The multiplicative impacts of Argentina, Brazil, Colombia, Costa Rica, Chile, Mexico, and Peru on the intra-industry trade in manufactures, 1995-2011

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Abstract

The objective of this work is to measure the *backward*, *forward*, and *total* multiplicative impacts of Argentina, Brazil, Colombia, Costa Rica, Chile, Mexico, and Peru on the Global Value Chains of manufacturing exports. By viewing the intra-industry trade in manufactures as an input-output system, we measure their multiplicative impacts from 1995 to 2011. Our results show that the multiplicative impacts of these Latin American countries are very weak. The reason is that the backward multiplicative impacts are bigger than the forward multiplicative impacts; in this sense, the quality level of their manufacturing exports is low.

JEL Classification: C67, F02, F14, L14, R15

Keywords: global value chains; multiplicative impacts; value-added; input-output system; manufacturing exports

1. Introduction

In the past few decades, the international fragmentation of production processes in some sectors (most prominently in manufacturing industries) has evolved rapidly. In 1995, manufacturing exports represented 60.5 percent of the total world exports; meanwhile, in 2011, signified 56.1 percent (OECD/WTO, 2017). The multiplicative impacts of manufacturing exports are stronger than other sector's: Its *direct* and *indirect* production processes increase the demand for raw materials, energy, construction, and services from a broad array of supplying industries (Manufacturing Institute et al., 2012).

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Kaldor (1968) explains why the manufacturing industry is the growth's engine and how it creates positive externalities in the economy. Other authors, such as Chenery (1980) and Haussmann *et al.* (2006), assert that manufacturing exports are the key elements of a country's economic development process. The higher the domestic value-added in manufacturing exports, the higher the export sector's share of national income. Exports of manufactured goods can lead to a greater expansion of the domestic market, and those exports can encourage growth both as a direct expansion of aggregate demand as well as through their multiplicative impacts on domestic demand.

The multiplicative impacts on the Global Value Chains (GVC) of intra-industry trade in manufactures is the notion that any variation in the world demand for manufacturing exports of individual countries has (direct and indirect) forward and backward impacts: Initially, if there is an exogenous increase in world demand for a particular manufactured good, we can assume that there will be an increase in the production of that product, as countries react to meet the increased demand: The initial effect creates a direct effect in first impacted countries by changing their domestic and foreign value-added demand for manufacturing exports. Then, the value-added suppliers of these countries must change their own domestic and foreign value-added demand for manufacturing, and so on down the GVC of manufacturing exports: These are the indirect (recursive) multiplicative impacts.

The total (direct and indirect) multiplicative impacts can be classified as *backward* and *forward* multiplicative impacts, which involve the flow of intermediate manufactured goods that some countries transform into final manufactured goods or in more sophisticated intermediate manufactured goods (Ferrarini, 2013; Gereffi and Fernandez-Stark, 2011; Ferrarini, 2011; Maurer and Degain, 2010; Koopman *et al.*, 2010; Gereffi and Sturgeon, 2009; and Hummels *et al.*, 2001).

The objective of this work is to measure the backward, forward, and total multiplicative impacts of Argentina, Brazil, Colombia, Costa Rica, Chile, Mexico, and Peru on the GVC of manufacturing exports. The paper is structured as follows. Section 2 is a detailed breakdown of the chosen method. Section 3 presents the findings of our research. The final section

discusses the main conclusions of our study and suggests further research on this subject. Data is provided by the Trade in Value Added (TiVA) database (OECD/WTO, 2017).

2. Methods

By viewing the intra-industry trade in manufactures as an *input-output system* is possible to measure the backward, forward, and total multiplicative impacts of a given country on the GVC of manufacturing exports.

2.1. Measuring the backward, forward, and total multiplicative impacts

Manufacturing exports are equal to Food products, beverages and tobacco + Textiles, textile products, leather and footwear + Wood, paper, paper products, printing and publishing + Chemicals and non-metallic mineral products + Basic metals and fabricated metal products + Machinery and equipment + Electrical and optical equipment, nec + Transport equipment + Manufacturing nec; recycling. Table 1 displays the intra-industry trade flows among countries through an Intercountry Input-Output table. We represent these transactions in terms of value-added (VA): Some countries export VA while others import it; thus, the element z_{ij} is the VA imported by country j from country i to export x_j^m .

Table 1. The intra-industry trade of manufactures

		Destination country						Destination of VA embodied in x^m		Exports
		p_1	p_2	…	p_j	…	p_n	To produce world's exports of manufactures	For other uses	
Origin country	p_1	0	z_{12}	…	z_{1j}	…	z_{1n}	v_1^m	w_1^m	x_1^m
	p_2	z_{21}	0	…	z_{2j}	…	z_{2n}	v_2^m	w_2^m	x_2^m
	⋮	⋮	⋮	⋱	⋮		⋮	⋮	⋮	⋮
	p_i	z_{i1}	z_{i2}	…	0	…	z_{in}	v_i^m	w_i^m	x_i^m
	⋮	⋮	⋮		⋮	⋱	⋮	⋮	⋮	⋮
	p_n	z_{n1}	z_{n2}	…	z_{nj}	…	0	v_n^m	w_n^m	x_n^m
Origin of VA embodied in x^m	Foreign	f_1^m	f_2^m	…	f_j^m	…	f_n^m			
	Domestic	d_1^m	d_2^m	…	d_j^m	…	d_n^m			
Exports		x_1^m	x_2^m	…	x_j^m	…	x_n^m			

Reading by columns, the intra-industry *origin* of the VA embodied in manufacturing exports of country *j* is domestic (d_j^m) and/or foreign (f_j^m):

$$x_j^m = d_j^m + f_j^m \quad (1)$$

Total foreign VA embodied in x_j^m is equal to $f_j^m = \sum_{i=1}^{n} z_{ij}$.

Reading by rows, the intra-industry *destination* of the VA embodied in manufacturing exports of county *i* is to produce the rest of world's manufacturing exports (v_i^m) and/or for other uses than producing the rest of the world exports of manufactures (w_i^m):

$$x_i^m = v_i^m + w_i^m \quad (2)$$

Total VA from country *i* embodied into the rest of the world's exports of manufactures is equal to $v_i^m = \sum_{j=1}^{n} z_{ij}$.

Table 1 shows that world production of manufacturing exports is a complex, integrated, and recurring system of intra-industry exchanges of VA in which all countries play a double role: They both supply VA that the rest of the world embodies in its manufacturing exports, and demand VA from the rest of the world to complement domestic VA in producing their manufacturing exports. All VA supplied and demanded comes from within this intra-industry system; therefore, a global equilibrium exists:$\sum_{j=1}^{n} f_j^m + \sum_{j=1}^{n} d_j^m = \sum_{i=1}^{n} v_i^m + \sum_{i=1}^{n} w_i^m$. This equilibrium implies that the sum of all VA that countries import from the rest of the world must equal the sum of all VA that they export, $\sum_{j=1}^{n} f_j^m = \sum_{i=1}^{n} v_i^m$, even though this equilibrium does not hold for every country; in other words, it is possible that $f_j^m \neq v_i^m$ when *i=j*.

Expressions (1) and (2) can be generalized as two systems of linear equations in which each equation shows how the exported and imported VA is *absorbed* (3) and *spread* (4), respectively:

$$\boldsymbol{x} = \boldsymbol{Z}\boldsymbol{i} + \boldsymbol{w} \quad (3)$$

$$\boldsymbol{x}^T = \boldsymbol{i}^T\boldsymbol{Z} + \boldsymbol{d}^T \quad (4)$$

where $\boldsymbol{Z} = \begin{bmatrix} 0 & z_{12} & \cdots & z_{1n} \\ z_{21} & 0 & \cdots & z_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ z_{n1} & z_{n2} & \cdots & 0 \end{bmatrix}$, $\boldsymbol{w} = \begin{bmatrix} w_1^m \\ \vdots \\ w_n^m \end{bmatrix}$, $\boldsymbol{d} = \begin{bmatrix} d_1^m \\ \vdots \\ d_n^m \end{bmatrix}$, $\boldsymbol{x} = \begin{bmatrix} x_1^m \\ \vdots \\ x_n^m \end{bmatrix}$, $\boldsymbol{i} = \begin{bmatrix} 1_1 \\ \vdots \\ 1_n \end{bmatrix}$, and *T* denote transposition.

Matrix **Z** is the core of the intra-industry VA exchanges. We can consider the elements of matrix **Z** to be fixed and constant proportions that describe the *composition* and *distribution* of the VA embodied in each country's manufacturing exports, respectively. Thus, we define:

$$a_{ij} = \frac{z_{ij}}{x_j^m} \quad (5)$$

$$b_{ij} = \frac{z_{ij}}{x_i^m} \quad (6)$$

Expression (5) shows the share of VA *by country of origin* required to produce x_j^m, while expression (6) shows the share of VA embodied in x_i^m that will be incorporated in manufacturing exports *by country of destination.* With (5) and (6), we can rewrite (3) and (4) as:

$$\boldsymbol{x} = \boldsymbol{A}\boldsymbol{x} + \boldsymbol{w} \quad (7)$$

$$\boldsymbol{x}^T = \boldsymbol{x}^T\boldsymbol{B} + \boldsymbol{d}^T \quad (8)$$

where $\boldsymbol{A} = \{a_{ij} | a_{ij} = 0, \forall i = j;\ \text{otherwise}\ a_{ij} \geq 0\}$ and $\boldsymbol{B} = \{b_{ij} | b_{ij} = 0, \forall i = j;\ \text{otherwise}\ b_{ij} \geq 0\}$. These *n*-order matrices represent the direct requirements of intra-industry VA: They show the amount of VA required from other countries to produce one unit of manufacturing exports in a given country.

If each country makes its manufacturing exports using a unique technology with fixed costs, then the columns of matrices **A** and **B** (taken as vectors) are linearly independent; therefore, they have bilateral inverses. By expanding (7) and (8) algebraically:

$$\boldsymbol{x} = \boldsymbol{L}^{-1}\boldsymbol{w} \quad (9)$$

$$\boldsymbol{x}^T = \boldsymbol{d}^T\boldsymbol{G}^{-1} \quad (10)$$

Where $\boldsymbol{L} = (\boldsymbol{I} - \boldsymbol{A})$ and $\boldsymbol{G} = (\boldsymbol{I} - \boldsymbol{B})$. Matrices $\boldsymbol{L}^{-1} = \{l_{ij} | l_{ij} \geq 1, \forall i = j;\ \text{otherwise}\ l_{ij} > 0\}$ and $\boldsymbol{G}^{-1} = \{g_{ij} | g_{ij} \geq 1, \forall i = j;\ \text{otherwise}\ g_{ij} > 0\}$ of constant coefficients describe the direct and indirect demand and supply of intra-industry VA as a function of **w** and **d**, respectively.

Based on $\mathbf{L}^{-1}$ and $\mathbf{G}^{-1}$, we propose three indicators to measure the relationship between an increase in world demand for manufacturing exports and the multiplicative impacts of a given country on the intra-industry trade in manufactures; these indicators allow a cross-country comparison.

$$\omega_i^- = \frac{\frac{1}{n}\left(\left(\sum_i l_{ij} - l_{ij}\right) \times \left(x_i / \sum_i x_i\right)\right)}{\frac{1}{n^2}\sum_j \left(\left(\sum_i l_{ij} - l_{ij}\right) \times \left(x_i / \sum_i x_i\right)\right)} \quad (11)$$

$$\omega_i^+ = \frac{\frac{1}{n}\left((\sum_j g_{ij} - g_{ij}) \times (x_i / \sum_i x_i)\right)}{\frac{1}{n^2}\sum_i \left((\sum_j g_{ij} - g_{ij}) \times (x_i / \sum_i x_i)\right)} \quad (12)$$

$$\omega_i = \frac{\frac{1}{n}\left((\sum_j g_{ij}) \times (x_i / \sum_i x_i)\right)}{\frac{1}{n^2}\sum_i \left((\sum_j g_{ij}) \times (x_i / \sum_i x_i)\right)} - \omega_i^- \quad (13)$$

Expression (11) measures the direct and indirect backward multiplicative impacts (dollars per unit) given a unit variation in w_j^m over x_i^m. In general terms, the matrix $\boldsymbol{L}^{-1} = \boldsymbol{I} + \boldsymbol{A} + \boldsymbol{A}^2 + \ldots + \boldsymbol{A}^n$ shows the direct (**A**) and indirect ($\boldsymbol{A}^2 + \boldsymbol{A}^3 + \ldots$) backward multiplicative impacts of all countries on the GVC of manufacturing exports, when $n \to \infty$.

Expression (12) measures the direct and indirect forward multiplicative impacts (dollars per unit) given a unit variation in d_j^m over x_i^m. In general terms, the matrix $\boldsymbol{G}^{-1} = \boldsymbol{I} + \boldsymbol{B} + \boldsymbol{B}^2 + \ldots + \boldsymbol{B}^n$ shows the direct (**B**) and indirect ($\boldsymbol{B}^2 + \boldsymbol{B}^3 + \ldots$) forward multiplicative impacts of all countries on the GVC of manufacturing exports.

Expression (13) measures the total multiplicative impacts of a given country on the intra-industry trade in manufactures. This indicator can be interpreted as the "gain" from participation in the GVC of manufacturing exports: it is the direct and indirect domestic VA from country *i* required by the rest of the world to satisfy the original dollar of new exports demand minus the direct and indirect foreign VA required by country *i* to satisfy the original dollar of new exports demand.

If ω_i^-, ω_i^+, and ω_i are > 1, it means that, compared to the other countries, a given country has above-average backward, forward, and total multiplicative impacts on the intra-industry trade in manufactures, respectively. It implies that a $1 spent on manufacturing exports of country *i* generates more dollars per unit than in the other countries

2.2. Typology of countries by multiplicative impacts

Based on the indicators of the backward and forward multiplicative impacts, we propose a typology of countries as shown in Table 2.

Table 2. Typology of countries by backward and forward multiplicative impacts

	$\omega_i^- \leq 1$	$\omega_i^- > 1$

$\omega_i^+ \leq 1$	Weak backward impacts Weak forward impacts	Strong backward impacts Weak forward impacts
$\omega_i^+ > 1$	Weak backward impacts Strong forward impacts	Strong backward impacts Strong forward impacts

The countries with weak backward multiplicative impacts and strong forward multiplicative impacts purchase final manufacturing goods and export intermediate manufacturing goods for further reprocessing and resale: They are the *initial* links of intra-industry trade chains of manufacturing exports. The countries with strong backward and forward multiplicative impacts purchase and exports intermediate manufacturing goods for further reprocessing and resale: They are the *intermediary* links of intra-industry trade chains of manufacturing exports The countries with strong backward multiplicative impacts and weak forward multiplicative impacts purchase intermediate manufacturing goods and export final manufacturing goods: They are the *final* links of intra-industry trade chains of manufacturing exports. The countries with weak backward and forward multiplicative impacts purchase and export essentially final manufacturing goods: They are the *isolated* links of intra-industry trade chains of manufacturing exports.

3. Results

The lack of recent data will likely require us to limit the scope of our empirical analysis, a fact that can be a significant obstacle in finding trends and relationships that can be fully interpreted in a theoretical economics framework; nevertheless, based on the Trade in Value Added (TiVA) database (OECD/WTO, 2017), we analyze the evolution of the intra-industry trade in manufactures between the years 1995 and 2011.

3.1. The backward, forward, and total multiplicative impacts

In Tables 3 we display the share of country's manufacturing exports in the world exports of manufactures between the years 1995 and 2011. In 1995, China (CHN), Germany (DEU), Japan (JPN), Korea (KOR), and the United States (USA) supplied 41.94 percent of the world exports of manufactures, while Argentina (ARG), Brazil (BRA), Colombia (COL), Costa

Rica (CRI), Chile (CHL), Mexico (MEX), and Peru (PER) supplied 3.42 percent; 16 years later, China, Germany, Japan, Korea, and the United States supplied 46.60 percent, whereas Argentina, Brazil, Colombia, Costa Rica, Chile, Mexico, and Peru supplied 4.87 percent of the world exports of manufactures. On average, China, Germany, Japan, Korea, and the United States supplied 43.27 percent of the world manufacturing trade, while Latin American countries 4.55 percent. Between the years 1995 and 2006, the United States had the highest participation in the world manufacturing trade. In 2007, China displaced the United States from the first place.

Table 3. The share of country's manufacturing exports in the world exports of manufactures

	CHN	USA	DEU	JPN	KOR	MEX	BRA	CHL	ARG	COL	PER	CRI
1995	2.63	13.98	12.04	10.20	3.10	1.71	0.87	0.33	0.29	0.09	0.08	0.06
1996	3.15	14.35	11.60	9.34	3.14	2.11	0.82	0.28	0.30	0.09	0.08	0.06
1997	3.82	15.49	10.73	9.09	3.22	2.37	0.89	0.29	0.34	0.10	0.09	0.07
1998	3.85	15.40	11.18	8.28	2.98	2.62	0.84	0.25	0.34	0.10	0.08	0.10
1999	3.91	15.28	10.58	8.79	3.23	2.91	0.78	0.25	0.28	0.10	0.08	0.15
2000	4.50	15.44	9.54	9.31	3.57	3.18	0.83	0.26	0.28	0.14	0.09	0.11
2001	5.04	14.77	10.45	7.87	3.23	3.20	0.89	0.28	0.33	0.15	0.10	0.09
2002	6.02	13.81	10.85	7.79	3.44	3.08	0.92	0.28	0.29	0.14	0.10	0.10
2003	6.99	12.17	11.57	7.76	3.69	2.59	0.93	0.25	0.33	0.13	0.10	0.09
2004	7.94	11.54	11.47	7.80	4.03	2.49	1.02	0.33	0.34	0.14	0.11	0.08
2005	9.18	11.34	11.25	7.68	4.09	2.50	1.12	0.38	0.35	0.15	0.13	0.08
2006	10.48	11.46	11.18	7.17	4.10	2.58	1.05	0.54	0.37	0.16	0.13	0.08
2007	11.00	10.92	11.81	6.75	4.05	2.38	1.06	0.53	0.37	0.17	0.12	0.08
2008	12.02	10.65	11.63	6.75	3.91	2.22	1.13	0.45	0.43	0.19	0.13	0.08
2009	12.65	11.49	10.49	6.18	4.31	2.23	1.08	0.52	0.45	0.18	0.13	0.08
2010	13.67	11.03	9.92	7.27	4.68	2.38	1.04	0.58	0.42	0.17	0.13	0.07
2011	14.16	10.85	10.38	6.53	4.68	2.40	1.05	0.57	0.45	0.18	0.15	0.07
Mean	7.71	12.94	10.98	7.91	3.73	2.53	0.96	0.37	0.35	0.14	0.11	0.09

Source: OECD/WTO database; authors' calculations

In Tables 4, 5, and 6 we display, respectively, the backward, forward, and total multiplicative impacts of countries on the intra-industry trade in manufactures between the years 1995 and 2011. On average, the backward multiplicative impacts of the United States show that for each dollar of extra manufacturing exports, the rest of the world generated $4.87; on the other hand, the forward multiplicative impacts show that for each dollar of the rest of the world's extra manufacturing exports, the United States generated $9.45 more than other countries. Finally, the total multiplicative impacts show that a $1 spent on manufacturing exports of the United States generated $9.44 more than other countries. On average, between the years 1995 and 2011, a $1 spent on manufacturing exports of the United States, China, Germany, Japan, and Korea generated more than one dollar per unit.

Compared to the other Latin American countries, the backward multiplicative impacts of Mexico show that for each dollar of extra manufacturing exports, the rest of the world generated $3.08; on the other hand, the forward multiplicative impacts show that for each dollar of the rest of the world's extra manufacturing exports, Mexico generated $0.72 more than the other Latin American countries. However, the total multiplicative impacts show that a $1 spent on manufacturing exports of Mexico generated $1.03. On average, between the years 1995 and 2011, a $1 spent on manufacturing exports of Argentina, Brazil, Colombia, Costa Rica, Chile, and Peru generated less than one dollar per unit.

Table 4. The backward multiplicative impacts, 1995-2011

	CHN	USA	DEU	JPN	KOR	MEX	BRA	CHL	ARG	COL	PER	CRI
1995	3.13	5.83	5.43	1.55	2.11	2.22	0.22	0.11	0.07	0.05	0.03	0.05
1996	3.66	5.85	5.25	1.60	2.26	2.76	0.22	0.12	0.08	0.05	0.03	0.05
1997	4.20	6.12	4.99	1.64	2.45	2.96	0.26	0.11	0.11	0.05	0.03	0.06
1998	4.34	5.92	5.17	1.41	2.13	3.31	0.26	0.11	0.11	0.05	0.03	0.11
1999	4.61	6.05	5.14	1.44	2.21	3.72	0.29	0.08	0.07	0.04	0.03	0.11
2000	5.02	6.05	4.74	1.60	2.36	3.93	0.28	0.06	0.07	0.06	0.03	0.09
2001	5.60	5.43	5.12	1.48	2.06	3.80	0.34	0.09	0.08	0.06	0.03	0.08
2002	7.02	4.96	5.00	1.56	2.22	3.80	0.35	0.07	0.09	0.06	0.03	0.10
2003	8.22	4.40	5.20	1.54	2.59	3.24	0.29	0.08	0.08	0.05	0.03	0.10
2004	8.73	4.15	5.17	1.64	2.77	3.13	0.29	0.09	0.10	0.05	0.04	0.07
2005	9.56	4.08	5.35	1.76	2.71	2.99	0.30	0.08	0.11	0.05	0.04	0.07

2006	9.98	4.16	5.59	1.87	2.69	2.99	0.28	0.09	0.11	0.06	0.05	0.08
2007	9.60	3.98	6.17	1.84	2.73	2.78	0.30	0.10	0.12	0.06	0.05	0.08
2008	9.30	4.19	6.25	1.99	3.14	2.55	0.38	0.12	0.15	0.07	0.05	0.08
2009	10.89	3.76	5.51	1.45	3.45	2.76	0.30	0.11	0.15	0.07	0.05	0.09
2010	11.37	3.90	4.97	1.75	3.60	2.85	0.30	0.13	0.14	0.06	0.05	0.08
2011	11.07	4.03	5.42	1.76	3.44	2.62	0.31	0.12	0.17	0.06	0.06	0.08
Mean	7.43	4.87	5.32	1.64	2.64	3.08	0.29	0.10	0.11	0.05	0.04	0.08

Source: OECD/WTO database; authors' calculations

Table 5. The forward multiplicative impacts, 1995-2011

	CHN	USA	DEU	JPN	KOR	MEX	BRA	CHL	ARG	COL	PER	CRI
1995	1.02	10.06	8.47	8.41	1.92	0.62	0.42	0.30	0.11	0.04	0.06	0.02
1996	1.19	10.60	8.07	7.92	2.08	0.74	0.39	0.24	0.11	0.04	0.07	0.02
1997	1.48	11.17	7.35	7.93	2.26	0.80	0.41	0.28	0.12	0.04	0.06	0.03
1998	1.50	11.46	7.62	7.41	2.11	0.80	0.40	0.24	0.12	0.04	0.06	0.04
1999	1.43	11.59	7.10	7.94	2.29	0.84	0.37	0.25	0.12	0.05	0.06	0.08
2000	1.69	11.68	6.39	8.57	2.47	0.87	0.41	0.27	0.13	0.07	0.06	0.06
2001	1.91	11.06	7.10	7.09	2.25	0.87	0.43	0.27	0.17	0.07	0.06	0.05
2002	2.24	10.46	7.33	7.08	2.57	0.77	0.47	0.28	0.16	0.07	0.06	0.05
2003	2.59	9.21	7.87	7.54	2.76	0.62	0.48	0.28	0.18	0.06	0.06	0.06
2004	3.10	8.70	7.82	7.57	3.01	0.58	0.53	0.40	0.17	0.06	0.07	0.05
2005	3.62	8.32	7.54	7.56	3.25	0.61	0.56	0.46	0.17	0.06	0.09	0.05
2006	4.33	8.16	7.36	7.01	3.30	0.64	0.54	0.72	0.16	0.07	0.10	0.06
2007	4.87	7.57	7.63	6.58	3.20	0.64	0.57	0.75	0.15	0.08	0.09	0.05
2008	5.82	7.34	7.47	6.41	2.85	0.65	0.69	0.57	0.17	0.09	0.11	0.04
2009	5.56	8.22	6.88	6.49	3.17	0.63	0.65	0.72	0.18	0.09	0.11	0.05
2010	5.95	7.73	6.54	7.28	3.43	0.70	0.63	0.80	0.18	0.08	0.12	0.04
2011	6.24	7.35	6.91	6.28	3.25	0.78	0.68	0.77	0.19	0.09	0.13	0.04
Mean	3.21	9.45	7.38	7.36	2.72	0.72	0.51	0.45	0.15	0.06	0.08	0.05

Source: OECD/WTO database; authors' calculations

Table 6. The total multiplicative impacts, 1995-2011

	CHN	USA	DEU	JPN	KOR	MEX	BRA	CHL	ARG	COL	PER	CRI
1995	1.25	9.84	8.34	7.92	1.94	0.77	0.60	0.25	0.19	0.05	0.05	0.03
1996	1.50	10.21	8.02	7.28	1.97	0.93	0.56	0.20	0.20	0.06	0.06	0.03
1997	1.85	11.06	7.39	7.18	2.02	1.05	0.60	0.22	0.22	0.06	0.06	0.04
1998	1.82	11.15	7.73	6.64	1.90	1.12	0.57	0.19	0.22	0.06	0.06	0.05
1999	1.77	11.09	7.24	7.10	2.08	1.20	0.51	0.20	0.19	0.07	0.06	0.09
2000	2.05	11.34	6.53	7.68	2.31	1.27	0.56	0.22	0.19	0.09	0.06	0.06
2001	2.32	10.87	7.19	6.40	2.11	1.33	0.59	0.23	0.23	0.10	0.07	0.05
2002	2.71	10.20	7.53	6.31	2.28	1.24	0.61	0.23	0.20	0.09	0.07	0.05
2003	3.08	9.02	8.10	6.46	2.40	1.00	0.64	0.21	0.23	0.08	0.07	0.05
2004	3.63	8.59	8.06	6.54	2.64	0.93	0.72	0.29	0.24	0.09	0.08	0.05
2005	4.31	8.41	7.82	6.46	2.76	0.96	0.78	0.34	0.24	0.10	0.09	0.05
2006	5.16	8.47	7.69	6.02	2.80	0.99	0.74	0.52	0.25	0.10	0.10	0.05
2007	5.73	8.03	8.02	5.67	2.72	0.92	0.76	0.52	0.24	0.11	0.09	0.04
2008	6.78	7.70	7.82	5.54	2.42	0.90	0.80	0.41	0.28	0.12	0.10	0.04
2009	6.80	8.49	7.08	5.21	2.69	0.89	0.77	0.48	0.30	0.12	0.10	0.04
2010	7.35	8.10	6.79	6.13	2.95	0.94	0.75	0.55	0.28	0.12	0.10	0.04
2011	7.78	7.88	7.08	5.42	2.94	1.03	0.77	0.54	0.29	0.12	0.11	0.04
Mean	3.88	9.44	7.55	6.47	2.41	1.03	0.67	0.33	0.24	0.09	0.08	0.05

Source: OECD/WTO database; authors' calculations

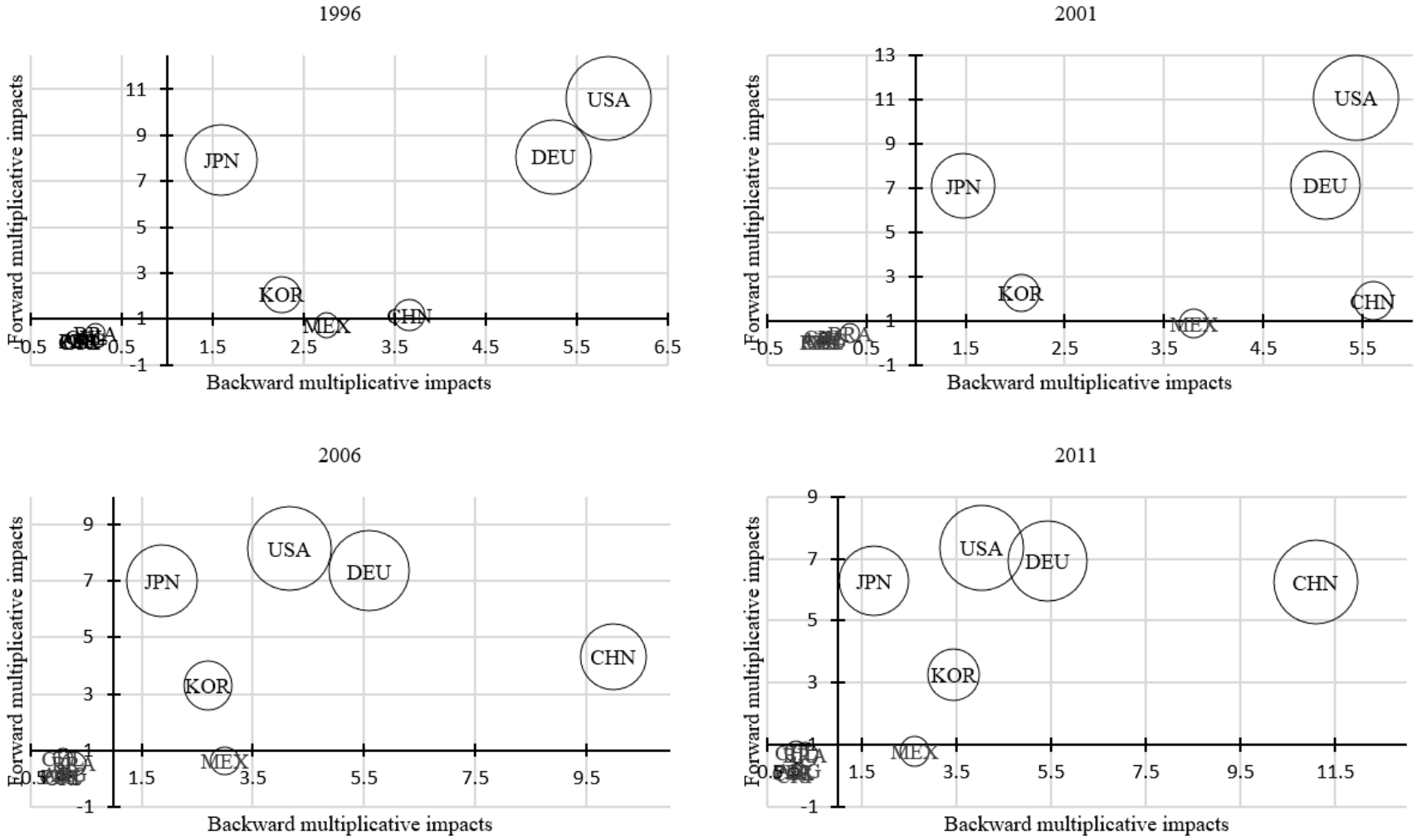
Starting in 1996, Figure 1 shows the typology of countries by backward and forward multiplicative impacts on the GVC of manufacturing exports every five years; the bubble size is proportional to the total multiplicative impacts.

China, Germany, Japan, Korea, and the United States comprised the intermediary-type group of countries because, compared to the others, these countries had above-average backward and forward multiplicative impacts; it implies that they purchased and exported intermediate manufacturing goods for further reprocessing and resale. They were the intermediary links of intra-industry trade chains of manufacturing exports.

Mexico was the only country in the final-type group of countries because, compared to the others, this country had above-average backward multiplicative impacts and below-average forward multiplicative impacts; it implies that Mexico purchased intermediate manufacturing goods and exported final manufacturing goods. This country was the final links of intra-industry trade chains of manufacturing exports.

Argentina, Brazil, Colombia, Costa Rica, Chile, and Peru comprised the isolated-type group of countries because, compared to the others, these countries had below-average backward and forward multiplicative impacts; it implies they purchased and exported essentially final manufacturing goods and services. They were the isolated links of intra-industry trade chains of manufacturing exports.

Figure 1. Typology of countries by backward and forward multiplicative impacts, 1996-2011



Source: OECD/WTO database; authors' calculations

4. Conclusions

The objective of this work was to measure the backward, forward, and total multiplicative impacts of Argentina, Brazil, Colombia, Costa Rica, Chile, Mexico, and Peru's manufacturing exports on the Global Value Chains of manufacturing exports. By viewing the intra-industry trade in manufactures as an input-output system, we provided three indicators that allowed a cross-country comparison.

Our results show that Argentina, Brazil, Colombia, Costa Rica, Chile, and Peru have very weak total multiplicative impacts on the Global Value Chains of manufacturing exports. The reason is that backward multiplicative impacts are bigger than forward multiplicative impacts; in this sense, the quality level of their manufacturing exports is low. In contrast, China, Germany, Japan, Korea, and the United States are the key countries of the intra-industry trade in manufactures because, among other factors, they have strong forward multiplicative impacts. On average, between the years 1995 and 2011, a $1 spent on manufacturing exports of these countries generated more than one dollar per unit.

Based on the typology of countries by backward and forward multiplicative impacts, the higher "gains" from participation in the Global Value Chains of manufacturing exports are found in the intermediary-type group of countries; it implies that the best way is to purchase and export intermediate manufacturing goods for further reprocessing and resale. For Latin American countries there are two possible ways to increase the domestic value-added embodied in manufacturing exports: The first one requires changing places in the Global Value Chains of manufacturing exports. Moving from areas where little value is added and developing production processes that add abundant value. The second option is to reduce the foreign value-added embodied in manufacturing exports by producing parts and components domestically. Yet for goods involved in the intra-industry trade in manufactures this option may have limited impact.

It seems that the starting point to increase the quantitative and qualitative impacts of Latin American countries' manufacturing exports on the intra-industry trade in manufactures is

developing its forward multiplicative impacts. The development of the intra-regional market could be an effective strategy to facilitate productive diversification (OECD/ECLAC/CAF, 2015) and international competitiveness. However, Latin American countries must develop interconnected and rigorous regulatory frameworks to reinforce regional integration and their response to the rest of world's trade strategies. But we must be careful: Economic benefits arising from participation in the Global Value Chains of manufacturing exports are not guaranteed because its distribution within each country is not equal. Furthermore, understanding how a country integrates into the intra-industry trade in manufactures requires more than just looking at relative participation rates (Kowalski et al., 2015). Structural and policy factors can influence the degree and type of integration into the Global Value Chains of manufacturing exports: market size, level of development, degree of industrialization, geographical location, regional trade tariffs and agreements, foreign direct investment openness, etc.

The study's limitations force us to proceed from describing a phenomenon we have observed to generalizing various aspects of it: Which key factors influence the backward and forward multiplicative impacts, and the strategy for enhancing Latin American countries' integration with the rest of the world. These pending issues are interesting suggestions for further research.

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