# Foreign affiliates position in global value chains and local sourcing in Chile: Evidence from plant-level panel data

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# 1. Introduction

- **Backward linkages** between foreign and local firms are the major source of **positive spillover effects of FDI** (e.g., demand for better inputs to satisfy the foreign firms and technological assistance that the foreign firms offer) in emerging countries (Jordaan et al., 2020; Murakami & Otsuka, 2020).
- However, **only a few studies have analysed the determinants of backward linkages**.

✓Several studies have analyzed these determinants using cross-sectional data.

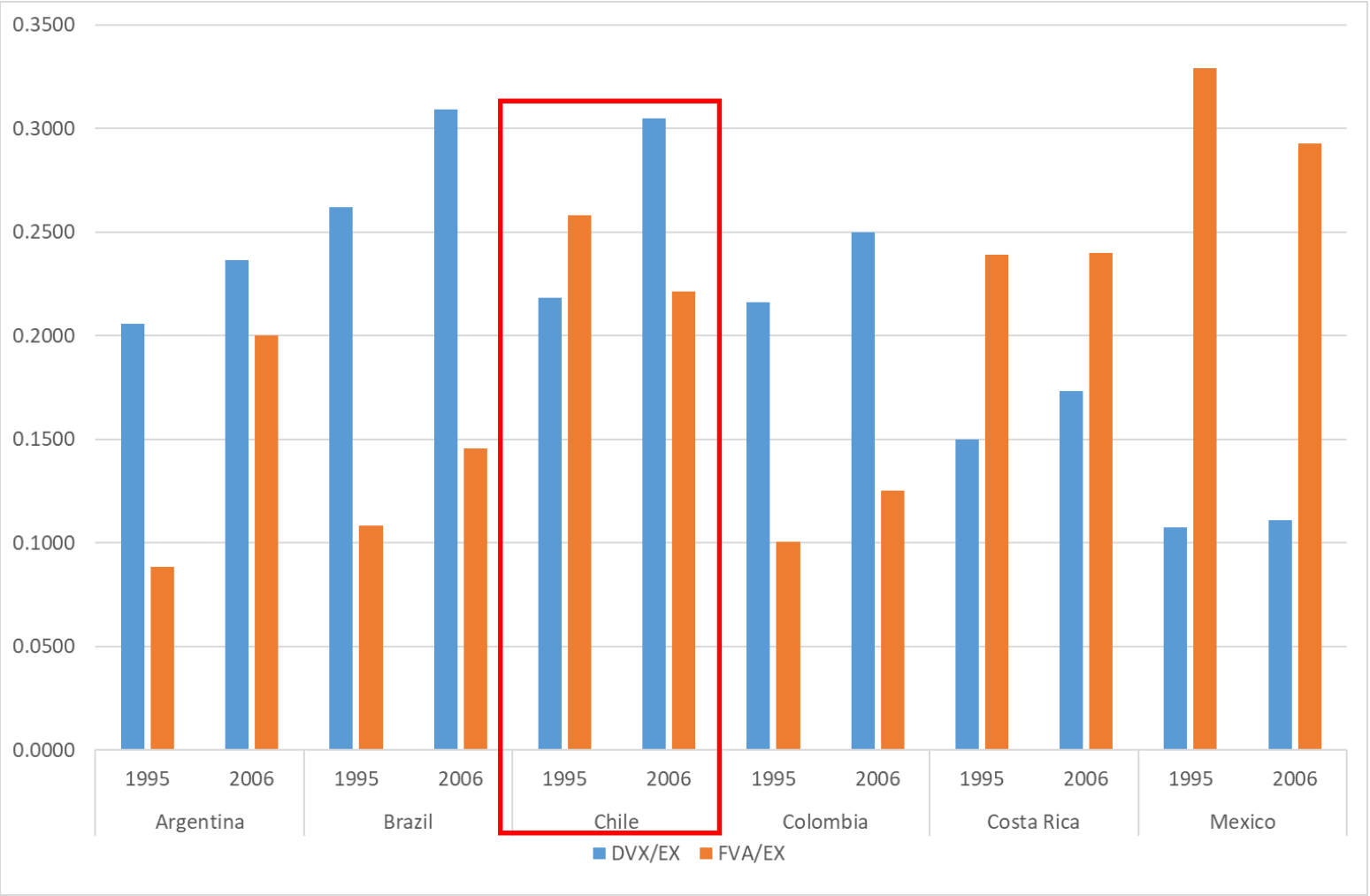
✓Very few studies have focused on a **specific emerging country** and used **panel data**.

- Previous studies commonly find that backward linkages are more likely to be established by affiliates characterized by **longer experience** in a host country, **local-market orientation** (horizontal FDI), **lower degree of foreign ownership** (joint ventures), and **higher level of autonomy** from their headquarters.
- By contrast, the effects of other affiliate characteristics such as firm size, productivity, and skill intensity are mixed.

- In the context of increased **international fragmentation of production processes**, Amendolagine et al. (2019) focus on the **positions** of foreign affiliates in **global value chains** (**GVCs**) as one of the significant determinants of local sourcing.
- They find that foreign affiliates involved in the **upstream** stages in GVCs (i.e., the production of intermediate inputs used by other countries for their exports) are more likely to provide technical assistance to local firms and source their inputs from them.

- Considered among the most successful Latin American countries (LACs) in terms of economic growth as well as far-reaching economic and institutional reforms, **Chile** is highly dependent on **natural resource exports** (typically, mining exports). The share of natural resource-based manufactures in total exports is quite high (Kuwayama, 2009).
- Thus, Chile is well-integrated into GVCs, although its position in GVCs is relatively **upstream**, mainly exporting raw materials and intermediate inputs (OECD, 2015, 2023, see figure).
- It has been pointed out that resource-seeking FDI, typically FDI in the mining sector, tends to have an enclave nature, which generates **very limited backward linkages to local firms** (Hirschman, 1958; Nunnenkamp & Spatz, 2004).
- Following this view, foreign affiliates operating in natural resource industries located upstream in GVCs are **less likely to source their inputs locally**.

# Figure: Positioning in GVCs of LACs including Chile

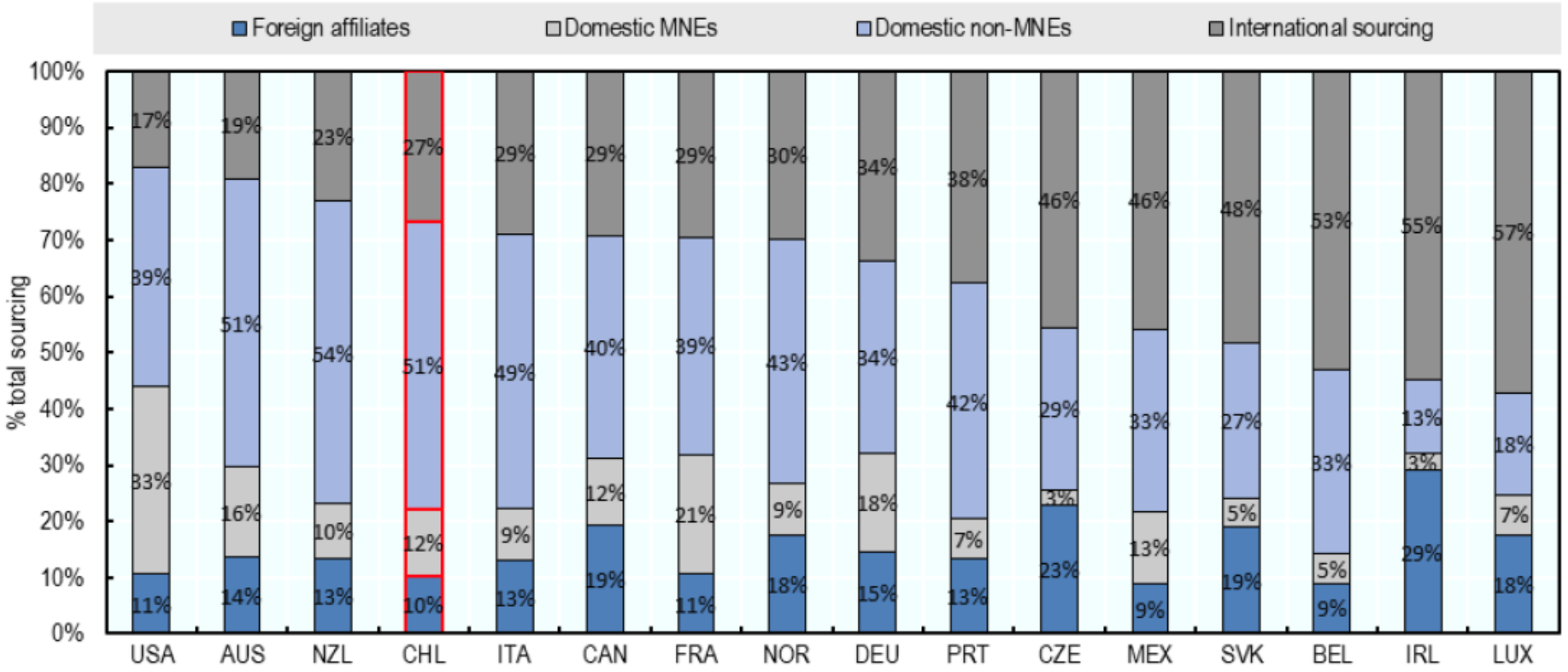



***DVX*** is forward participation index; ***FVA*** is backward participation index (Kowalski et al., 2015). **Upstreamness** is defined as the difference between DVX and FVA.

Source: Author's own calculations based on the data from UNCTAD-Eora Global Value Chain Database.

- Nevertheless, several studies show the **positive spillover effects of FDI** on the productivity of local manufacturing firms in Chile through backward linkages (Canavire-Bacarreza & Peñarrieta, 2021) and forward linkages from FDI in services (Fernandes & Paunov, 2012).
- OECD (2023) recently revealed that the **share of locally sourced inputs of foreign affiliates** in Chile is **higher** than that in other small open European Union countries.
- Kuwayama (2009) points out that primary and natural resource-based products in Chile are highly **differentiated** and generate **backward linkages** through the purchase of local inputs and engineering services.
- Therefore, in contrast to the traditional view, these findings suggest that foreign affiliates have developed **backward linkages** with local suppliers in Chile, even though they operate in **natural resources** and related manufacturing sectors located relatively **upstream** in GVCs.
- However, the determinants of vertical linkages are beyond the scope of these studies.

# Sourcing structure of foreign affiliates by country, 2016




Foreign firms in Chile purchased **73%** of total intermediate goods **locally** (51% from domestic firms).

Source: OECD (2023: 37) Figure 2.13

- Therefore, this study aims to empirically analyze whether **foreign affiliates' upstream positions** have positive effects on their **local sourcing** (defined as the share of local material inputs to total costs) in Chile.
- We consider that the GVC positions are exogenously determined by the **international fragmentation of production** for a given industry.
- For this purpose, we **match industry-level panel data**, including the **position in GVCs** sourced from the UNCTAD-Eora Global Value Chain Database, with unusually long **plant-level panel data** from the National Annual Manufacturing Survey (*Encuesta Nacional Industrial Anual*, ENIA) for the period from1995 to 2006.
- This study is the first to analyze **the determinants of local sourcing of foreign affiliates** in Chile, focusing on the **positions** of foreign affiliates in GVCs using plant-level panel data.

# 2. Empirical model

- Following Amendolagine et al. (2013) and Kiyota et al. (2008), we estimate foreign affiliates' demand for local material inputs using a translog cost function.
- We start with the following **total cost function** faced by a foreign affiliate *i* operating in industry *j* at time *t*:

(1) $C_{ijt}(\boldsymbol{P}_{ijt}, y_{ijt})$,

- where $\boldsymbol{P}_{ijt}$is a vector of factor prices and $y_{ijt}$ represents gross output of the affiliate. The gross output is produced by a set of factor inputs $n \in \{L, K, D, M\}$, where $L$ is labor, $K$ is capital stock, $D$ is local material inputs, $M$ is imported material inputs.
- The second-order Taylor's series approximation of the cost function in logarithms yields

(2) $\ln C_{ijt} = \beta_0 + \sum_{n\in N} \beta_n \ln p_{ijt}^n + \beta_y \ln y_{ijt} + \frac{1}{2}\sum_{n\in N}\sum_{m\in N} \beta_{nm} \ln p_{ijt}^n \ln p_{ijt}^m + \sum_{n\in N} \beta_{ny} \ln p_{ijt}^n \ln y_{ijt} + \frac{1}{2}\beta_{yy}(\ln y_{ijt})^2$,

- where the subscript of $\beta$ represents the partial derivatives of $\ln C_{ijt}^0$with respect to the price of subscript variable (e.g., $\beta_n = \frac{\partial \ln C_{ijt}^0}{\partial \ln p_{ijt}^n}$, $\beta_{nm} = \frac{\partial^2 \ln C_{ijt}^0}{\partial \ln p_{ijt}^n \partial \ln p_{ijt}^m}$), and $\beta_{nm} = \beta_{mn}$.

- Thus, differentiating Equation (1) with respect to $\ln p_{ijt}^{D}$ yields:

(3) $\frac{\partial \ln C_{ijt}}{\partial \ln p_{ijt}^{D}} = \beta_D + \beta_{DL}\ln p_{ijt}^{L} + \beta_{DK}\ln p_{ijt}^{K} + \beta_{DD}\ln p_{ijt}^{D} + \beta_{DM}\ln p_{ijt}^{M} + \beta_{Dy}\ln y_{ijt}.$

- Using Shephard's lemma, the **share of local material inputs to the total costs** $s_{ijt}^{D}$ becomes

(4) $s_{ijt}^{D} = \frac{p_{ijt}^{D} x_{ijt}^{D}}{C_{ijt}} = \frac{p_{ijt}^{D}}{C_{ijt}} \frac{\partial C_{ijt}}{\partial p_{ijt}^{D}} = \frac{\partial \ln C_{ijt}}{\partial \ln p_{ijt}^{D}}$ ,

where $x_{ijt}^{D}$ is the demand for local material inputs of the affiliate.

- Therefore, combining Equations (3) and (4) yields:

(5) $s_{ijt}^{D} = \beta_D + \beta_{DL}\ln p_{ijt}^{L} + \beta_{DK}\ln p_{ijt}^{K} + \beta_{DD}\ln p_{ijt}^{D} + \beta_{DM}\ln p_{ijt}^{M} + \beta_{Dy}\ln y_{ijt}.$

- Introducing regional dimension $r$ and adding the vector of GVC variables at industry $j$ in which the foreign affiliate $i$ is operating $\boldsymbol{GVC}_{jt}$, vector of other time-varying characteristics of the foreign affiliate $\boldsymbol{Z}_{ijt}$, time-varying regional fixed effects $\lambda_{rt}$, time-invariant industry fixed effects $\mu_j$, time-invariant affiliate fixed effects $\theta_i$, and the error term $\varepsilon_{ijrt}$, we obtain the following **empirical specification**:

$$(6) \quad s_{ijrt}^{D} = \beta_D + \beta_{DL}\ln p_{ijt}^{L} + \beta_{DK}\ln p_{ijt}^{K} + \beta_{DD}\ln p_{ijt}^{D} + \beta_{DM}\ln p_{ijt}^{M} + \beta_{Dy}\ln y_{ijt} + \boldsymbol{GVC}_{jt}'\boldsymbol{\gamma} + \boldsymbol{Z}_{ijt}'\boldsymbol{\delta} + \lambda_{rt} + \mu_j + \theta_i + \varepsilon_{ijrt}.$$

- We include the time-varying regional fixed effects (rather than region and year fixed effects separately) to control for time-varying region-level socioeconomic characteristics, including the availability of local suppliers.
- we include industry fixed effects in addition to plant fixed effects because about 15% of all plants in our full panel dataset changed their industry affiliations.

# 3. Data sources, variable definitions, and descriptive statistics
## *Data sources*

- We use **plant-level unbalanced panel data** for 1995-2006 from the ENIA.
- The survey covers all manufacturing plants with at least 10 employees and provides detailed plant-level detailed information on sales, employment, wages, input material and service expenditures, and fixed assets.
- These data have been used extensively in previous studies on production function estimation, international trade, and FDI.
- The plant-level panel data is available for the period 1995 to 2007.
- The ENIA survey 2007 reports the industrial classification only in international standard industrial classification (ISIC) Revision 3, which is not consistently matched with the classification of the GVC indicators.

- We calculate the industry-level GVC indicators for 1995 to 2006 from the UNCTAD-Eora Global Value Chain Database.
- Following Casella et al. (2019), we use the country/sector by country matrix and country by country/sector matrix for the calculation of $DVX_{jt}$ and $FVA_{jt}$, respectively.
- The database preserves **each country's national input-output (I-O) table in its native classification scheme**, the industry classification of the GVC indicators corresponds to Chilean I-O table for 1996.
- Based on the correspondence tables, we convert the **ISIC Revision 2** into the classification of the **1996 I-O table classification** (37 manufacturing sectors)

✓ISIC Revision 2 ➔I-O table for 1986➔I-O table for 1996

- We apply the 1996 I-O table classification to other industry-level variables and industry fixed effects.

# *Variable definitions*

- Share of local material inputs to the total costs : $s_{ijrt}^{D}$

✓ $s_{ijrt}^{D}$ is defined as the **local material inputs** (total material inputs less imported material inputs) divided by **total costs** (sum of the costs of **labor**, **capital**, and **total material inputs**).

✓The **labor costs** are defined as the **sum of annual real wages and bonus** (deflated by the national consumer price index (CPI)) for skilled and unskilled workers.

✓The **capital costs** are defined as the product of **total real capital stock** and **capital price**. The real capital stock is constructed for each of three types of capital (**buildings**, **machinery and equipment**, and **vehicles**) using the **perpetual inventory method**.

❖Following Fernandes and Paunov (2012), we assume that the depreciation rates of 3.0%, 7.0%, and 11.9% for buildings, machinery and equipment, and vehicles, respectively.

❖We winsorize the top 1% of the distribution of the calculated real capital stock of each capital and replace the negative values of the real capital stock with zero.

- Input prices: $p_{ijt}^{L}, p_{ijt}^{K}, p_{ijt}^{D}, p_{ijt}^{M}$

✓Following Petrin and Sivadasan (2013), the **price of labor** $p_{ijt}^{L}$, is defined as the **total labor cost** divided by the **number of skilled and unskilled workers**.

✓Based on the formula of the user cost of capital (Hall & Jorgenson, 1967), the **price of capital** $p_{ijt}^{K}$ is defined as follows:

(7) $p_{ijt}^{k} = p_{ijt}^{I}(r_t + \delta_{ijt})$,

✓where $p_{ijt}^{I}$ is the affiliate-specific **investment goods price deflator** defined as the average of the deflators for buildings, machinery and equipment, and vehicles weighted by the real capital stock of the each capital type; $r_t$ is the **real interest rate** defined as the lending interest rate minus annual change of CPI; and $\delta_{ijt}$ is the affiliate-specific **depreciation rate**.

❑As the affiliate-specific **prices of the local and imported material inputs** $p_{ijt}^{D}$ and $p_{ijt}^{M}$ are **not observable**, we use **industry-specific prices** $p_{jt}^{D}$ and $p_{jt}^{M}$.

✓ We calculate $p_{jt}^{D}$ by:

(8) $p_{jt}^{D} = \sum_k \alpha_{jk}^{D} \, p_{kt}^{DO}$ ,

✓ where $p_{kt}^{DO}$ is the **domestic wholesale price index** of industry *k*, $\alpha_{jk}^{D}$ is the **share of domestic inputs purchased from industry *k*** in the total domestic inputs of industry *j*. The domestic input share is based on the domestic input coefficient matrix of the Chilean I-O table for 1996.

✓ Regarding $p_{jt}^{M}$, the imported inputs prices need to be multiplied by (one plus) industry-level **input tariff rates** $\tau_{jt}$:

(9) $p_{jt}^{M} = (\sum_k \alpha_{jk}^{M} \, p_{kt}^{MO}) * (1 + \tau_{jt})$,

where $p_{kt}^{MO}$ is the wholesale price index of imported products of industry *k*, and $\alpha_{jk}^{M}$ is share of imported inputs purchased from industry *k* in the total imported inputs of industry *j*. The imported input share is based on the imported input coefficient matrix of the 1996 I-O table. The input tariff rate of industry *j* is calculated by:

(10) $\tau_{jt} = \sum_k \alpha_{jk}^{M} \tau_{kt}^{O}$,

where $\tau_{kt}^{O}$ is the **output tariff rates** of industry *k*, measured by the **effective tariff rates** on final goods.

❖Unlike previous studies, this study **appropriately measures all four input prices**.

- Gross output: $y_{ijt}$

✓ The gross output is **total real revenue** adjusted for inventory change. We use an industry output price deflator.

- GVC indicators: $\boldsymbol{GVC}_{jt}$

✓ Following Amendolagine et al. (2019) and Koopman et al. (2010), we define the **GVC position index** as follows:

(11) $GVCposition_{jt} = \ln(1 + DVX_{jt}) - \ln(1 + FVA_{jt}),$

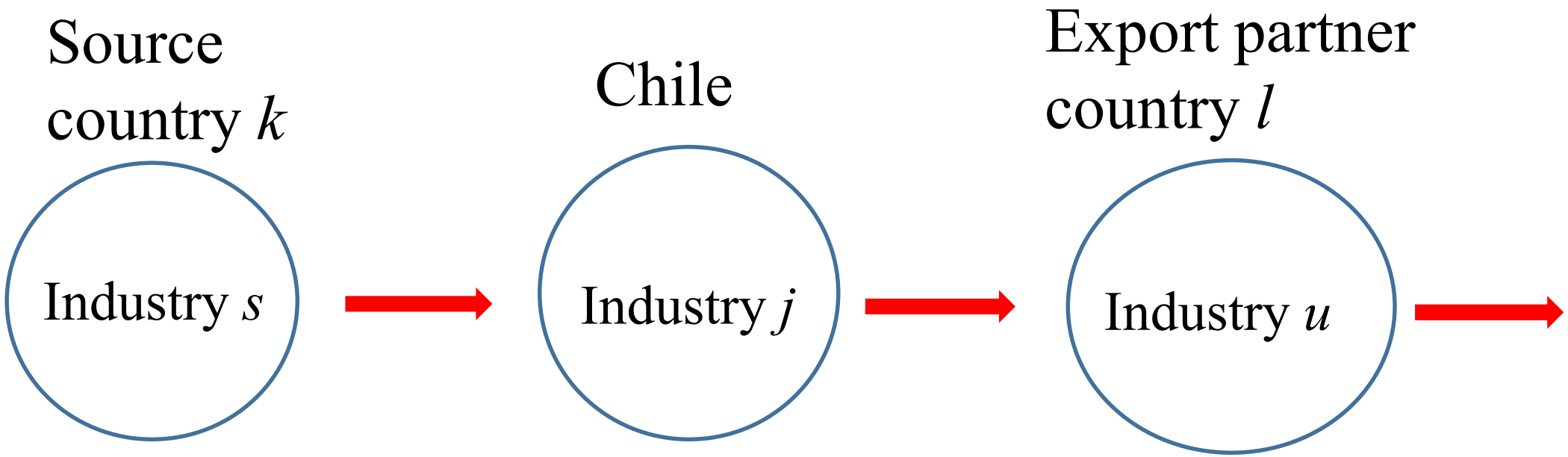
✓ where $DVX_{jt} = \frac{\Sigma_{ul} VA_{lt}^{uj}}{GrossExports_t}$ is the sum of **intermediate inputs supplied by the industry *j* (of Chile) that are used as intermediate inputs by industry *u* of Chile's export partner country *l* to produce the country's own exports to other countries**, divided by $GrossExports_t$, Chile's total exports; and $FVA_{jt} = \frac{\Sigma_{sk} VA_{kt}^{js}}{GrossExports_t}$ is the sum of **intermediate inputs supplied by sector *s* of source country *k* that are used by industry *j* (of Chile) for producing exports**, divided by $GrossExports_t$.

✓ We also define the **GVC participation index** as follows:

(12) $GVCparticilation_{jt} = DVX_{jt} + FVA_{jt}.$

✓ Following Amendolagine et al. (2019), we include interaction terms between the GVC indicators and the export share of foreign affiliates. Thus, the vector $\boldsymbol{GVC}_{jt}$ include at most four variables, depending on the specifications.

Note that GVCs are configured around a specific product/ industry.




$$\sum_{sk} VA_k^{js}$$

The sum of intermediate inputs supplied by sector $s$ of source country $k$ that are used by the industry $j$ (of Chile) for producing exports.

$$\sum_{ul} VA_l^{uj}$$

The sum of intermediate inputs supplied by the industry $j$ (of Chile) that are used as intermediate inputs by industry $u$ of Chile's export partner country $l$ to produce the country's own exports to other countries.

- Other foreign affiliate characteristics: $\boldsymbol{Z}_{ijt}$

✓Share of **export sales** to total sales (*Export*),

✓Share of **foreign-owned capital** to total capital (*Foreign*),

✓A dummy variable that equals 1 if the share of foreign-owned capital was 10% or more in the entry year (*Greenfield*),

✓**Years of operation** since the entry (*Years*),

✓Ratio of expenditures on **licenses and foreign technical assistance** to total sales (*License*),

✓Share of labor costs of **skilled workers** to total labor costs (*Skill*), and

✓Levinsohn–Petrin (Levinsohn and Petrin 2003) total factor productivity (*TFP*).

❖Following Ramondo (2009), we define the entry as the first year in which a plant appears in the dataset. As we do not have data prior 1995, we set the year of entry for all affiliates started their operation prior to 1995 at 1995.

## *Descriptive statistics*

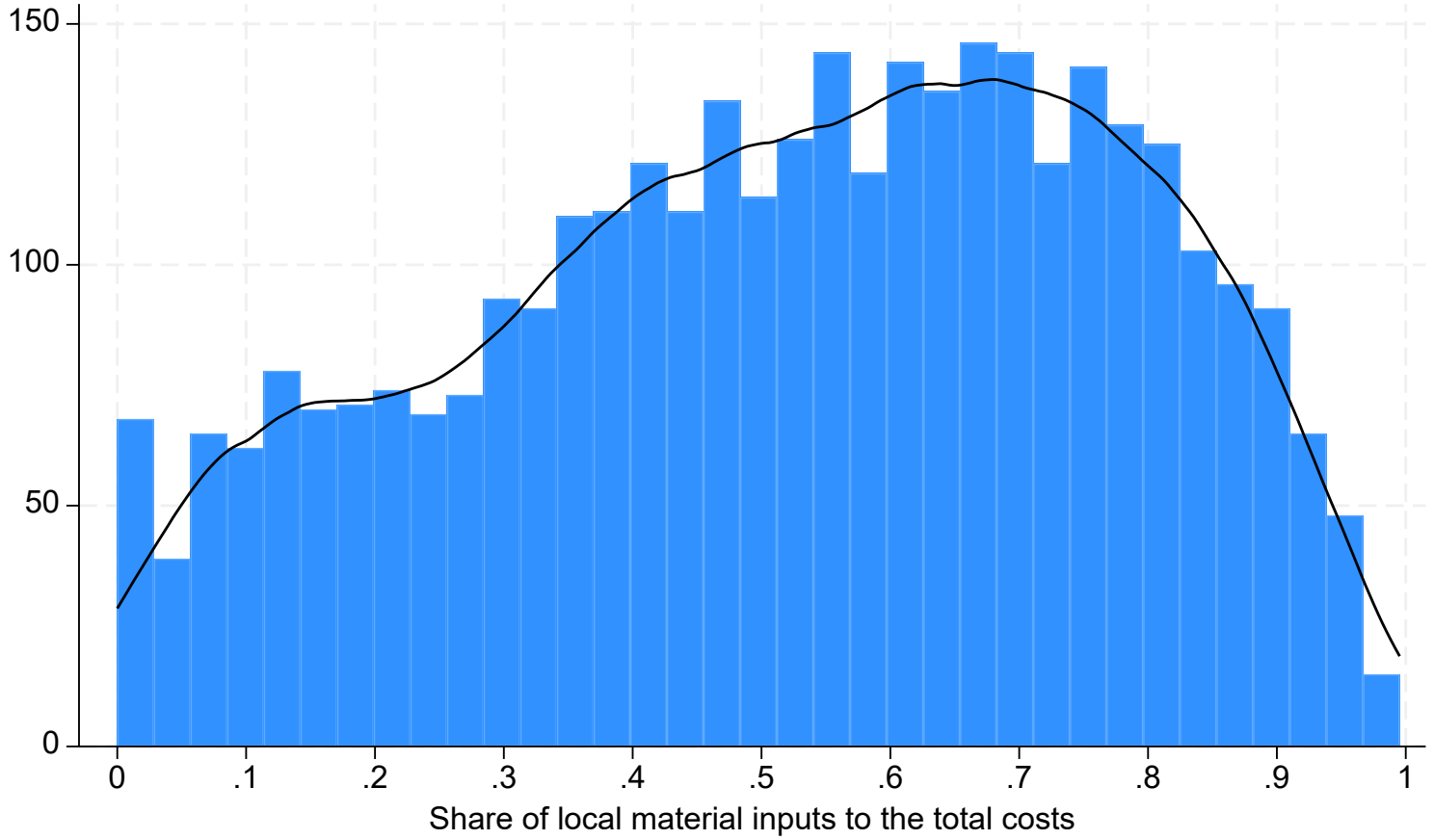
- The original panel dataset including local firms contains 65,182 plant-year observations.
- After applying minimum data-cleaning (excluding plants with zero and negative values for real gross output and zero values for real capital stock, total employment, and labor cost), we obtain **62,173** plant-year observations.
- We define plants with a share of foreign-owned capital of **10% or more** as **foreign**.
- Based on this definition, finally we obtain **3,445** plant-year observations for foreign affiliates.

# Table 1. Descriptive statistics of variables.

| Variable | Observations | Mean | Std. dev. | Min | Max |
|---|---|---|---|---|---|
| $s^D$ | 3,445 | 0.5259 | 0.2490 | 0.0000 | 0.9953 |
| $\ln p^L$ | 3,445 | 8.0861 | 0.6851 | 2.0683 | 11.7361 |
| $\ln p^K$ | 3,445 | -1.6569 | 0.2430 | -2.7233 | -1.0512 |
| $\ln p^D$ | 3,445 | 0.5147 | 0.2644 | 0.0750 | 1.3761 |
| $\ln p^M$ | 3,445 | 0.4919 | 0.1562 | -0.0619 | 1.4972 |
| $\ln y$ | 3,445 | 14.9016 | 1.7947 | 8.2248 | 20.7614 |
| GVCposition | 3,445 | -0.0024 | 0.0049 | -0.0146 | 0.0209 |
| GVCparticipation | 3,445 | 0.0082 | 0.0099 | 0.0001 | 0.0368 |
| Export | 3,445 | 0.2242 | 0.3335 | 0.0000 | 1.0000 |
| Foreign | 3,445 | 0.8065 | 0.2724 | 0.1000 | 1.0000 |
| Greenfield | 3,445 | 0.5353 | 0.4988 | 0.0000 | 1.0000 |
| Years | 3,445 | 5.1216 | 3.3016 | 1.0000 | 12.0000 |
| License | 3,445 | 0.0039 | 0.0146 | 0.0000 | 0.2410 |
| Skill | 3,445 | 0.6262 | 0.2725 | 0.0000 | 1.0000 |
| TFP | 3,445 | 2.9541 | 1.5565 | -1.7182 | 9.8842 |

Source: Author’s own calculations based on the data sources presented in Section 3.

# Distribution of the Share of local material inputs to the total costs




Source: : Author's own calculations based on the data from ENIA.

# Table 2. Correlation matrix of variables.

| | $s^D$ | $\ln p^L$ | $\ln p^K$ | $\ln p^D$ | $\ln p^M$ | $\ln y$ | GVC position | GVC participation | Export | Foreign | Greenfield | Years | License | Skill | TFP |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| $s^D$ | 1.000 | | | | | | | | | | | | | | |
| $\ln p^L$ | -0.122 | 1.000 | | | | | | | | | | | | | |
| $\ln p^K$ | -0.008 | -0.065 | 1.000 | | | | | | | | | | | | |
| $\ln p^D$ | -0.052 | 0.222 | -0.389 | 1.000 | | | | | | | | | | | |
| $\ln p^M$ | 0.073 | 0.115 | -0.553 | 0.722 | 1.000 | | | | | | | | | | |
| $\ln y$ | 0.117 | 0.499 | -0.021 | 0.087 | 0.057 | 1.000 | | | | | | | | | |
| GVC position | -0.006 | 0.048 | 0.039 | -0.138 | 0.027 | -0.143 | 1.000 | | | | | | | | |
| GVC participation | -0.057 | 0.188 | -0.035 | 0.313 | 0.139 | 0.125 | -0.482 | 1.000 | | | | | | | |
| Export | 0.105 | -0.052 | -0.080 | 0.083 | 0.040 | 0.261 | -0.443 | 0.184 | 1.000 | | | | | | |
| Foreign | -0.021 | 0.143 | 0.013 | 0.044 | -0.024 | 0.019 | -0.028 | -0.025 | 0.015 | 1.000 | | | | | |
| Greenfield | 0.015 | -0.017 | -0.035 | 0.009 | -0.020 | -0.094 | -0.015 | 0.111 | 0.023 | 0.053 | 1.000 | | | | |
| Years | 0.007 | 0.180 | -0.295 | 0.466 | 0.502 | 0.190 | 0.022 | 0.025 | 0.001 | -0.004 | -0.355 | 1.000 | | | |
| License | -0.085 | 0.176 | -0.054 | 0.078 | 0.043 | 0.117 | 0.008 | 0.000 | -0.016 | 0.083 | -0.006 | 0.073 | 1.000 | | |
| Skill | -0.022 | 0.489 | 0.021 | 0.054 | 0.020 | 0.155 | 0.119 | 0.059 | -0.145 | 0.117 | -0.019 | 0.032 | 0.111 | 1.000 | |
| TFP | -0.059 | 0.311 | 0.056 | 0.104 | 0.055 | 0.289 | -0.284 | 0.522 | 0.030 | -0.017 | 0.056 | 0.018 | -0.039 | 0.180 | 1.000 |

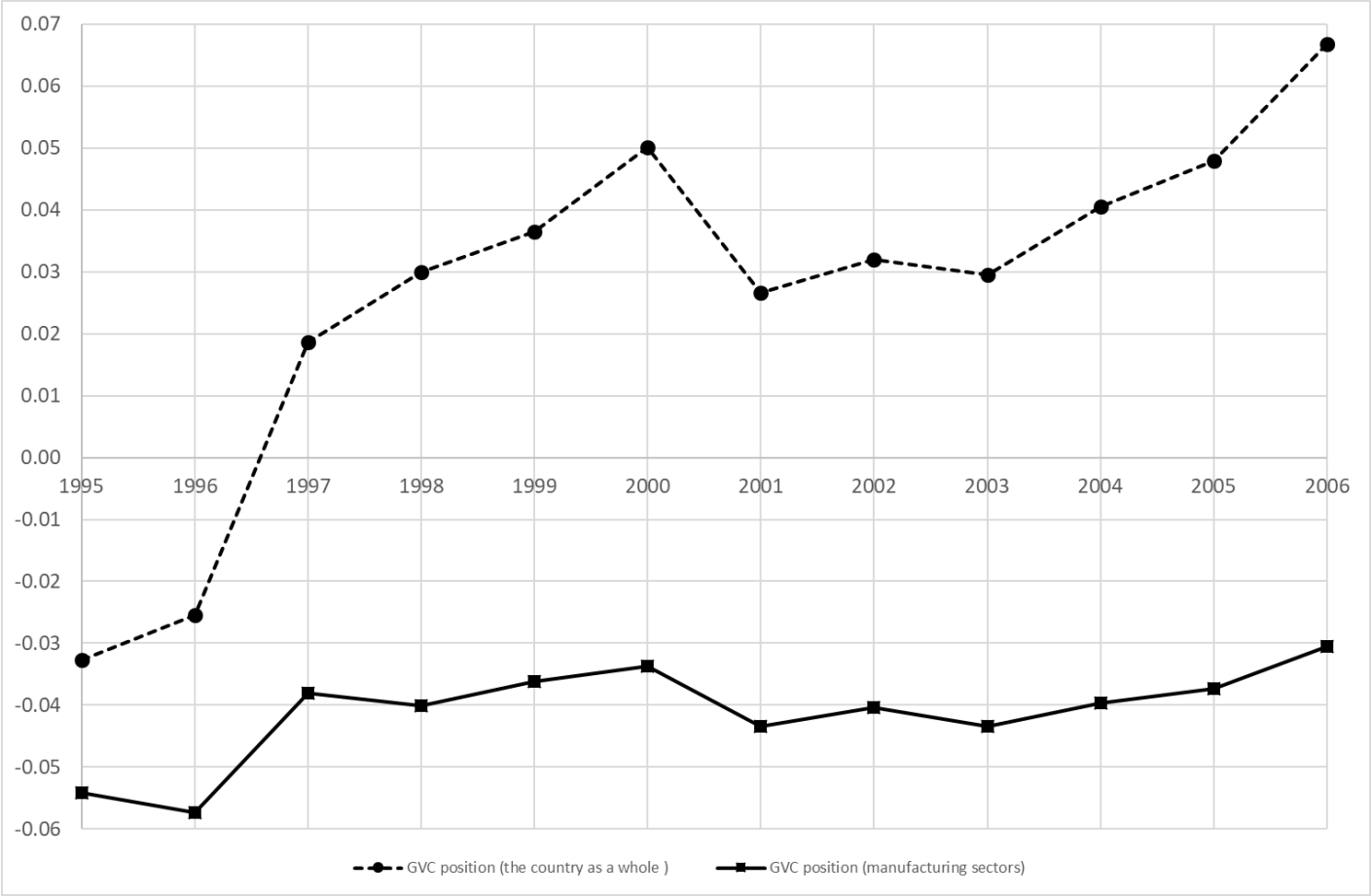
Source: Author's own calculations based on the data sources presented in Section 3.

- We find that Chile **moved towards further upstream in GVCs** not only in the country as a whole but also in manufacturing sectors from 1995 to 2006 (see Figure 1).
- We find **basic and fabricated metal products**, such as basic iron and steel (code 40) and fabricated metal products except for machinery and equipment (code 42), in which Chile has a comparative advantage, were the most upstream sectors among the 37 manufacturing sectors (see Table A2).

❖Note that if we include primary sectors (codes 1-10), copper (code 9), other minerals (10), forestry products (4), and seafood (5) has consistently been the most upstream sectors among 47 tradable sectors.

- Overall, **food and beverages** (codes 15, 21, 13, and 16, in this order) and footwear and clothing (codes 29 and 27), for which Chile also has a comparative advantage, have a higher share of local material inputs.

# Figure 1. Evolution of GVC position in Chile from 1995 to 2006.




Source: Author's own calculations based on the data from UNCTAD-Eora Global Value Chain Database.
Note: "The country as a whole" includes 73 sectors of the classification of the Chilean I-O table for 1996, while "Manufacturing sectors" includes sectors from 11 to 47 (see Table A1) of the classification. The GVC position index is defined by Equation (11).

# Table A2. Average GVC position index of foreign affiliates from 1995 to 2006 for each industry.

| Code | Industry name | Observations | Mean |
|---|---|---|---|
| 11 | Meat | 30 | -0.0010 |
| 12 | Seafood | 199 | -0.0128 |
| 13 | Canned fruits and vegetables | 117 | -0.0044 |
| 14 | Oils and fats | 30 | -0.0005 |
| 15 | Dairy Products | 122 | -0.0006 |
| 16 | Grain mill products | 25 | -0.0002 |
| 17 | Animal feed | 26 | 0.0001 |
| 18 | Bread, noodles and pasta | 87 | -0.0001 |
| 19 | Sugar and starch | 91 | 0.0001 |
| 20 | Other food products | 26 | -0.0046 |
| 21 | Liquors & Spirits | 9 | 0.0000 |
| 22 | Wines | 81 | -0.0039 |
| 23 | Beer | 20 | 0.0000 |
| 24 | Non-alcoholic beverages | 70 | 0.0003 |
| 25 | Snuff products | 9 | 0.0008 |
| 26 | Textiles | 91 | -0.0010 |
| 27 | Clothing | 64 | -0.0007 |
| 28 | Leather and leather products | 3 | 0.0000 |
| 29 | Footwear | 8 | -0.0001 |
| 30 | Wood and wood products | 187 | -0.0041 |
| 31 | Paper and paper products | 98 | -0.0047 |
| 32 | Forms and records | 58 | 0.0002 |
| 33 | Fuel and other petroleum products | 81 | 0.0161 |
| 34 | Basic Chemicals | 303 | -0.0073 |
| 35 | Other chemicals | 498 | -0.0004 |
| 36 | Rubber Products | 52 | 0.0003 |
| 37 | Plastic Products | 248 | -0.0005 |
| 38 | Glass and glass products | 16 | -0.0003 |
| 39 | Non-metallic mineral products | 97 | 0.0002 |
| 40 | Basic iron and steel | 39 | 0.0013 |
| 41 | Basic products of nonferrous metals | 147 | -0.0119 |
| 42 | Metal products | 126 | 0.0005 |
| 43 | Non-electrical machinery and equipmen | 104 | -0.0014 |
| 44 | Machinery and electrical equipment | 180 | -0.0012 |
| 45 | Transportation equipment | 50 | -0.0016 |
| 46 | Furniture | 11 | -0.0005 |
| 47 | Other manufactured products | 42 | -0.0012 |
| | Total | 3445 | -0.0024 |

- The maximum value of the GVC position index is $\ln(2) - \ln(0) = 0.6931$. Similarly, the minimum value is $\ln(0) - \ln(2) = -0.6931$.
- Note that the code 12 is not “Fishing” (ISIC130) but “Canning, preserving and processing of fish, crustacea and similar foods” (ISIC 3114).

Source: Author’s own calculations based on UNCTAD-Eora Global Value Chain Database

# Table A3. Average share of local material inputs to the total costs of foreign affiliates from 1995 to 2006 for each industry.

| Code | Industry name | Observations | Mean |
|---|---|---|---|
| 11 | Meat | 30 | 0.4443 |
| 12 | Seafood | 199 | 0.5674 |
| 13 | Canned fruits and vegetables | 117 | 0.6902 |
| 14 | Oils and fats | 30 | 0.6294 |
| 15 | Dairy Products | 122 | 0.7733 |
| 16 | Grain mill products | 25 | 0.7088 |
| 17 | Animal feed | 26 | 0.6100 |
| 18 | Bread, noodles and pasta | 87 | 0.6310 |
| 19 | Sugar and starch | 91 | 0.5814 |
| 20 | Other food products | 26 | 0.4895 |
| 21 | Liquors & Spirits | 9 | 0.7599 |
| 22 | Wines | 81 | 0.5715 |
| 23 | Beer | 20 | 0.3161 |
| 24 | Non-alcoholic beverages | 70 | 0.5383 |
| 25 | Snuff products | 9 | 0.4169 |
| 26 | Textiles | 91 | 0.4911 |
| 27 | Clothing | 64 | 0.6548 |
| 28 | Leather and leather products | 3 | 0.5184 |
| 29 | Footwear | 8 | 0.7214 |
| 30 | Wood and wood products | 187 | 0.6243 |
| 31 | Paper and paper products | 98 | 0.4570 |
| 32 | Forms and records | 58 | 0.3626 |
| 33 | Fuel and other petroleum products | 81 | 0.6451 |
| 34 | Basic Chemicals | 303 | 0.4163 |
| 35 | Other chemicals | 498 | 0.5204 |
| 36 | Rubber Products | 52 | 0.3820 |
| 37 | Plastic Products | 248 | 0.3840 |
| 38 | Glass and glass products | 16 | 0.3809 |
| 39 | Non-metallic mineral products | 97 | 0.5005 |
| 40 | Basic iron and steel | 39 | 0.4890 |
| 41 | Basic products of nonferrous metals | 147 | 0.6573 |
| 42 | Metal products | 126 | 0.4738 |
| 43 | Non-electrical machinery and equipmen | 104 | 0.4797 |
| 44 | Machinery and electrical equipment | 180 | 0.4647 |
| 45 | Transportation equipment | 50 | 0.3425 |
| 46 | Furniture | 11 | 0.6281 |
| 47 | Other manufactured products | 42 | 0.4696 |
| | Total | 3445 | 0.5259 |

Source: Author’s own calculations based on the data sources presented in Section 3.

# 4. Estimation results

## *Baseline estimation results*

- Following Kiyota et al. (2008), we use a linear model to estimate Equation (6).
- As our dependent variable is constrained in the interval [0, 1), it is possible to use a two-limit Tobit model. However, we have very few censored observations (12 out of the 3,445 observations).
- We find that the **price of labor** is **negative** and highly significant (the local material inputs and labor are **complements**), whereas the **price of capital** is **positive** and highly significant in all specifications (the imported material inputs and capital are complements; the local material inputs and capital are **substitutes**).
- The prices of local and imported material inputs are expectedly negative and positive, although they are not significant.
- The gross output is also positive and significant.

- We find that the GVC position index is **positive** and highly significant.

✓The coefficient (column 2 of Table 3) indicates that moving from the lowest to highest average values of the index among the 37 sectors (-0.0128 for code 12 and 0.0161 for code 33; see Table A2) leads to a 47.9% increase in the share of local material inputs.

✓The estimated coefficient (16.398) in column 2 of Table A4 is about **13 times larger** than the coefficient of Amendolagine et al. (2019: 79), who employ the similar empirical specification but do not control for any input prices and time-invariant affiliate characteristics.

✓Foreign affiliates' **upstream positions** in GVCs are **strong driver** for **local linkages** in Chile.

- Although the interaction term between GVC position index and the export share is negative and significant, the threshold level of the export share shows that no foreign affiliates practically experience the negative effect.
- The GVC participation index by itself is not significant.

- Regarding the control variables, the ration of **expenditures on licenses and foreign technical assistance** and **TFP** are **negative** and and the latter is highly significant

✓This could be because foreign affiliates with higher productivity and licensed foreign technologies do not want to share advanced technology with potential competitors, while local suppliers do not have sufficient capacity to supply specialized inputs for such affiliates

✓Iizuka (2005), who foreign affiliates in the salmon industry in Chile tend to internationally source specialized inputs with high technology, supports our finding.

# Table 3. Baseline estimation results of Equation (6)

| | Dependent variable: Share of local material inputs to the total costs | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| lnpl | -0.0427*** | -0.0427*** | -0.0427*** | -0.0428*** |
| | (0.0086) | (0.0086) | (0.0086) | (0.0086) |
| lnpk | 0.1007** | 0.1009*** | 0.1014*** | 0.0985** |
| | (0.0391) | (0.0391) | (0.0391) | (0.0391) |
| lnpd | -0.0521 | -0.0520 | -0.0522 | -0.0439 |
| | (0.0376) | (0.0376) | (0.0376) | (0.0376) |
| lnpm | 0.0907 | 0.0692 | 0.0896 | 0.0586 |
| | (0.0562) | (0.0626) | (0.0562) | (0.0626) |
| lny | 0.1468*** | 0.1468*** | 0.1466*** | 0.1467*** |
| | (0.0083) | (0.0083) | (0.0083) | (0.0083) |
| GVCposition | 15.1908*** | 16.5677*** | 15.5200*** | 16.1578*** |
| | (5.6651) | (5.9356) | (5.7093) | (5.9464) |
| GVCposition×Export | | | -1.8304 | -13.3911** |
| | | | (3.9003) | (5.3694) |
| GVCparticipation | | 3.7278 | | 5.0972 |
| | | (4.7920) | | (4.8509) |
| GVCparticipation×Export | | | | -11.4184*** |
| | | | | (3.5024) |
| Export | -0.0261 | -0.0255 | -0.0375 | 0.0152 |
| | (0.0226) | (0.0226) | (0.0333) | (0.0368) |
| Foreign | -0.0420 | -0.0424 | -0.0420 | -0.0393 |
| | (0.0287) | (0.0287) | (0.0287) | (0.0286) |
| Greenfield | 0.1992 | 0.2045 | 0.1987 | 0.2280 |
| | (0.2283) | (0.2284) | (0.2283) | (0.2281) |
| Years | -0.0118 | -0.0120 | -0.0120 | -0.0113 |
| | (0.0179) | (0.0179) | (0.0179) | (0.0179) |
| License | -0.4546* | -0.4610* | -0.4550* | -0.4652* |
| | (0.2651) | (0.2652) | (0.2651) | (0.2648) |
| Skill | 0.0208 | 0.0213 | 0.0204 | 0.0228 |
| | (0.0174) | (0.0174) | (0.0174) | (0.0174) |
| TFP | -0.1487*** | -0.1490*** | -0.1486*** | -0.1481*** |
| | (0.0107) | (0.0107) | (0.0107) | (0.0107) |
| Region-year fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Affiliate fixed effects | Yes | Yes | Yes | Yes |
| Number of observations | 3,445 | 3,445 | 3,445 | 3,445 |

The result supports our main hypothesis!!

negative but the threshold level of the export share 1.207>1

Affiliates with higher productivity and using licensed foreign technologies are less likely to source their inputs locally.

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Numbers in parentheses represent standard errors.

# *Robustness checks*
# *Different entry modes*

- Seminal works analyzing the FDI spillovers through backward linkages, such as Javorcik (2004), find that the **entry mode** of FDI (e.g., joint ventures versus wholly owned subsidiaries) is an important factor affecting the spillover magnitude.
- We verify that our baseline results are robust to different entry modes.

❑Wholly owned subsidiaries versus joint ventures.

- Wholly-owned subsidiaries: the share of foreign capital >=99%.
- Joint ventures: 10%<=the share of foreign capital <99%
- The GVC position index is **positive** and significant in all specifications in **both subsamples**.

❑Greenfield investments versus mergers and acquisitions.

- Greenfield investments: the share of foreign capital >=10% in the entry year.
- mergers and acquisitions: the share of foreign capital <10% in the entry year and later increased >=10%.
- The GVC position index is **positive** and highly significant in the case of **mergers and acquisitions**. Thus, only affiliates that are embedded **in the local economy** can develop **local linkages** when involved in the upstream stages of GVCs.
- The **years of operation** since entry is positive and weakly significant only for **greenfield investments**.

# Table 4. Estimation results of Equation (6) for wholly owned subsidiaries and joint ventures.

| | Dependent variable: Share of local material inputs to the total costs | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Wholly owned subsidiaries | | | | Joint ventures | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| lnpl | -0.0449*** | -0.0449*** | -0.0446*** | -0.0438*** | -0.0315** | -0.0312** | -0.0316** | -0.0313** |
| | (0.0114) | (0.0114) | (0.0114) | (0.0114) | (0.0145) | (0.0145) | (0.0146) | (0.0146) |
| lnpk | 0.0633 | 0.0650 | 0.0670 | 0.0648 | 0.0639 | 0.0604 | 0.0634 | 0.0602 |
| | (0.0558) | (0.0559) | (0.0561) | (0.0560) | (0.0625) | (0.0626) | (0.0625) | (0.0627) |
| lnpd | -0.0705 | -0.0701 | -0.0697 | -0.0659 | 0.0168 | 0.0172 | 0.0168 | 0.0238 |
| | (0.0524) | (0.0524) | (0.0524) | (0.0523) | (0.0631) | (0.0632) | (0.0632) | (0.0635) |
| lnpm | 0.1847** | 0.1655* | 0.1832** | 0.1591* | 0.0245 | -0.0238 | 0.0240 | -0.0340 |
| | (0.0823) | (0.0885) | (0.0824) | (0.0884) | (0.0869) | (0.1024) | (0.0870) | (0.1030) |
| lny | 0.1930*** | 0.1930*** | 0.1926*** | 0.1915*** | 0.1113*** | 0.1117*** | 0.1112*** | 0.1122*** |
| | (0.0128) | (0.0128) | (0.0128) | (0.0128) | (0.0118) | (0.0118) | (0.0118) | (0.0118) |
| GVCposition | 16.2041** | 17.0713** | 16.9234** | 16.6022** | 15.2669* | 18.9508* | 15.4300* | 19.2673* |
| | (8.0311) | (8.1663) | (8.0930) | (8.1919) | (9.0006) | (9.9025) | (9.0549) | (9.9232) |
| GVCposition×Export | | | -3.8219 | -17.7072** | | | -1.3749 | -7.9571 |
| | | | (5.2482) | (7.1238) | | | (7.9478) | (10.7746) |
| GVCparticipation | | 3.8786 | | 5.7799 | | 7.2140 | | 8.0710 |
| | | (6.5704) | | (6.6550) | | (8.0811) | | (8.1882) |
| GVCparticipation×Export | | | | -13.9685*** | | | | -6.5295 |
| | | | | (4.7042) | | | | (6.3844) |
| Export | -0.0242 | -0.0236 | -0.0502 | 0.0142 | 0.0092 | 0.0104 | 0.0028 | 0.0348 |
| | (0.0300) | (0.0300) | (0.0466) | (0.0512) | (0.0412) | (0.0412) | (0.0556) | (0.0619) |
| Foreign | | | | | -0.0167 | -0.0196 | -0.0175 | -0.0210 |
| | | | | | (0.0471) | (0.0472) | (0.0474) | (0.0475) |
| Greenfield | -0.0407 | -0.0403 | -0.0429 | -0.0888 | 0.0925 | 0.0916 | 0.0924 | 0.1071 |
| | (0.1894) | (0.1894) | (0.1894) | (0.1896) | (0.1395) | (0.1395) | (0.1395) | (0.1404) |
| Years | -0.0041 | -0.0039 | -0.0039 | -0.0073 | -0.0270* | -0.0276* | -0.0270* | -0.0264* |
| | (0.0307) | (0.0307) | (0.0307) | (0.0306) | (0.0153) | (0.0154) | (0.0153) | (0.0154) |
| License | -0.7573** | -0.7649** | -0.7573** | -0.7617** | 0.6720 | 0.6896 | 0.6746 | 0.6882 |
| | (0.3286) | (0.3289) | (0.3287) | (0.3281) | (0.5392) | (0.5397) | (0.5397) | (0.5401) |
| Skill | 0.0738*** | 0.0739*** | 0.0720*** | 0.0749*** | -0.0490* | -0.0472* | -0.0490* | -0.0467* |
| | (0.0264) | (0.0264) | (0.0265) | (0.0265) | (0.0254) | (0.0255) | (0.0254) | (0.0255) |
| TFP | -0.2073*** | -0.2076*** | -0.2071*** | -0.2052*** | -0.1010*** | -0.1019*** | -0.1009*** | -0.1019*** |
| | (0.0166) | (0.0166) | (0.0166) | (0.0166) | (0.0145) | (0.0146) | (0.0145) | (0.0146) |
| Region-year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Affiliate fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Number of observations | 2,066 | 2,066 | 2,066 | 2,066 | 1,379 | 1,379 | 1,379 | 1,379 |

The positive effect of GVC position is robust to the difference between wholly-owned subsidiaries and joint ventures.

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Numbers in parentheses represent standard errors.

# Table 5. Estimation results of Equation (6) for greenfield investments and mergers and acquisitions.

| | Dependent variable: Share of local material inputs to the total costs | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Greenfield investments | | | | Mergers and acquisitions | | | |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| lnpl | -0.0582*** | -0.0576*** | -0.0584*** | -0.0584*** | -0.0336*** | -0.0338*** | -0.0344*** | -0.0345*** |
| | (0.0132) | (0.0132) | (0.0133) | (0.0133) | (0.0113) | (0.0113) | (0.0113) | (0.0113) |
| lnpk | 0.0372 | 0.0420 | 0.0373 | 0.0434 | 0.1481*** | 0.1451*** | 0.1526*** | 0.1479*** |
| | (0.0593) | (0.0594) | (0.0593) | (0.0593) | (0.0541) | (0.0542) | (0.0542) | (0.0546) |
| lnpd | -0.0197 | -0.0191 | -0.0201 | -0.0136 | -0.1189** | -0.1184** | -0.1207** | -0.1184** |
| | (0.0556) | (0.0555) | (0.0556) | (0.0556) | (0.0521) | (0.0521) | (0.0521) | (0.0524) |
| lnpm | 0.2836*** | 0.2303** | 0.2843*** | 0.2216** | -0.1590** | -0.2009** | -0.1605** | -0.1985** |
| | (0.0818) | (0.0897) | (0.0820) | (0.0897) | (0.0795) | (0.0918) | (0.0795) | (0.0920) |
| lny | 0.1656*** | 0.1661*** | 0.1656*** | 0.1660*** | 0.1148*** | 0.1146*** | 0.1138*** | 0.1137*** |
| | (0.0123) | (0.0123) | (0.0123) | (0.0122) | (0.0118) | (0.0118) | (0.0118) | (0.0118) |
| GVCposition | 6.1448 | 8.5859 | 5.9325 | 7.5011 | 27.5596*** | 30.8539*** | 28.4263*** | 31.1764*** |
| | (7.9650) | (8.1374) | (8.0508) | (8.1826) | (8.5305) | (9.2564) | (8.5585) | (9.2642) |
| GVCposition×Export | | | 1.0809 | -7.4483 | | | -7.0991 | -8.9628 |
| | | | (5.8524) | (7.6003) | | | (5.8473) | (9.0187) |
| GVCparticipation | | 9.6430 | | 11.2948* | | 6.7755 | | 6.1379 |
| | | (6.6500) | | (6.7605) | | (7.3874) | | (7.4905) |
| GVCparticipation×Export | | | | -10.6175** | | | | -2.1981 |
| | | | | (5.0434) | | | | (6.2816) |
| Export | -0.0525 | -0.0514 | -0.0451 | 0.0233 | 0.0049 | 0.0055 | -0.0338 | -0.0227 |
| | (0.0348) | (0.0347) | (0.0532) | (0.0600) | (0.0321) | (0.0321) | (0.0452) | (0.0505) |
| Foreign | -0.0591 | -0.0579 | -0.0590 | -0.0509 | -0.0111 | -0.0126 | -0.0118 | -0.0130 |
| | (0.0497) | (0.0497) | (0.0498) | (0.0498) | (0.0356) | (0.0356) | (0.0356) | (0.0356) |
| Years | 0.0412* | 0.0393* | 0.0412* | 0.0372 | 0.0016 | 0.0024 | -0.0005 | 0.0014 |
| | (0.0235) | (0.0235) | (0.0235) | (0.0235) | (0.0180) | (0.0181) | (0.0181) | (0.0184) |
| License | -0.3185 | -0.3329 | -0.3187 | -0.3275 | -0.7963** | -0.7983** | -0.7925** | -0.7990** |
| | (0.3832) | (0.3832) | (0.3834) | (0.3828) | (0.3704) | (0.3705) | (0.3704) | (0.3708) |
| Skill | 0.0220 | 0.0235 | 0.0220 | 0.0250 | 0.0385 | 0.0391 | 0.0355 | 0.0362 |
| | (0.0248) | (0.0248) | (0.0248) | (0.0248) | (0.0255) | (0.0256) | (0.0257) | (0.0257) |
| TFP | -0.1595*** | -0.1604*** | -0.1594*** | -0.1593*** | -0.1281*** | -0.1284*** | -0.1264*** | -0.1267*** |
| | (0.0160) | (0.0160) | (0.0161) | (0.0160) | (0.0150) | (0.0150) | (0.0151) | (0.0151) |
| Region-year fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Affiliate fixed effects | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Observations | 1,844 | 1,844 | 1,844 | 1,844 | 1,601 | 1,601 | 1,601 | 1,601 |

The GVC position index is positive and highly significant **only** for **mergers and acquisitions**.

The years of operation since entry is positive and weakly significant only for greenfield investments.

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Numbers in parentheses represent standard errors.

# *Decomposition of the GVC indicators*

- We decompose the GVC indicators into its original two components *DVX* and *FVA*.
- We check whether the two-component variables yield the expected signs, and identify **which component is more relevant** for the effect on local sourcing.
- We separately include *DVX* and *FVA* instead of the GVC indicators in Equation (6).
- Expectedly, *DVX* is **positive** and significant and *FVA* is **negative** and significant.
- The effect of ***DVX* is larger**.
- To produce intermediate inputs that can be used for other countries' exports, both local suppliers and foreign affiliates in Chile are required to **satisfy the requirements** of the **global buyers** of those inputs, which fosters the capabilities of local suppliers and backward linkages (OECD, 2015).

# Table 6. Estimation results of Equation (6) decomposing the GVC indicators.

| | Dependent variable: Share of local material inputs to the total costs | |
|---|---|---|
| | (1) | (2) |
| lnpl | -0.0427*** | -0.0428*** |
| | (0.0086) | (0.0086) |
| lnpk | 0.1009*** | 0.0985** |
| | (0.0391) | (0.0391) |
| lnpd | -0.0519 | -0.0438 |
| | (0.0376) | (0.0376) |
| lnpm | 0.0687 | 0.0582 |
| | (0.0626) | (0.0626) |
| lny | 0.1468*** | 0.1467*** |
| | (0.0083) | (0.0083) |
| DVX | 20.1291** | 21.0786** |
| | (8.6009) | (8.5931) |
| FVA | -12.6085** | -10.8500* |
| | (6.3543) | (6.4731) |
| DVX×Export | | -24.7025*** |
| | | (8.1519) |
| FVA×Export | | 1.8395 |
| | | (3.8962) |
| Export | -0.0254 | 0.0155 |
| | (0.0226) | (0.0367) |
| Foreign | -0.0424 | -0.0394 |
| | (0.0287) | (0.0286) |
| Greenfield | 0.2045 | 0.2279 |
| | (0.2284) | (0.2281) |
| Years | -0.0120 | -0.0113 |
| | (0.0179) | (0.0179) |
| License | -0.4610* | -0.4651* |
| | (0.2652) | (0.2648) |
| Skill | 0.0213 | 0.0228 |
| | (0.0174) | (0.0174) |
| TFP | -0.1490*** | -0.1481*** |
| | (0.0107) | (0.0107) |
| Region-year fixed effects | Yes | Yes |
| Industry fixed effects | Yes | Yes |
| Affiliate fixed effects | Yes | Yes |
| Observations | 3,445 | 3,445 |

An increase in the supply of intermediate inputs for other countries' exports has positive effect on local sourcing.

A decrease in the use of imported intermediate inputs for exports in an industry has positive effect on local sourcing.

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Numbers in parentheses represent standard errors.

# *Lagged affiliate-level variables*

- We consider that the GVC indicators are **exogenously** determined by the **international fragmentation of production** for a given industry in which a foreign affiliate operates.
- Moreover, unlike previous studies employing cross-sectional data, this study adequately controls for unobservable **time-invariant affiliate** and **industry characteristics**, which are correlated with both affiliates' propensity to source their inputs locally and industry-level GVC involvement.
- Although we cannot completely rule out the possibility of reverse causality, we can exclude the possibility that a single affiliate's performance affects industry-level GVC indicators.
- Nevertheless, **some affiliate-level variables,** such as the share of exports, ratio of expenditures on licenses and foreign technical assistance, share of labor costs of skilled workers, and TFP, are likely to be **endogenous** with respect to the share of local material inputs.
- Thus, we estimate Equation (6) using the four variables **lagged by one-year**.
- Given that **observations in entry and reentry years do not have the lagged values**, we exclude those observations from the sample in this estimation. Consequently, the number of plant-year observations of foreign affiliates decreased from 3,445 to 2,831.
- We conclude that the **positive** effect of the GVC position index is robust to the use of lagged affiliate-level variables.

# Table 7. Estimation results of Equation (6) using lagged affiliate-level variables.

| | Dependent variable: Share of local material inputs to the total costs | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| lnpl | -0.0421*** | -0.0421*** | -0.0426*** | -0.0424*** |
| | (0.0095) | (0.0095) | (0.0095) | (0.0095) |
| lnpk | 0.1087** | 0.1086** | 0.1118** | 0.1106** |
| | (0.0474) | (0.0474) | (0.0474) | (0.0474) |
| lnpd | -0.0508 | -0.0509 | -0.0487 | -0.0466 |
| | (0.0424) | (0.0424) | (0.0424) | (0.0425) |
| lnpm | 0.0815 | 0.0961 | 0.0720 | 0.0878 |
| | (0.0612) | (0.0687) | (0.0613) | (0.0688) |
| lny | 0.0735*** | 0.0736*** | 0.0726*** | 0.0726*** |
| | (0.0084) | (0.0084) | (0.0084) | (0.0084) |
| GVCposition | 20.4542*** | 19.2236*** | 22.2634*** | 20.7906*** |
| | (6.5045) | (7.0143) | (6.5578) | (7.0399) |
| GVCposition×Lagged Export | | | -9.2113** | -13.9250** |
| | | | (4.4535) | (6.2941) |
| GVCparticipation | | -2.6904 | | -3.2671 |
| | | (5.7327) | | (5.8096) |
| GVCparticipation×Lagged Export | | | | -4.1346 |
| | | | | (4.1745) |
| Lagged Export | -0.0359 | -0.0364 | -0.0906** | -0.0772* |
| | (0.0261) | (0.0261) | (0.0371) | (0.0408) |
| Foreign | -0.0563* | -0.0561* | -0.0576* | -0.0559* |
| | (0.0322) | (0.0322) | (0.0322) | (0.0322) |
| Greenfield | 0.2849** | 0.2858** | 0.2851** | 0.2872** |
| | (0.1395) | (0.1395) | (0.1394) | (0.1394) |
| Years | 0.0304 | 0.0310 | 0.0287 | 0.0298 |
| | (0.0286) | (0.0286) | (0.0286) | (0.0286) |
| Lagged License | 0.4638 | 0.4696 | 0.4461 | 0.4568 |
| | (0.3102) | (0.3105) | (0.3101) | (0.3104) |
| Lagged Skill | 0.0071 | 0.0067 | 0.0068 | 0.0065 |
| | (0.0193) | (0.0193) | (0.0193) | (0.0193) |
| Lagged TFP | -0.0079 | -0.0076 | -0.0077 | -0.0068 |
| | (0.0063) | (0.0063) | (0.0063) | (0.0063) |
| Region-year fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Affiliate fixed effects | Yes | Yes | Yes | Yes |
| Observations | 2,831 | 2,831 | 2,831 | 2,831 |

The positive effect of GVC position indicator is robust to the use of lagged affiliate-level variables.

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Numbers in parentheses represent standard errors.

## *Exclusion of affiliates with changes in industry affiliation*

- A non-negligible share of foreign affiliates in our dataset changed their industry affiliations.
- Thus, a possible concern is that **affiliate-specific time-variant shocks** would affect industry changes, which might also be correlated with affiliates' propensity to source their inputs locally.
- To rule out this possibility, we **exclude all affiliates that changed their industry affiliations** in the period under analysis. Consequently, the number of plant-year observations for foreign affiliates decreased from 3,445 to 2,774.
- The estimation results are remarkably similar to the baseline results presented in Table 3.

# Table 8. Estimation results excluding affiliates with changes in industry affiliation.

| | Dependent variable: Share of local material inputs to the total costs | | | |
|---|---|---|---|---|
| | (1) | (2) | (3) | (4) |
| lnpl | -0.0416*** | -0.0416*** | -0.0416*** | -0.0419*** |
| | (0.0093) | (0.0093) | (0.0093) | (0.0093) |
| lnpk | 0.1419*** | 0.1419*** | 0.1423*** | 0.1389*** |
| | (0.0428) | (0.0428) | (0.0428) | (0.0428) |
| lnpd | -0.0693* | -0.0697* | -0.0694* | -0.0607 |
| | (0.0408) | (0.0408) | (0.0408) | (0.0409) |
| lnpm | 0.0446 | 0.0595 | 0.0439 | 0.0457 |
| | (0.0649) | (0.0733) | (0.0650) | (0.0734) |
| lny | 0.1381*** | 0.1381*** | 0.1380*** | 0.1380*** |
| | (0.0091) | (0.0091) | (0.0091) | (0.0090) |
| GVCposition | 15.7612** | 14.6866** | 15.9462** | 14.1336** |
| | (6.3885) | (6.8414) | (6.4771) | (6.8745) |
| GVCposition×Export | | | -0.7620 | -11.0544* |
| | | | (4.3591) | (5.8271) |
| GVCparticipation | | -2.3916 | | -1.1162 |
| | | (5.4404) | | (5.5228) |
| GVCparticipation×Export | | | | -9.8527*** |
| | | | | (3.7674) |
| Export | -0.0186 | -0.0189 | -0.0237 | 0.0203 |
| | (0.0239) | (0.0239) | (0.0375) | (0.0418) |
| Foreign | -0.0511* | -0.0508* | -0.0509* | -0.0485 |
| | (0.0301) | (0.0301) | (0.0301) | (0.0301) |
| Greenfield | 0.0821 | 0.0832 | 0.0817 | 0.0835 |
| | (0.0892) | (0.0893) | (0.0892) | (0.0892) |
| Years | -0.0096 | -0.0096 | -0.0097 | -0.0057 |
| | (0.0106) | (0.0106) | (0.0106) | (0.0107) |
| License | -0.7258** | -0.7220** | -0.7247** | -0.7255** |
| | (0.2959) | (0.2960) | (0.2960) | (0.2958) |
| Skill | 0.0035 | 0.0032 | 0.0033 | 0.0048 |
| | (0.0192) | (0.0192) | (0.0192) | (0.0192) |
| TFP | -0.1425*** | -0.1423*** | -0.1425*** | -0.1415*** |
| | (0.0115) | (0.0115) | (0.0115) | (0.0115) |
| Region-year fixed effects | Yes | Yes | Yes | Yes |
| Industry fixed effects | Yes | Yes | Yes | Yes |
| Affiliate fixed effects | Yes | Yes | Yes | Yes |
| Number of observations | 2,774 | 2,774 | 2,774 | 2,774 |

Note: ***, **, and * indicate significance at 1%, 5%, and 10% levels, respectively. Numbers in parentheses represent standard errors.

# 5. Concluding remarks

- We found that the **upstream** positions of foreign affiliates in GVCs are **positively** associated with the share of **local material inputs** to total costs.

✓The magnitude of the coefficient of the GVC position index is substantially larger than that of the previous study.

✓We conclude that that the upstream positions of foreign affiliates in GVCs are **strong drivers for local linkages** in Chile.

- This finding **contradicts the traditional view** that FDI in natural resource-related sectors has an enclave nature with very limited backward linkages.
- The positive effect of the upstream positions on local linkages is particularly large in the case of **mergers and acquisitions**.
- The positive effect is robust to the difference in entry modes between joint ventures and wholly owned subsidiaries, decomposition of the GVC position index into its two components, use of lagged affiliate-level variables, and exclusion of affiliates with changes in industry affiliation.

❑Policy implications

- Our main finding indicates that foreign affiliates engaging in upstream activities in GVCs, which are required to satisfy the requirements of global buyers purchasing their inputs, have a strong incentive to provide technical assistance and technology transfer to local suppliers.➔ Policies that would promote **further technical assistance for local suppliers** could be useful (e.g., the Supplier Development Program and the World Class Supplier Program).
- Our finding indicates that technology gaps between foreign affiliates and local suppliers prevent the creation of local linkages. ➔Policies to improve **local suppliers' technological capabilities** are required.
- Such policies can promote mutually beneficial relationship between foreign affiliates and local suppliers, which, in turn, will contribute to technological upgrading of the country.

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