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Department of Economics

Henrique Galan & Maria Paula Fontoura

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2000s: an approach with income transfers**

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Global Value Chains assessment in the 2000s: an approach with income transfers

*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

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ABSTRACT

In this paper, we make use of recent data published by the World Input-Output Database to (i) measure the degree of total and net “transferred” gains of major Organization for Economic Co-operation and Development (OECD)-member countries and emerging economies by being part of a Global Value Chain (GVC) with two income-related indicators built for this purpose and (ii) capture whether the bilateral degree of GVC insertion of this group of countries, measured with the proposed indicators, contributes to Foreign Direct Investment (FDI) inflows in the 2000s. The pooled regression model estimated shows that bilateral FDI inflows, controlling for other possible FDI determinants, are positively associated to the total “transferred” income generated by GVC-induced bilateral trade of inputs, taken as a proxy to the degree of GVC-embeddedness of those countries, while correlation with GVC-associated net gains was not confirmed. The regression also shows the negative impact of the global financial crisis of 2008-9 and the significant role played by the People’s Republic of China on FDI inflows.

Keywords: Globalization, Global Value Chains, Foreign Direct Investment, Pooled-regression model

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

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 fragmentation of global production with different stages of production performed in different countries. UNCTAD (2013) estimates that value chains administered by multinational enterprises already account for 80% of global trade¹.

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 goods². 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, while 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, 2013). 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 calculated³. 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.

To overcome the fact that traditional statistics of international trade fail to fully reflect the new reality that globalization created, 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. 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 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. Of these new databases, the most used one by researchers is by far the World Input-Output Database (WIOD), coordinated by the University of Groningen, launched in April 16, 2012 (see Timmer *et al.*, 2015), covering, in its first release, 40 countries, mostly Organization for Economic Co-operation and Development (OECD)-effective members and major emerging economies⁴ (hereinafter referred to as OE countries), representing nearly 82% of world's Gross Domestic Output (GDP), and 35 sectors. A comparable listing with other similar databases also recently published is presented in Table A-1 in the Appendix.

¹ Growth rates observed in parts and components has persistently outstripped the one observed in final goods for the last decades (Jones *et al.*, 2005; Athukorala and Yamashita, 2006).

² 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 (2013), 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.

³ 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.

⁴ The following OECD members are not included in this first WIOD's release: Chile, Iceland, Israel, New Zealand, Norway and Switzerland. With regard to the non-OECD countries included in this database, they are the following Brazil, Bulgaria, Cyprus, India, Indonesia, Lithuania, Malta, PRC, Romania, Russia and Taiwan.

This paper aims to improve knowledge about the GVCs by using data for income associated to GVC-induced trade flows published by the first release of the WIOD database. Compared to previous research, this contribution aims to improve knowledge in two aspects.

Firstly, we build two income-related indexes to measure the degree of insertion of a country into GVCs, which capture the “transferred” income associated to trade of inputs (components and subparts of unfinished goods) generated by fragmented production in terms of total and net gains. Calculations are made for each of the 40 OE countries and the last year (2011) considered in the WIOD database used.

Secondly, we explore the impact of being part of GVCs on Foreign Direct Investment (FDI) inflows. For this purpose, we estimate this effect for bilateral relations between the OE countries with the two proposed GVC-related indicators in the 2000s (namely, in the decade from 2002 to 2011). Considering the beneficial direct and indirect effects that a country may expect from FDI⁵, a positive relation suggests that economic policies aiming to promote economic growth should favor the free trade of inputs and other policies favoring firms’ embeddedness into GVCs.

The paper is organized as follows. Section 2 presents the two income-related indexes to measure the degree of insertion of a country into GVCs and the calculations made for each of the OE countries with the first release of the WIOD database. Section 3 analyzes, for the period 2002-2011, whether the degree of insertion of a country into GVCs, measured with the two proposed indicators, promotes FDI inflows, by considering the bilateral relations of the OE countries and other FDI determinants usually found in the literature. Section 4 concludes.

2. MEASURING THE IMPACT OF GLOBAL VALUE CHAINS FOR OE COUNTRIES

Many indicators have been proposed in literature to capture the degree of insertion of a country into GVCs, such as 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, 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.

In this section, we propose two income-related indicators that help measuring the impact for a given country of having economic activity that is inserted into GVCs and use the WIOD database (first release) for this purpose. Namely, we propose an “Income measure of a country’s embeddedness into GVCs” (GVC embeddedness, in short) and an “Income measure of a country’s net gains from participating in GVCs” (GVC net gains, in short). The basic information used to build these indicators is the income involved in the production of the inputs (parts and components) exported and imported by the country under study, i.e. flows of “transferred” income. We either add both of these “flows” of income, as in the case of the “GVC embeddedness” indicator, or subtract them, as in the case of the “GVC net gains” indicator.

⁵ With regard to indirect effects, see, for instance, Crespo and Fontoura (2007).

In relation to the previously-used indicators mentioned above, the ones that we propose have several advantages, which are made possible by using an internationally-linked IO database⁶. Firstly, we consider two approaches (downstream and upstream), while those referred above merely cover a downstream approach. While the downstream approach (also known as supplier’s approach) only provides a partial idea of how inserted into GVCs is a given economy by informing about foreign production that is incorporated as inputs into its production, the upstream approach (also known as user’s approach) provides the other partial information missing by using the inputs of that given economy used in the production processes of other countries. Secondly, the indicators proposed are based on the actual use of the goods and services as inputs in the production process and not in their classification as intermediate or final goods or services, as it is the case of the referred previous indexes. Thirdly, we estimate income “transfers” between countries to assess GVC participation, instead of assessing it by means of trade flows. The advantage of considering income is to directly capture the ultimate goal of economy activity associated with fragmented production.

a. The GVC embeddedness measure

The first measure proposed (EMBICO), according to Index 1 below, is an income measure of GVC embeddedness for country *i* based on the sum of the income appropriated by country *i* due to the use by foreign countries of country *i*’s inputs (GAININCO) and the income appropriated by foreign countries due to the use by country *i* of foreign inputs (LOSTINCO). In Index 1, *i* refers to a given country, *j* to foreign country, and OUTPUT is the total value of the domestic production of country *i* at basic prices⁷.

INDEX 1

THE GVC EMBEDDEDNESS MEASURE

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

The results of the application of Index 1 are presented in Table 1 for the year 2011. Luxembourg is the economy (within the set of 40 countries assessed here) more embedded in GVCs. The total income arising from participation of Luxembourg in GVCs equals almost 87% of the total output of this economy. Other countries where that amount represents at least half of their domestic output are Ireland (58%) and Hungary (53%).

TABLE 1

The GVC embeddedness measure (2011)

⁶ For a comprehensive explanation of the basic structure of an IO table, also known as supply and use table, see Wixted *et al.* (2006).

⁷ 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).

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%
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%
USA	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, 1st release.

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

b. The GVC net gains measure

The second measure proposed (GOODINCO), according to Index 2 below, is an income measure of net gains of country *i* from participating in GVCs based on the difference between the income appropriated by country *i* due to the use by foreign countries of country *i*'s inputs (GAININCO) and the income appropriated by foreign countries due to the use by country *i* of foreign inputs (LOSTINCO). In Index 2, *i* refers to a given country *i*, *j* to foreign country, and OUTPUT is the total value of the domestic production of country *i* at basic prices.

INDEX 2 THE GVC NET GAINS MEASURE

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

The results are shown in Table 2 below for the year 2011. Russia appears as the economy (of the set of 40 countries assessed here) with the highest net gains obtained from participating in GVCs. In 2011, total exports of Russian 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, which means an annual net gain sum of USD 310 billion. 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 partners⁸. Apart from Russia, Luxembourg and Taiwan are the most benefitted economies 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 benefitted country (USD 435 billion. On the opposite side of the spectrum, Greece and India emerge as the less benefitted countries in absolute terms while in relative terms the negative net gains amounted to 3.6% and 1.7% of total domestic output, respectively.

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 and employment.

TABLE 2
The GVC net gains measure (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%

⁸ Russian petroleum and gas was the main input in the case of Lithuania, Bulgaria, Finland, Italy and Greece in 2011, accounting for 7%, 3%, 2%, 1% and 1% of those countries' total output, respectively.

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%
USA	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, 1st release.

Of course, these indicators can be replicated for pairs of countries, as illustrated in Table A-2 in the Appendix for Portugal.

3. THE LINK BETWEEN GLOBAL VALUE CHAINS AND THE FOREIGN DIRECT INVESTMENT

In this section, we test the impact on the bilateral FDI stocks between OE members of the two income-related indexes above proposed in a pooled-regression model for the period 2002-2011 inspired by literature on FDI determinants. We use the 37 countries of the WIOD database that are also covered by OECD (2015) database⁹ for outward bilateral FDI stock.

A vast empirical literature has been developed determining the factors attracting FDI, most of them making use of cross-country regressions (see, for instance, Chakrabarti, 2001, Onyeiwu, 2003, and Jabri *et al.*, 2013). We will run a pooled-regression model explaining bilateral FDI stocks between countries in the period from 2002 to 2011 making use of explanatory variables usually found in the literature to empirically explain FDI inflows plus the two income-related indexes EMBINCO and GOODINCO (calculated at bilateral level). The equation to be estimated is presented in Index 3 below.

INDEX 3

POOLED-REGRESSION MODEL FOR BILATERAL FDI STOCKS

$$\begin{aligned}
 FDI_{i,j}^t = & \alpha + \beta_1. GDPpc_i^t + \beta_2. GDPpc_j^t + \beta_3. GDP_i^t + \beta_4. GDP_j^t + \\
 & + \beta_5. OPENESS_i^t + \beta_6. OPENESS_j^t + \beta_7. DIST_{i,j} + \beta_8. CONTIG_{i,j} + \beta_9. COMLANG_OFF_{i,j} + \\
 & + \beta_{10}. COLONY_{i,j} + \beta_{11}. OFFSHORE_{i,j} + \beta_{12}. EMBINCO_{i,j}^t + \beta_{13}. GOODINCO_{i,j}^t + \\
 & + \beta_{14-23}. YEAR_DUMMIES_2002to2011 + \beta_{24-60}. COUNTRY_DUMMIES + e_{i,j}^t
 \end{aligned}$$

The variables included in the model are as follows.

Dependent variable

⁹ This means that Latvia, Lithuania, and Taiwan included in previous section are excluded in this part of the study.

$FDI_{i,j}^t$ is the outward bilateral FDI stock in year t from country j to country i , at current prices, in million US dollars; t ranges from 2002 to 2011. It makes use of the third 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 and data was retrieved 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, 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, 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 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.

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, in US dollars. Exports are imports are retrieved from World Bank (2015b) and complemented with data of The Observatory of Economic Complexity (2016).

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:

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)¹⁰, in kilometers, retrieved from Mayer and Zignago (2011)¹¹.

5. $CONTIG_{i,j}$ 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).

6. $COMLANG_OFF_{i,j}$ is a dummy variable indicating whether the two countries share the same official language, retrieved 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 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*, one can assume that

¹⁰ «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).

¹¹ 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.

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 $DIST_{i,j}$, 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 investment costs.

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 center¹², following IMF (2000). 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, British Virgin Islands, Mauritius and Cyprus are, in this order, the largest foreign direct investors in PRC, India and Russia. 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 two income-related GVC indexes above proposed:

9. $EMBINCO_{i,j}^t$ is the GVC embeddedness measure defined in the previous section. This variable is expected to be positively related to the stock of FDI for economies well inserted into GVCs, as it is the case of most countries considered in this study.

10. $GOODINCO_{i,j}^t$ is the GVC net gains measure defined in the previous section¹³. If this variable is significant, one can expect a positive sign assuming that foreign investors will consider larger net "transfers" of income due to GVC participation as a proxy for less macroeconomic adjustments in the future.

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

11. $YEAR_DUMMIES_{2002to2011}^t$ are 10 time-specific dummy variables indicating the year t, ranging from 2002 to 2011; and

12. $COUNTRY_DUMMIES_i$ and $COUNTRY_DUMMIES_j$ are 37 country-specific dummy variables indicating that a given country is origin (i) or

¹² It is the case of Cyprus, Ireland, Luxembourg and Malta. The only official list of "Offshore Financial Centre" by the IMF dates back to 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.

¹³ Correlation between EMBINCO and GOODINCO for the set of data analyzed is 27.4%.

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) $TGDP_{i,j}^t$, defined as the joint market size equalling $(GDP_i^t + GDP_j^t)$, and (v) one of the countries being subject to main international sanctions.

Finally, $e_{i,j}^t$ 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)¹⁴. 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 $e_{i,j}^t$ in Index 3 above can be written as $e_{i,j}^t = \alpha_i + \alpha_j + \mu^t + v_{i,j}^t$, with the $v_{i,j}^t$ zero mean, constant variance shocks uncorrelated across time and countries, the μ^t being the unknown individual effects to be estimated for each year, and α_i and α_j 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 α_i 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 parameters¹⁵. In any case, we performed a Hausman test, which indicated that both the fixed and the random effects models can be used. Under the fixed effects assumption, Index 3 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 (Table 3).

TABLE 3

Results of a pooled regression model to estimate the determinants of bilateral FDI stock with the GVC-related indicators in the period 2002-2011

- Descriptive statistics -

¹⁴ 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.

¹⁵ See Baltagi (2013).

Variable	Obs	Mean	Std. Dev.	Min	Max
FDI	13320	10868.86	36058.90	0	645098
GDPpcj		30054.50	19005.25	486.6405	113731.7
GDPpci		27874.25	19398.5	486.6405	113731.7
GDPj		1.43e+12	2.63e+12	4.30e+09	1.62e+13
GDPi		1.36e+12	2.54e+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
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
EMBINCO		.395248	7.498547	9.59e-06	240.3026
GOODINCO		.182547	4.813666	-1.688337	146.4376

- Econometric results-

Source	SS	df	MS	Number of obs =	13320
Model	6.2321e+12	61	3.4798e+11	F(61, 13258) =	434.37
Residual	9.1487e+12	13258	844999257	Prob > F =	0.0000
Total	1.5313e+13	13319	1.3894e+09	R-squared =	0.4979
				Adj R-squared =	0.4915
				Root MSE =	27155
				LR Chi ² =	32119.67
				Prob Chi ² > X =	0.0000

FDI	Coef.	Std. Err.	t	P> t	[95% Conf. Interval]	
CONST	-10531.57	865.8559	-11.60	0.000	-8878.99	-12254.84
GDPpcj	0.2855884	0.015576	18.51	0.000	.2543525	.3151514
GDPpci	0.209845	0.0153361	12.87	0.000	.1695457	.2311565
GDPj	2.63e-09	1.19e-10	21.16	0.000	2.61e-09	2.65e-09
GDPi	2.02e-09	1.24e-10	15.99	0.000	2.00e-09	2.05e-09
OPENNESSi	979.9859	25.8758	34.98	0.000	928.1101	1031.005
OPENNESSj	814.0902	20.4407	31.19	0.000	780.102	836.2584
DIST	-6255714	0.0681551	-11.43	0.000	-.7422501	-.5022456
CONTIG	11605.42	1315.408	8.87	0.000	8966.053	14319.77
COMLANG_OFF	27945.47	1801.103	15.77	0.000	24301.59	32001.14
COLONY	14657.56	1339.041	10.03	0.000	12140.32	17512.13
OFFSHORE	1551.15	731.2202	1.86	0.056	-90.0021	3122.1047
EMBINCO	5.19e-06	9.59e-07	5.43	0.000	4.89e-06	5.43e-06
GOODINCO	-6.01e-07	8.19e-07	-0.87	0.489	-23.21e-07	10.71e-07
Y2008	-2005.998	400.4531	-4.97	0.000	-2933.232	-1234.954
Y2009	-2304.774	405.5475	-5.14	0.000	-3148.4301	-1493.0041
Y2010	-992.3201	487.8811	-2.60	0.022	-1896.4457	-101.6564
Y2011	-1675.042	426.5047	-3.43	0.000	-2487.0347	-777.0623
PRC	6001.047	2615.554	3.70	0.000	1403.888	12341.491

Source: Authors estimations by making use of a pooled OLS regression, as explained above. Apart from the explanatory variable GOODINCO, only statistically significant explanatory variables are presented in the table.

The model is statistically significant and it explains around 50% 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 4 below.

TABLE 4

Expected and observed signs 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

*+ 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 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 FDI¹⁶.

Second, the EMBINCO variable, defined as the income measure of country embeddedness in GVCs, is significantly positive. *Ceteris paribus*, we concluded that the higher the total income "transferred" between two given countries by GVCs, the higher the FDI flows between those two countries. 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 this EMBINCO variable to be a proxy for openness but a particular one, openness (country embeddedness) to GVCs.

Third, the GOODINCO variable, defined as the income measure of net gains from a country's participation in GVCs, is not statistically significant. It means that we find no statistical relationship between net gains of "transferred" income between two given countries and the size of the bilateral FDI stock.

Fourth, 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.

Fifth, there is only one country dummy variable introduced in the model that is statistically significant: PRC. The explanation for this result must be due to the dimension

¹⁶ 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-workshop-on-foreign-direct-investment-and-global-value-chains-19-october-2015-paris.htm>).

of the PRC economy and its economic growth, in a period characterized by openness of this country to the world economy, in part led by FDI inflows.

4. 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 build two indicators for measuring the degree of participation and the net gains of OE countries by joining GVCs in terms of “transferred” income.

As we pointed out, relatively to the indicators usually found in the literature to capture the degree of GVC insertion, those proposed in this study have the advantage of covering both the downstream and the upstream approaches, instead of using exclusively the former; of being 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; and of considering income “transfers” instead of trade flows.

We also used the proposed indicators in a regression to explain FDI bilateral inflows of OE countries. With respect to the first of these new measures, it is statistically significant in explaining the bilateral FDI stock, meaning that the higher the total income “transferred” between two given countries by GVCs, taken as a proxy to the participation of those countries in GVCs, the higher the bilateral FDI inflows. We did not detect a statistical correlation between the GVC-associated net gains and FDI inflows, which means that this macroeconomic information is not relevant for investment decisions, which is to be expected first of all because of the opacity of this information. 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 limitations may be pointed out in this study, namely: (i) the narrow number of countries included in the WIOD, despite representing nearly 82% of the world's GDP in 2011; (ii) trade in value-added being an estimate based on a number of assumptions, rather than a measurement, as mentioned by Escaith and Timmer (2012)¹⁷; (iii) the fact that IO databases published so far do not consider at least second-round effects in the use of intermediates by GVCs, i.e. the inputs used in the production of the inputs (which can also be in fact third, fourth, fifth and so on -round effects); and (v) the OECD’s broad definition of FDI.

Finally, several avenues for further research stem from this study, such as to individualize each one of the three regional value “ladders”¹⁸ identified by OECD *et al.* (2014), namely Southeast Asia, North America and Central Europe, carrying out separate estimates for each one of these regions to capture their differences; to deepen the study of the relationship between GVC and FDI, for instance, by separating the downstream approach from the upstream one and including GVC indicators based on trade flows; and, more ambitious, to build more robust international IO databases.

¹⁷ 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 interpolations. 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.

¹⁸ OECD *et al.* (2014) defends that there is not such a thing as GVCs, but three different regional value “ladders” that work independently. The term “ladder” is used in the sense that the disaggregation of production into separate stages allows the firms involved not only to find their place on the “ladder”, but to move up the rungs as their capabilities improve.

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APPENDIX

TABLE A-1

Comparative listing of scope and reach of internationally-linked IO databases

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 and 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 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.

TABLE A-2

The GVC net gains in the case of 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%

USA	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	-

* OUTPUT was replaced by GAININCO, aiming a change in scale that avoids ending up with too small numbers.

Source: Authors estimations based on WIOD, 1st release.