands for statistically insignificant.

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 to FDI stock as well, as expected, as they work as proxies for proximity and familiarity factors that make investors feel comfortable about investing in adjacent countries, such as common legal, social and tax structures. Distance works on the opposite direction, as a proxy for remoteness factors that make investors feel uncomfortable about investment in environments where they feel unfamiliar with legal, social, and/or cultural rules.

The five sets of remaining variables deserve particular attention.

First, we must bear in mind that the OECD's definition of FDI implicit to the data used in this thesis was still the one under the third edition of the OECD's benchmark definition of FDI. That definition did not differentiate between sorts of transnational financial flows, including therefore productive or speculative, short or long run investment in the same level. That's why one should not be surprised to find in OECD's data that British Virgin Islands, Mauritius and Cyprus are, in this same order, the largest foreign direct investors in PRC, India and Russia. The last round of negotiations that originated the fourth edition of the OECD's benchmark definition of FDI was concluded on 2008 but the OECD only started to publish data under new assumptions in September 2014 (see OECD 2008). Productive and medium- and long-term investments are certainly less sensitive to offshore financial centers than speculative and short-term investments. In fact, the lack of disaggregation between what one could call as financial FDI (portfolio, short-term, volatile investment) and productive FDI (used in industries, medium and long-term, stable investment) is particularly relevant for the "offshore" explanatory variable. One could expect this variable to have a significant positive impact on the financial FDI, meaning that offshore financial centers would stock higher levels of speculative FDI, but it would be expected to be insignificant or just slightly significant (positive) for productive FDI (e.g. through indirect links such as the recycling of some part of the stocked

financial FDI in productive activities). We found the offshore variable to be positive, but significant just at 90% level, which is consistent in our view with the limitations of the OECD's data of FDI bilateral stock referred above. One should note in this regard that OECD's definition of FDI will evolve quickly to cope with the challenge posed by GVC, probably by differentiating both types of FDI, i.e. productive and speculative (see in this regard 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[12]). This workshop and its impact will definitely open an additional vein of research in the core aim of this thesis. One could expect that better results would have been obtained for this model in terms of statistical significance if the dependent variable of FDI stock could be reformulated to separate speculative from productive FDI stock.

Second, the EMBINCO variable, defined as the income measure of country embeddedness of participation in GVC, is significantly positive. *Ceteris paribus*, and assuming that the higher the transnational income generated between two given countries by GVC, the higher the FDI observed between those two countries, one could expect that EMBINCO variable to be statistically significant, underpinning the statistical linkage between FDI and GVC. Previous studies usually found openness variables (such as exports, imports or the ratio of the sum of exports and imports to GDP) to be positive, although sometimes insignificant. We consider this EMBINCO variable, which we find to be positive and significant, to be a proxy to openness, but a particular one, openness (and country embeddedness) to GVC.

Third, the GOODINCO variable, defined as the income measure of country net gains of participation in GVC, is not statistically significant. It means that we find no statistical relationship between an unbalanced transnational net transfer of income between two given countries (e.g. inflows much higher than outflows, or vice-versa) and the size of the bilateral FDI stock between those countries.

Fourth, we found that the year dummies included in the model are statistically insignificant from 2002 to 2008, but they are statistically significant from 2009 to 2012. The statistical significance of these years is particularly strong in 2009 (98%) and decreases from that year onwards (94% in 2010, 93% in 2011 and 86% in 2012). The explanation for this result of the model is related in our view to the global financial crisis that emerged in 2009, after the filing for bankruptcy by Lehman Brothers in September, 15 2008. These four year dummies being negative and statistically significant at 90% could be interpreted as a consequence of the decrease in FDI stocks in result of that global financial crisis, *ceteris paribus* for the other explanatory variables of FDI stocks.

Fifth, there is only one country dummy variable introduced in the model that is statistically significant: PRC. All things equal, bilateral FDI stock between PRC and any other 36 countries assessed in this model are, on average, USD 6.6 billion larger than other bilateral FDI stocks. The explanation for this result could emerge in our view from the outward bias of the PRC's economy, deliberately promoted by the economic policies of the Chinese government, that creates relatively low levels of domestic demand, relative high levels of savings and a great deal of liquidity for investment (PRC's hold nearly 40% of the world's foreign exchange reserves) and high levels of foreign trade and FDI.

**Conclusion**

We aimed to contribute to the new field of research that intends to bring up-to-date the tools and statistics currently used to look to the current reality given by GVC in international trade and FDI. We made use of the most recent data published by the WIOD to suggest two indicators of measuring the participation and the net gains of countries joining GVC in terms of income. All indexes found in literature merely cover the downstream approach, while the indicators proposed in this paper put both approaches (downstream and upstream) together. In addition, the proposed indicators are based on the actual use of the goods and services as inputs in the production process and not in its classification as intermediate or final goods or services. The first of these new measures proves to be statistically significant in explaining the bilateral stock of FDI in OECD countries, meaning that the higher the transnational income generated between two given countries by GVC, taken as a proxy to the participation of those countries in GVC, the higher one could expect the FDI entering those countries to be.

The regression ran to test the statistical significance of that variable also statistically proves the negative impact of the global financial crisis that started in 2009 in the world's bilateral FDI stocks and, additionally, the particular and significant role played by PRC in determining these stocks.

Limitations of this study are related to (i) the narrow number of countries included in the WIOD (covering just 40 countries); (ii) trade in value-added being an estimate based on a number of assumptions,

[12] In http://www.oecd.org/investment/oecd-technical-worshop-on-foreign-direct-investment-and-global-value-chains-19-october-2015-paris.htm.

rather than a measurement, as mentioned by Escaith and Timmer (2012)[13]; (iii) IO databases published so far not considering at least second-round effects in the use of intermediates by GVC, i.e. the inputs used in the production of the inputs (which can also be in fact third and fourth and fifth and so on-round effects); (iv) the shortcomings of the methodology used to analyze the income transfer, namely the fact that the IO databases should be treated as an estimate based on a number of assumptions and intrapolations (most of the data results from interpolation by using national accounts and supply-use annual tables, since national IO databases are only available for 1995, 2000, 2005 and 2009), rather than a measurement, as mentioned by Escaith & Timmer (2012); and (v) OECD's broad definition of FDI, since OECD's definition of FDI does not differentiate between speculative and productive FDI stock and one should admit that determinants of both sorts of FDI stocks are different. Nevertheless, OECD statistics will evolve quickly to cope with this challenge.

Finally, we identify several other veins for research, which can be tackled in future work, namely (i) the use of the coefficients obtained in the regression to predict the investment potential of countries, following an analogous methodology to that used by Proença et al (2008) for international trade flows; (ii) update the analysis with updated or new international input-output databases covering a wider number of countries, such as Eora Multi-Region IO database; (iii) individualize each one of the three regional value ladders[14] identified by OECD et al (2014), Southeast Asia, North America and Central Europe, carrying out separate estimates for each one of these regions to see if they present some sort of differences; and, more ambitiously, or (iv) build more robust databases, for instance increasing raw data available per year and per country aiming at diminishing the number of inferences and interpolations, or including second- (and third-) round effects.

**Bibliography**


Amador, J. & Cabral, S. (2009). Vertical specialization across the world: a relative measure. *The North American Journal of Economics and Finance*. 20 (3). pp. 267-280.

Arndt, S.W. & Kierzkowski, H. (Eds.) (2001). *Fragmentation: New production patterns in the world economy*. Oxford University Press. Oxford.

Athukorala, P.C. & Yamashita, N. (2006). Production fragmentation and trade integration: East Asia in a global context. *The North American Journal of Economics and Finance*. 17 (3). pp. 233-256.

Baldone, S., Sdogati, F. & Tajoli, L. (2007). On some effects of international fragmentation of production on comparative advantages, trade flows and the income of countries. *The World Economy*, 30 (11). pp. 1726-1769.

Baldwin, R. & Lopez-Gonzalez, J. (2013). Supply chain trade: a portrait of global patterns and several testable hypotheses. National Bureau of Economic Research Working Paper Series number 18,957. Cambridge, MA. US.

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

Bureau of Economic Analysis (2015). Gross Domestic Product for the U.S. territories [online]. Available in: http://www.bea.gov/national/gdp_territory.htm, U.S. Department of Commerce, retrieved on 24.08.2015.

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

Cheng, L.K. & Kierzkowski, H. (Eds.) (2001). *Global production and Trade in East Asia*. Kluwer Academic. Massachusetts.

Dullien, S. (2010). Integração produtiva na União Europeia: uma perspetiva alemã. Chapter 4 in: Agência Brasileira de Desenvolvimento Industrial (Eds.) *Integração produtiva, caminhos para o Mercosul*. Série de cadernos da indústria ABDI. Volume XVI. Agência Brasileira de Desenvolvimento


[13] For instance, large discrepancies between the values recorded in input-output national accounts and in international trade statistics have to be reconciled, as well as between importers' and exporters' reports. Additionally, IO-based databases of international trade are based on IO domestic tables that are not estimated on an annual basis (every five years at best) and years in between those estimations are mere extrapolations. Lastly, firm surveys are needed to split the IO table in export-oriented and domestic-oriented firms. See OECD and WTO (2012, pp. 16-17) for a detailed explanation of those assumptions. In this regard, one should refer to the technical advisory group created in 2013 under the MIWI to ensure that there is widespread agreement on the nature of the assumptions on which the creation of a future global IO table would be based.

[14] OECD et al. (2014) defends that there is not such a thing as global value chains, but three different regional value ladders that work independently. Ladders in the sense that the disaggregation of production into separate stages allows their firms not only to find their place on the ladder, but to move up the rungs as their capabilities improve.

Industrial. Brasília. In collaboration with Comissão Económica das Nações Unidas para a América Latina e as Caraíbas (CEPAL) and Instituto de Pesquisa Económica Aplicada brasileiro (IPEA).

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.

Feenstra, R.C. (1998). Integration of trade and disintegration of production in the global economy. *Journal of Economic Perspectives*, 12 (4), pp. 31-50.

Feenstra, R.C. & Hanson, G.H. (1996). Globalization, outsourcing and wage inequality. *The American Economic Review*, 86 (2), pp. 240-245.

Ferrarini, B. (2011). Mapping vertical trade. ADB Economics Working Paper Series, 263. Asian Development Bank. Manila

Flôres, R.G.J., Fontoura, M.P. & Guerra Santos, R. (2007). Foreign Direct Investment spillovers in Portugal: additional lessons from a country study. *The European Journal of Development Research*, 19 (3), pp. 372-390.

Guerrieri, P. & Caffarelli, F.V. (2004). International fragmentation of production and Euro-Med integration. European University Institute Working Paper Series, 2004-28. Robert Schuman Centre for Advanced Studies. Florence.

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 on 24.08.2015.

Hummels, D.L., Raporport, D. & Yi, K.M. (1998). Vertical specialization and the changing nature of world trade. *Economic Policy Review*, June, pp. 79-99.

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 (2015). Offshore Financial Centers (OFCs): IMF Staff Assessments (OFCA) – Sorted by Jurisdiction. Available in: http://www.imf.org/external/NP/ofca/OFCA.aspx#P, retrieved on 15.05.2013.

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).

Jones, R.W., Kierzkowski, K. & Lurong, C. (2005). What does the evidence tell us about fragmentation and outsourcing?. *International Review of Economics and Finance*. 14 (3). pp. 305-316.

Kurshnir, I. (2015). World Macroeconomic Research statistics [database]. Available in: http://kushnirs.org/macroeconomics/gdp/gdp_world.html#rank, retrieved on 24.08.2015.

Lamy, P. (2010). Facts and fictions in international trade economics [online]. Speech made at the Conference of trade and inclusive globalization, Paris School of Economics. Paris. April, 12. Available in: www.wto.org/english/news_e/sppl_e/sppl152_e.htm

Maurer, A. & Degain, C. (2010). Globalization and trade flows: what you see is not what you get!. WTO Staff Working Paper Series. Number ERSD 2010-12.

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 on 24.08.2015.

Meng, B., Yamano, N. & Webb, C. (2010). Vertical specialization indicator based on supply-driven Input-Output model. Institute of Developing Economies Discussion Papers, n. 270. Tokyo.

Meng, B., Yamano, N. & Webb, C. (2011). Application of factor decomposition techniques to vertical specialization measures. Institute of Developing Economies Discussion Papers, n. 276. Tokyo.

Mirodout, S., Lanz, R. & Ragoussis, A. (2009). Trade in intermediate goods and services. OECD TAD/TC Working Paper Series, n. 1. Paris. Available in: www.oecd.org/std/its/44056524.pdf.

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 2012, retrieved on 10.10.2015.

OECD & WTO (2012). Trade in value-added: concepts, methodologies and challenges [online]. Joint OECD-WTO note. Available in: www.wto.org/english/res_e/statis_e/miwi_e/oecd_wto_mar2012_e.doc.

OECD & WTO (2013). OECD-WTO Database on Trade in Value-Added [database]. Available in: www.wto.org/english/res_e/statis_e/miwi_e/tradedataday13_e/oecdbrochurejanv13_e.pdf.

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.

Onyeiwu, S. (2003). Analysis of FDI flows to developing countries: is the MENA region different? [online]. Paper presented at ERF 10th annual conference in Marrakech Morocco, December, available in http://www.mafhoum.com/press6/172E11.pdf.

The Observatory of Economic Complexity (2016). Exports [database]. Available in: http://atlas.media.mit.edu/en/, retrieved on 18.02.2016.

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

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.

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 (2015a). World Database Indicators Statistics [database]. Available in: http://data.worldbank.org/indicator, retrieved on 15.06.2015.

World Bank (2015b). World Integrated Trade Solution [database]. Available in: http://wits.worldbank.org/about_wits.html, retrieved on 17.02.2016.

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.

Yamano, N., Meng, B. & Fukasaku, K. (2011). Fragmentation and changes in the Asian trade network. Economic Research Institute for ASEAN and East Asia Research Brief Series, Jakarta.

Yeats, A.J. (2001). Just how big is global production sharing?. Chapter 7 in: Arndt, S.W. & Kierzkowski, H. (Eds.) *Fragmentation: New production patterns in the world economy*. Oxford University Press. Oxford.

Yi, K.M. (2003). Can vertical specialization explain the growth of world trade?. *Journal of Political Economy*, 111 (1), pp. 52-102.