

INTERNATIONAL TRADE

Beyond the copper sector

Chile's engagement in international
production networks

Dayna Zaalicever



UNITED NATIONS



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SOSTENIBLE CON IGUALDAD

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United Nations publication

ISSN: 1680-872X (electronic version)

ISSN: 1680-869X (print version)

LC/TS.2018/3

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Printed at United Nations, Santiago, Chile

S.18-00008

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Abstract

Although international trade has been a major driver of Chile's economic growth in the last decades, exports remain highly concentrated in the mining and metals sectors (which capture copper products at different levels of processing). This export specialization pattern reflects in Chile's insertion in international production networks, where it is positioned as an upstream provider of low and medium low-technology inputs.

This document analyses Chile's engagement in international value chains along the period 1995-2014, providing evidence at both the aggregate and firm level. The data show that the bulk of the intermediate inputs supplied by Chile to other countries' exports are natural resource-based goods, although some more technology-intensive industries have a significant participation in intra-regional linkages (which represent a low share of the total). Chile's forward linkages are also concentrated in terms of exporting firms. For many sectors, intra-regional intermediate exports are more diversified at the firm and product level than those oriented to extra-regional markets (particularly, China). Also, the proportion of small and medium-sized exporters tends to be significantly higher among firms selling intermediates to other Latin American and Caribbean countries.

In order to maximize the positive spillovers associated with GVC activities (e.g., productivity gains, creation of high-quality jobs, skills and technology transfer to local firms, greater integration of small and medium-sized enterprises), Chile needs to upgrade and diversify its participation in international value chains through innovation and deeper regional integration, reducing its dependence on the copper sector.

Introduction

Since 1990 Chile deepened the economic liberalization process initiated in the early 1970s, aiming at increasing its integration into the world economy. Along with engaging in unilateral trade openness, this pioneer of trade liberalization in Latin America and the Caribbean (Mesquita Moreira and Blyde, 2006) implemented numerous bilateral and plurilateral preferential trade agreements (including those signed with the United States, the European Union and several Asian countries—like China, Japan, and Korea—, as well as many intra-regional agreements). Simultaneously, the Chilean economy opened to foreign direct investment (FDI). This liberalization process took place in a context of increasing international fragmentation of production, which created opportunities for countries like Chile to participate in international trade without the need to develop vertically integrated industries at home.

Although international trade has been a major driver of Chile's economic growth in the last decades, exports remain highly concentrated in natural resource-based products, mostly copper. This exposes the economy to exogenous shocks to commodity prices, holds back the development of innovation-intensive activities, and carries an environmental cost (OECD, 2015). As for Chile's engagement in global value chains (GVCs),¹ this export specialization pattern reflects in a relatively low level of backward participation, since the production of natural resource-intensive goods tends to use comparatively few imported inputs. In contrast, due to its specialization, Chile's forward linkages are relatively high, revealing an upstream position in international value chains (as a source of low and medium low-technology inputs for other countries downstream).

The use of inter-country input-output (ICIO) tables has become a common approach for evaluating countries' participation in international production networks, although the availability of data on developing economies is still limited.² By providing information on the domestic and foreign inputs used in the production by each industry, ICIO tables allow identifying inter-country and inter-industry

¹ The term GVC refers in this document to any international production network, regardless of its geographical location and scope.

² Some ICIO databases provide extensive country coverage; however, the inclusion of countries with poor quality/non-official data results in a loss of statistical rigor.

production linkages. Thus, they are able to account for international fragmentation of production, tackling the problems that affect conventional trade data.³

Analyses based on ICIO tables are, however, constrained by these tables' high sector aggregation, which does not reflect the detailed level of specialization that characterizes the fragmentation of production processes across countries (Ahmad et al., 2017). To address this issue, the use of firm-level data has recently emerged as a new line of research on GVCs, following different approaches (e.g., Corcos et al., 2013; Veugelers et al., 2013; Blyde, 2014; López González, 2017). Yet, progress in this front has been limited by restrictions in data availability.

This document looks into Chile's participation in international value chains, providing a first (descriptive) approach to the use of firm-level data. GVC measures computed from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables are initially used to give an aggregate insight of Chile's engagement in international production networks along the period 1995-2014.⁴ With that background, a firm-level analysis based on customs data is then performed to further characterize Chile's forward insertion into GVCs (i.e., as an exporter of intermediate products that are incorporated into other countries' exports). The study limits to goods exports, for which firm-level data are available.

The document is organized in three sections. Section I presents the aggregate view of Chile's participation in international value chains. Section II analyses Chilean firms' forward engagement in GVC activities. Finally, section III summarizes the main findings and draws some policy implications.

³ International trade data do not provide a link between the industry of origin and the industry actually using the intermediates in its production process. In addition, they are affected by a double-counting problem, arising from the fact that the value of intermediate products is recorded each time they cross a national border, as they move along the production chain.

⁴ See <http://www.oecd.org/sti/ind/measuringtradeinvalue-addedanoecd-wtojointinitiative.htm>.

I. Chile's participation in international value chains: an aggregate view

Countries' participation in international production networks can be measured through the concept of vertical specialization, which links the imported inputs required by one country with its exports (Hummels et al., 2001). A country's backward participation in international value chains is given by the foreign intermediate inputs used, directly and indirectly, in the production of its exports.⁵ Similarly, a country's forward linkages are measured by its intermediate exports that are incorporated into other countries' exports. Thus, backward participation looks at vertical specialization from the perspective of an exporting country demanding intermediate inputs from abroad, while forward participation measures vertical specialization from the viewpoint of an exporting country supplying intermediates abroad (Yi, 2003).

The use of ICIO tables allows measuring —at the aggregate or sector level— countries' engagement in international production networks, both in gross and value-added terms. An analysis based on gross data considers the cumulated value embodied in traded products, not just the value added in the exporting country, which results in an overstatement of the domestic content of exports. In contrast, measures based on trade in value added quantify the actual contribution of each exporting country to the value generated in the production chain. They also allow identifying the industries where value added originates.⁶

The analysis carried out in this section characterizes Chile's aggregate participation in international value chains along the period 1995-2014, setting the background for the firm-level analysis performed in section II.⁷

A. Backward participation

Chile's gross vertical specialization level (i.e., its gross backward participation in international value chains) is relatively low (20% of goods exports in 2014), as compared to those of Costa Rica, Mexico and extra-regional

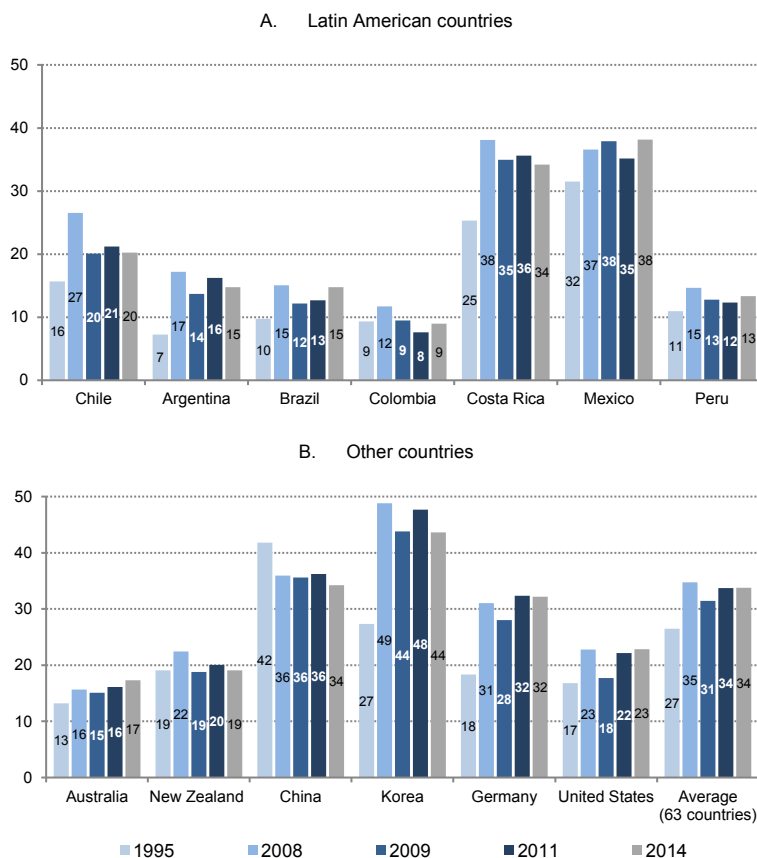
⁵ The production of exports requires the direct use of domestic and foreign intermediate inputs. The production of domestic inputs may, in turn, require the use of imported intermediates (as well as other domestic inputs, and so on). Ignoring these indirect import requirements leads to an underestimation of the foreign content of exports.

⁶ For details on the two types of measures, see Ahmad et al. (2017).

⁷ As mentioned in the introduction, this document limits the analysis to Chile's goods exports, for which firm-level data are available.

countries (see figure 1).⁸ This reflects Chile's specialization in primary products and natural resource-based intermediate goods, which require relatively few imported inputs. However, other countries specialized in natural resources have lower aggregate levels of vertical specialization than Chile, including Argentina, Brazil, Colombia and Peru in Latin America, and, to a lesser extent, Australia. Notwithstanding this, the level of backward linkages varies greatly across exporting sectors within countries. In manufacturing, Chile, Colombia and Peru's gross vertical specialization levels are, on aggregate, very similar (around 20% of goods exports in 2014), while that of Australia is somewhat higher (26%).⁹

Figure 1
Selected countries: Gross backward participation in GVCs, 1995, 2008, 2009, 2011 and 2014^a
(Percentages of gross exports)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Services exports are excluded.

Along with specialization patterns, countries' backward participation in international production networks—which captures the demand side of value chains—is driven by other structural characteristics, such as market size and level of development. While a larger domestic market is associated with larger capabilities for sourcing intermediate inputs domestically and, therefore, a lower backward participation in GVCs, the level of economic development is positively associated with countries' backward linkages (i.e., more developed countries tend to source more from abroad) (Kowalski et al., 2015).

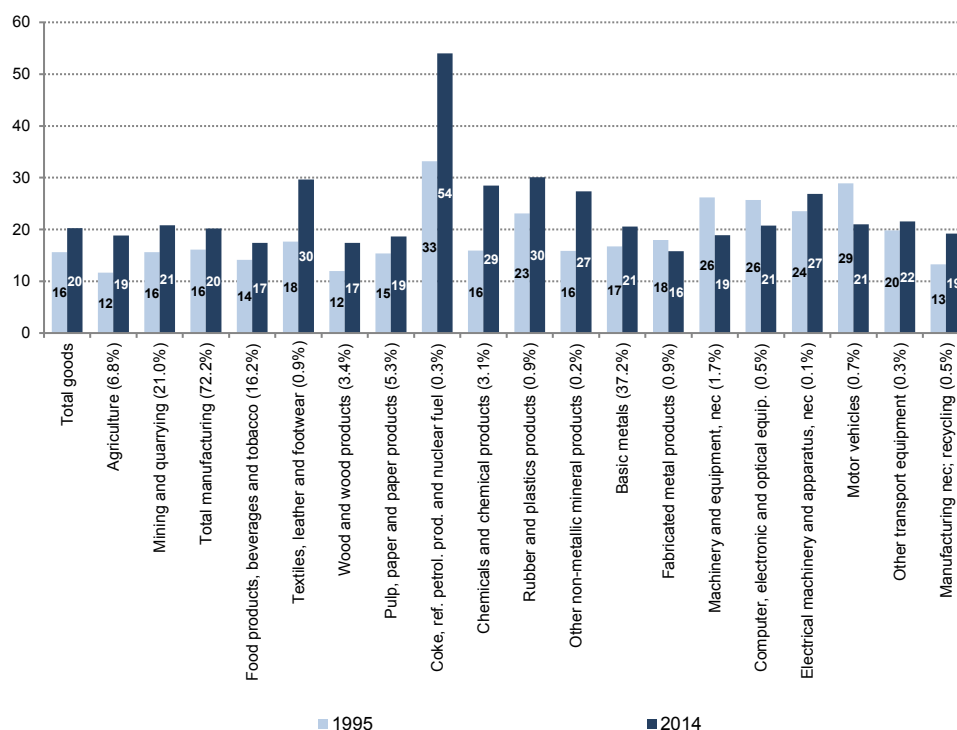
⁸ The OECD's ICIO tables cover 7 Latin American countries (Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, and Peru), with a total of 63 countries. See tables A.1 and A.2 in the annex for a list of the industries and countries covered, respectively.

⁹ The overall level of Colombia's vertical specialization (only 9% in 2014) is largely determined by the mining sector (which accounted for over 50% of total goods exports in 2014, with a gross vertical specialization level of only 3%). The same holds for Peru.

The increasing international fragmentation of production reflected, until 2008, in growing vertical specialization levels. The global economic crisis of 2008-2009 affected international trade, causing a temporary decline in countries' backward production linkages. The latest data available indicate that international fragmentation of goods production would have stalled, or even reverted, since 2011 (see figure 1; Timmer et al., 2016; OECD, 2016).

A more disaggregated analysis for Chile shows that the three main exporting sectors in goods, Basic metals, Mining and quarrying, and Food products, beverages and tobacco, as well as other natural resource-based sectors with a significant participation in Chilean exports (like Agriculture, and Pulp, paper and paper products) have similar vertical specialization levels (see figure 2). For most sectors, the foreign content of exports increased between 1995 and 2014, reaching the highest levels before 2011 (the exceptions are Fabricated metal products, and the more technology-intensive industries Machinery and equipment, not elsewhere classified (n.e.c.), Computer, electronic and optical equipment, and Motor vehicles, which account for a low share of total exports).¹⁰

Figure 2
Chile: Gross backward participation in GVCs by exporting sector, 1995 and 2014^a
(Percentages of gross exports)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

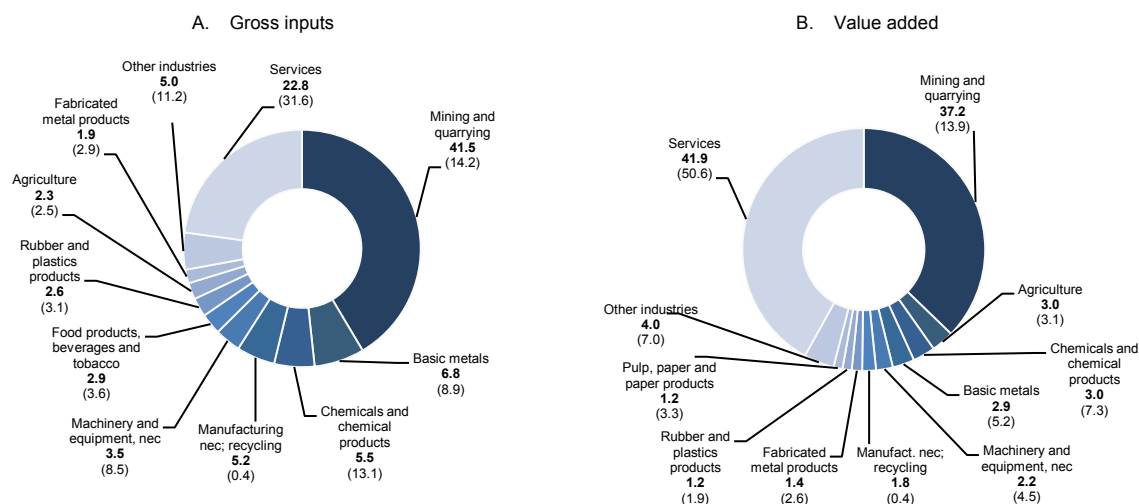
^a Percentages in brackets indicate the share of each sector in total goods exports in 2014.

The composition by source sector shows that, in gross terms, over 50% of the imported intermediates used in the production of Chilean goods exports originate in mining-related sectors (Mining and quarrying, Basic metals, and metal waste and scrap—included in Manufacturing n.e.c., recycling—)

¹⁰ The use of foreign intermediate inputs is found to be positively correlated with export performance (i.e., sectors with increasing backward linkages experience larger increases in exports), due to a productivity-enhancing effect. Thus, Chile's competitiveness in global markets could be fostered by facilitating the use of foreign intermediates (OECD, 2015).

(see figure 3.A).¹¹ It should be noted, however, that the increase in the share of Mining and quarrying between 1995 and 2014 is largely explained by the boom in prices experienced in the 2000s by oil and mineral ores.¹²

Figure 3
Chile: Imported intermediate inputs embodied in gross goods exports by source sector,
1995 and 2014^{a,b}
(Percentages of the total)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each source sector in 1995.

^b Fuels are excluded.

Services also account for a large proportion of foreign inputs (particularly, Wholesale and retail trade, and Transport and storage). In value-added terms (i.e., considering the sectors where the value added embodied in imported intermediates is generated), the share of services increases significantly, while that of intermediate goods reduces (except for agricultural inputs) (see figure 3.B).¹³ Particularly, the participation of research and development (R&D), computer and other business activities shows a large increase (from 1% of gross inputs to 7% in value added terms, in 2014). This reflects the contribution of intermediate services to goods exports, which is not accounted for in gross trade data.¹⁴

In terms of origin countries, the foreign intermediates used in the production of Chile's goods exports are imported mostly from outside the Latin American region (particularly, from the United States, the European Union, and China) (see figure 4). However, Brazil and, to a lesser extent, Argentina and

¹¹ The high participation of Mining and quarrying is mostly determined by the mining sector itself, as well as by Basic metals (i.e., foreign mining provides inputs mostly—though not only—to the mining and metals sectors). The data also show other important intra-sectoral production linkages (particularly, in Electrical machinery and apparatus, n.e.c., Textiles, leather and footwear, and Motor vehicles, which have a very low participation in Chile's exports).

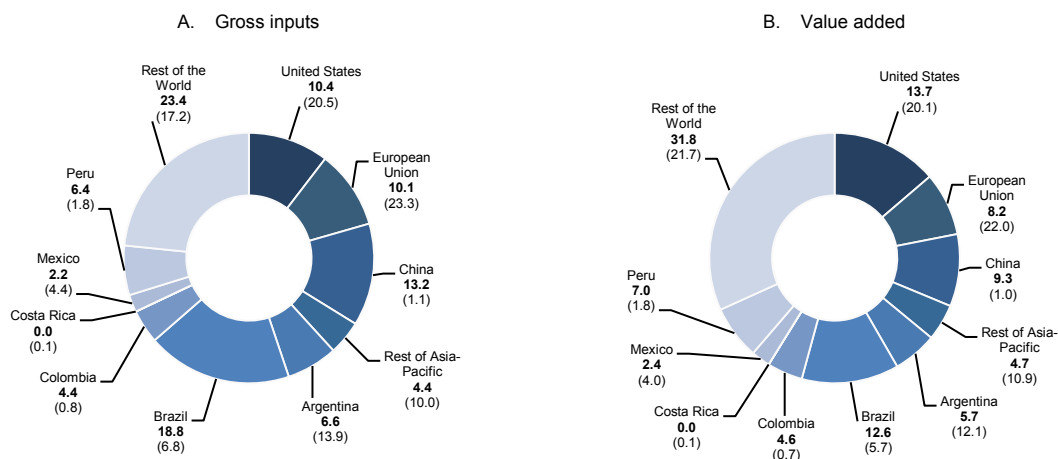
¹² In that respect, care is needed in interpreting GVC measures over time, due to differential price changes across products.

¹³ It should be noted that, for total imported inputs, there are not significant differences between Chilean exporting sectors' gross backward participation in international value chains and that measured in value-added terms. This reflects the fact that the domestic value added that returns to Chile embodied in intermediate imports—subsequently used in the production of exports—is very low.

¹⁴ The so-called servicification of manufacturing refers to the increasing use of intermediate services in the production of goods. Gross trade data do not reflect the value originating in service-related activities that is embodied in traded goods.

Chile's Pacific Alliance partners Peru, Colombia and Mexico are also an important source of foreign inputs for Chilean exports (with a joint participation of over one third of the total in 2014).^{15,16}

Figure 4
Chile: Imported intermediate goods embodied in gross goods exports by geographical origin, 1995 and 2014^{a,b}
(Percentages of the total)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each origin country/region in 1995.

^b Fuels are excluded.

The data presented in figure 4 show an increasing participation of China as a source of foreign intermediates for Chile's goods exports. This has affected the United States and the European Union, as well as other Asia-Pacific countries (particularly, Japan and Korea),¹⁷ who lost participation in Chile's backward linkages since the 2000s. China became the main provider of inputs from Basic metals and metal waste and scrap, reaching also a large participation in Fabricated metal products, Rubber and plastics products, Machinery and equipment, n.e.c., and Chemicals and chemical products (see figure 5). In addition, China turned into an important source of inputs with a lower participation in Chile's backward linkages, particularly Textiles, leather and footwear and Computer, electronic and optical equipment (with 75% and nearly 70% of the total, respectively, in 2014).

¹⁵ The United States, the European Union, China and several other Asia-Pacific countries (including Australia, Japan, Korea, and India) enjoy preferential access to the Chilean market. Also, Chile has implemented trade agreements with Mexico, Peru and other members of the Andean Community, the Caribbean Community (CARICOM) and the Southern Common Market (MERCOSUR).

¹⁶ Other countries from Latin America and the Caribbean, excluding those covered in the OECD's ICIO tables (i.e., Argentina, Brazil, Colombia, Costa Rica, Mexico, and Peru) would have a very low participation in Chile's backward linkages (Zaclicever, 2017).

¹⁷ The Asia-Pacific region includes in this document Australia, Brunei Darussalam, Cambodia, China, Hong Kong (Special Administrative Region of China), India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Republic of Korea, Singapore, Thailand, Taiwan (Province of China), and Viet Nam.

Figure 5
Chile: Main imported intermediate goods embodied in gross goods exports by geographical origin, 1995 and 2014^a
(Percentages of the total)

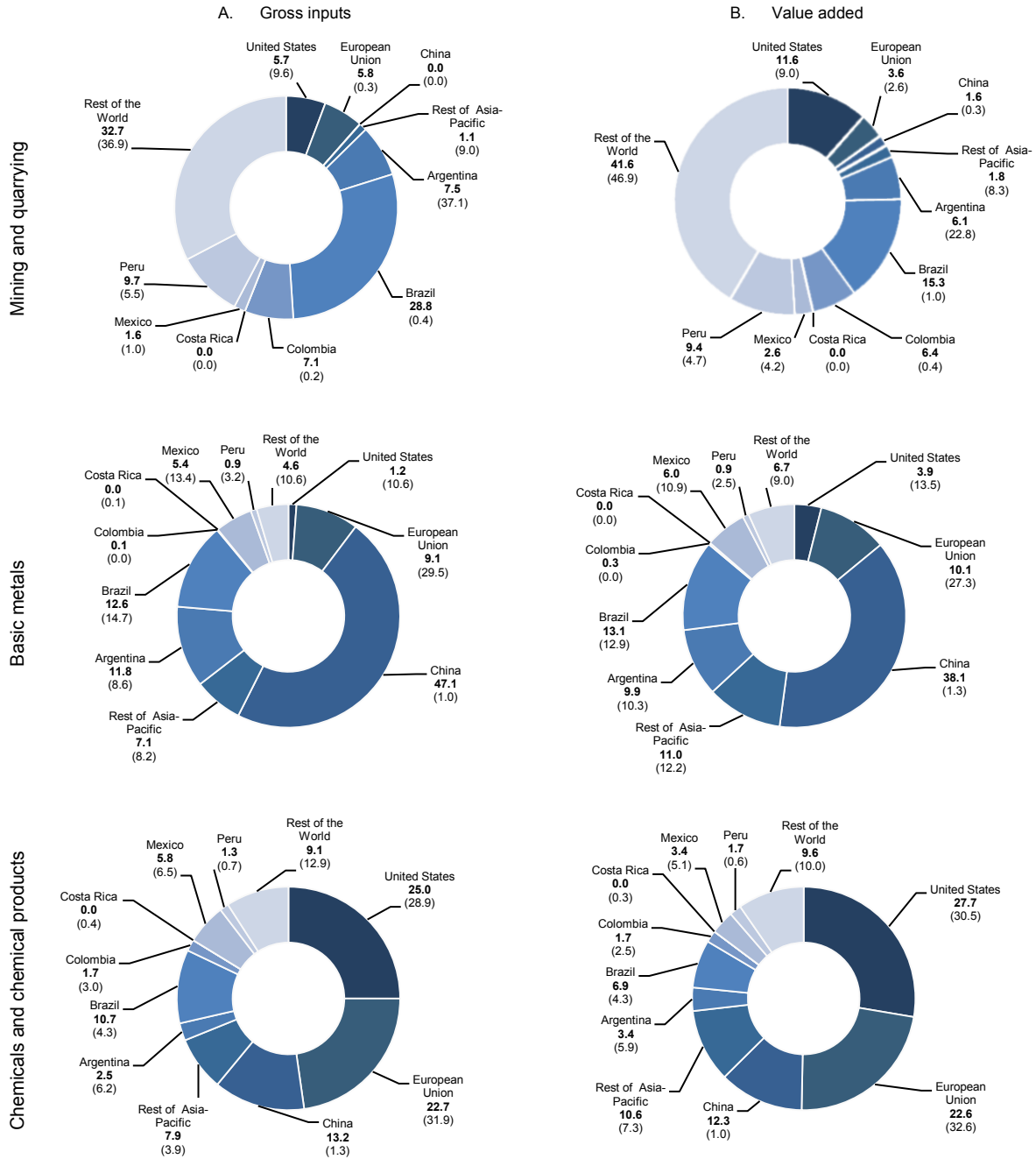


Figure 5 (continued)

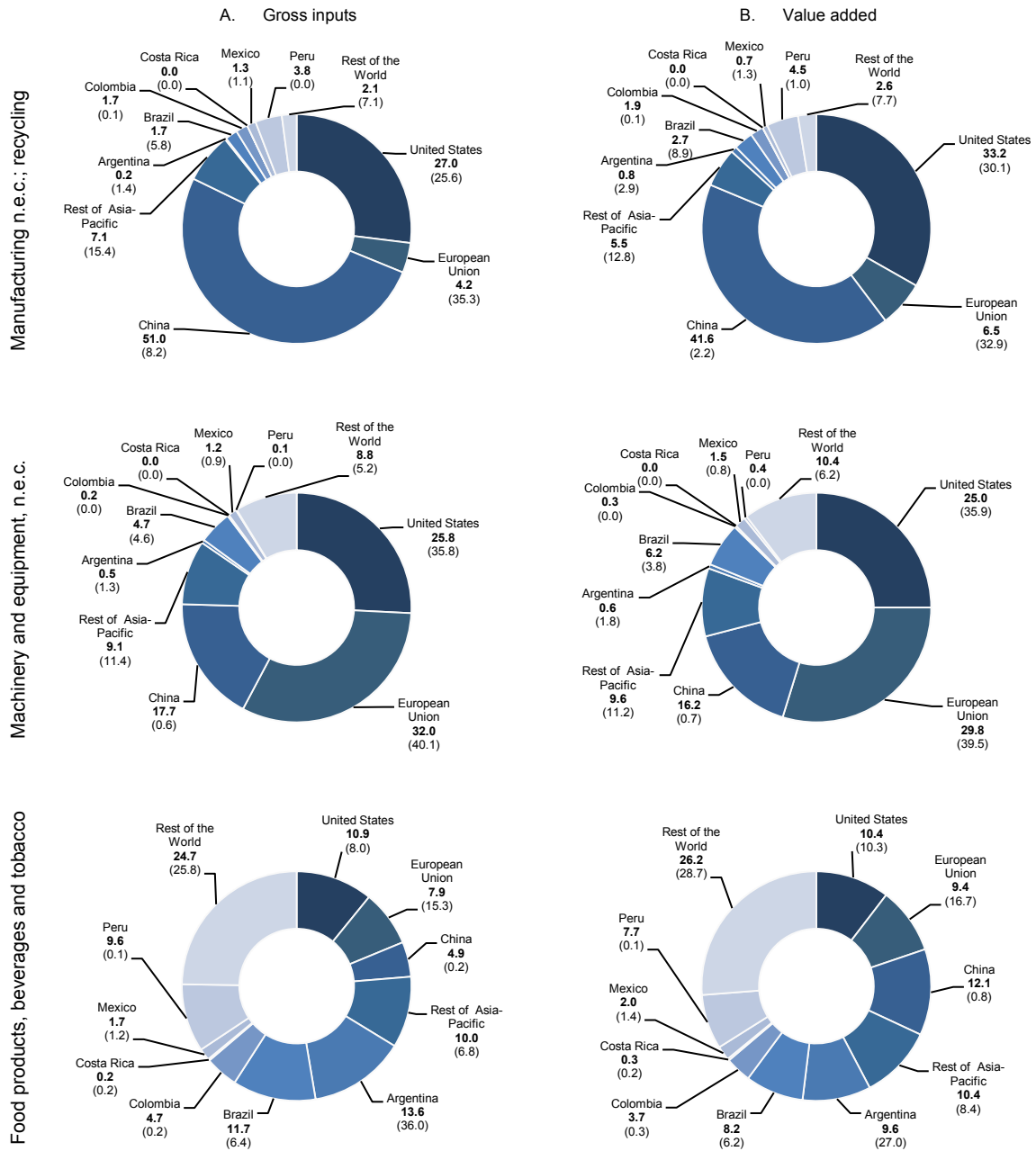
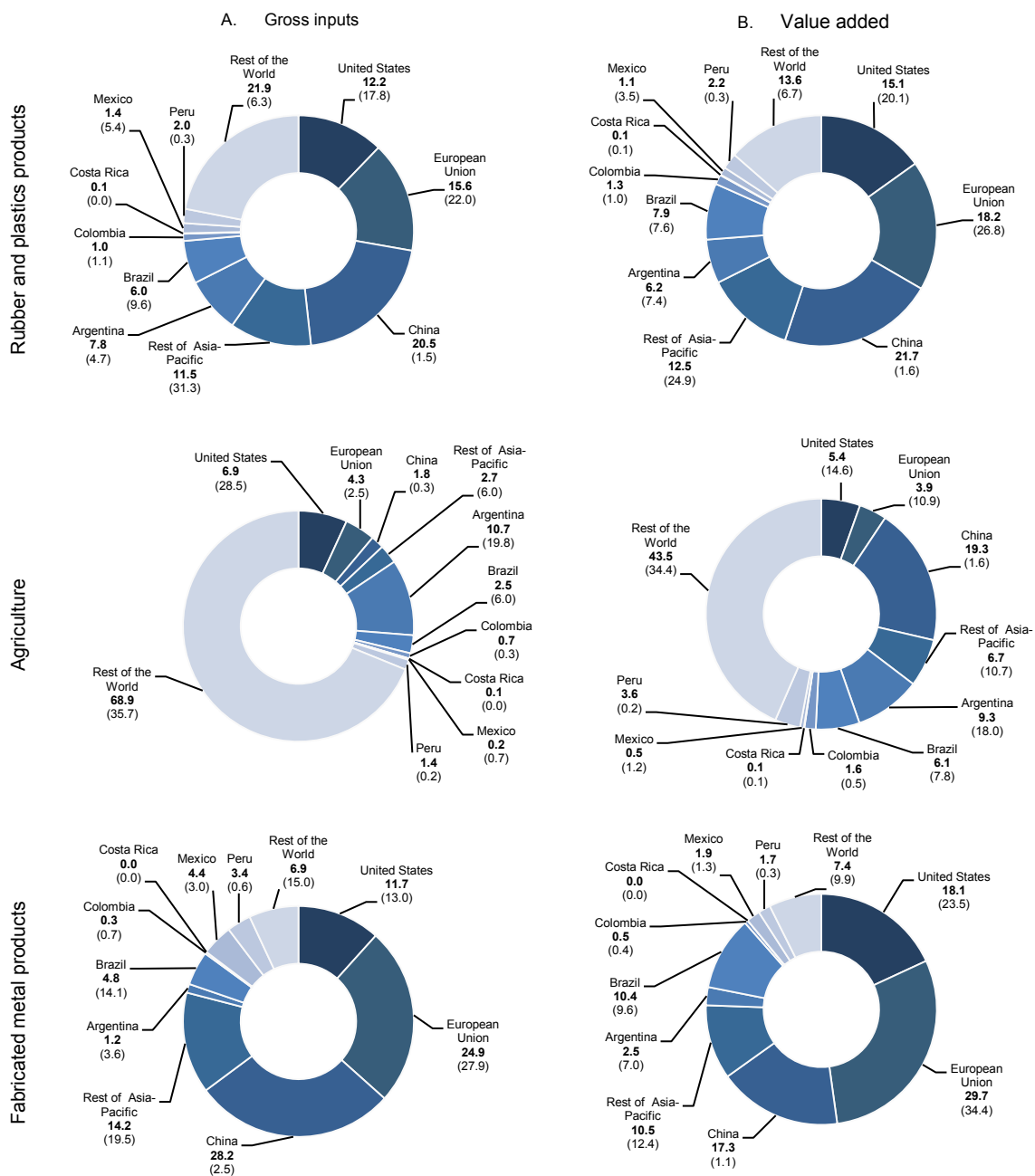


Figure 5 (concluded)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Sectors are decreasingly ordered according to their share in total imported intermediate goods in 2014 (see figure 3). Percentages in brackets indicate the share of each origin country/region in 1995.

It should be noted that a large proportion of the value added embodied in Chinese technology-intensive industries' gross exports is supplied from abroad (mostly from other Southeast Asian countries, the United States and the European Union). Thus, in value-added terms, the participation of China as a source of inputs for Chile's goods exports reduces significantly in Computer, electronic and optical equipment (to 24% in 2014,

compared to 60% for Textiles, leather and footwear). In contrast, the share of other Asia-Pacific countries, the United States and, to a lesser extent, the European Union, increases considerably.¹⁸

The United States and the European Union also account for a large proportion of foreign inputs in industries like Machinery and equipment, n.e.c., Chemicals and chemical products, Fabricated metal products and Rubber and plastics products (see figure 5), as well as in other industries with a low participation in Chile's input basket (including Pulp, paper and paper products). As for Latin American countries, Brazil and, to a lesser extent, Peru, Argentina and Colombia are the main suppliers of inputs from Mining and quarrying (with a joint participation of over 50% in 2014). Intra-regional inputs also represent a significant share of the total in the other main source sectors of Chile's backward linkages (particularly, Food products, beverages and tobacco, Basic metals, and Chemicals and chemical products).

B. Forward participation

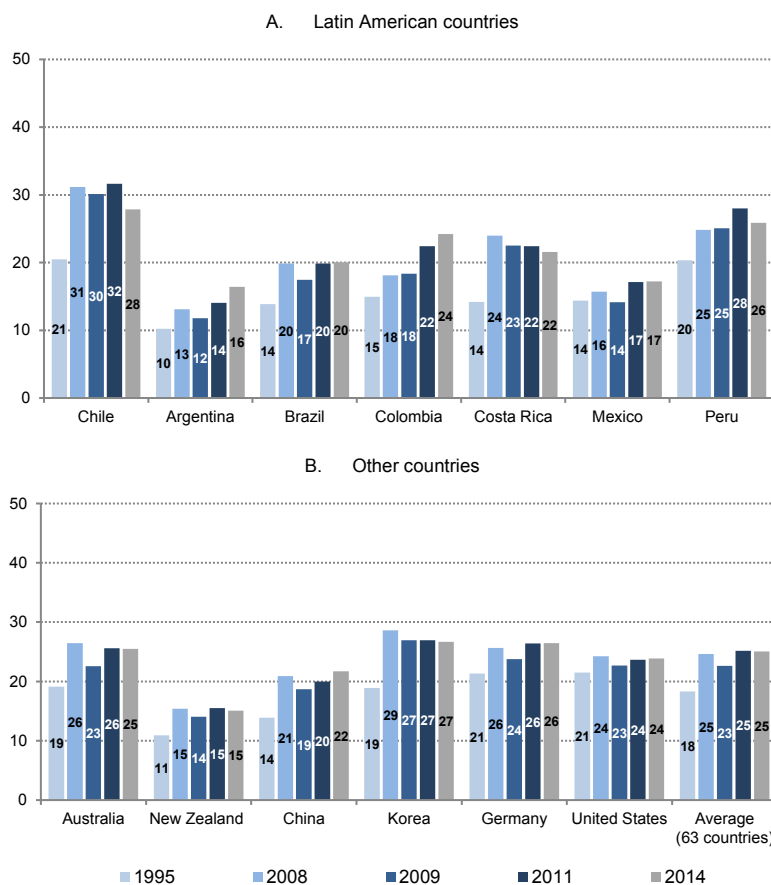
Forward participation in international production networks captures the extent to which a country's exports are used by other countries for further export generation. As an exporter of natural resource-based products, Chile is more integrated in upstream segments of the value chains, providing inputs to other countries downstream. This reflects in a relatively high level of forward participation in GVCs, particularly until 2011 (when reached 32% of gross exports, compared to 28% in 2014) (see figure 6). Other countries specialized in natural resources have, however, lower aggregate forward participation levels than Chile (particularly, Argentina and Brazil in Latin America, and New Zealand).

Countries' forward engagement in international production networks—which captures the supply side of value chains—is driven by structural characteristics such as market size and level of development, as well as by specialization patterns (Kowalski et al., 2015). A larger domestic market is associated with a higher forward participation in GVCs, since countries with a larger market can draw on a wider range of inputs to supply abroad. Also, more developed countries tend to sell a higher share of their exports as intermediate products and, therefore, tend to have higher forward linkages. On the other hand, by determining international transport costs and delivery times, geographical distance can be negatively associated with countries' forward engagement in GVCs (particularly, distance to the main manufacturing hubs in North America, Europe and Asia, around which most GVC activity is organized).

As shown in figure 7, the level of forward linkages varies greatly across Chilean exporting sectors. The largest ratios are found in Basic metals and Mining and quarrying (42% and 29% of gross exports, respectively, in 2014), the two main goods exporters. In contrast, Food products, beverages and tobacco—another natural resource-intensive sector—shows one of the lowest forward participation levels (only 8% of gross exports in 2014). For most sectors, forward linkages increased between 1995 and 2014, reaching the highest levels before 2011 (except for Agriculture, Food products, beverages and tobacco, Wood and wood products, and Machinery and equipment, n.e.c., which show higher ratios in 2014).

¹⁸ As shown in figure 5, the geographical origin of the main imported intermediates used in the production of Chilean goods exports shows smaller differences between gross and value-added shares.

Figure 6
Selected countries: Gross forward participation in GVCs, 1995, 2008, 2009, 2011 and 2014^a
(Percentages of gross exports)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

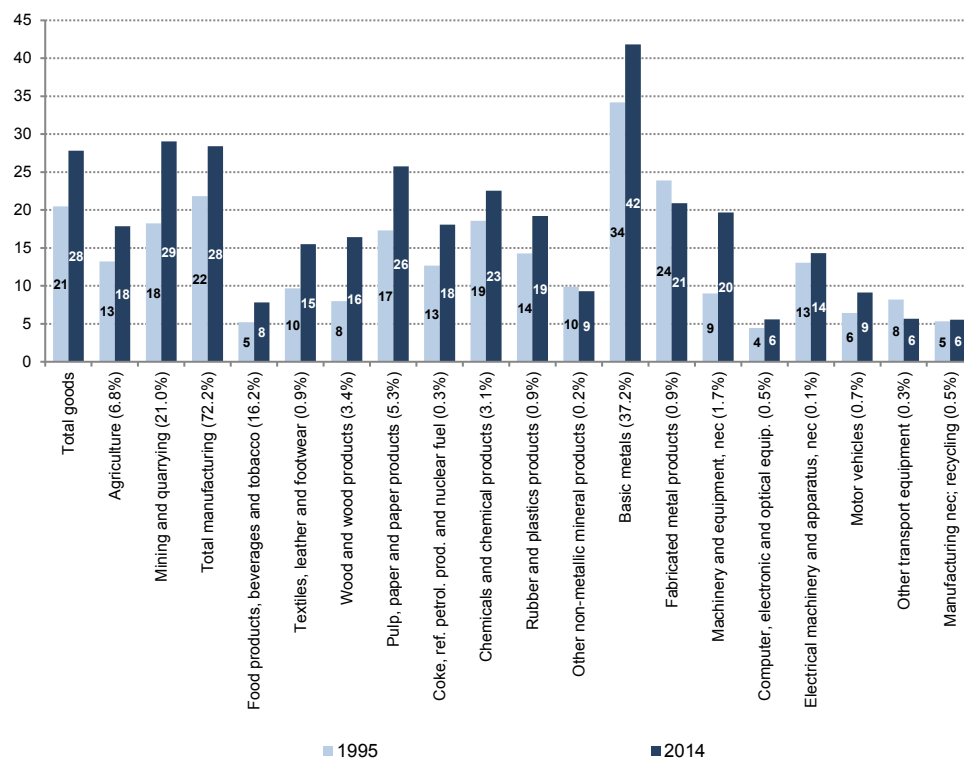
^a Services exports are excluded.

For countries away from the major GVC regions, the high transport costs implied by long distances are most likely compensated with savings in production costs arising from strong comparative advantages (Estevadeordal et al., 2013). As shown in figure 8, Chile's forward engagement in international value chains has taken place in sectors where the country's comparative advantages are the strongest. Thus, the bulk of the intermediate goods supplied by Chile to produce other countries' exports originates in the mining and metals sectors (Mining and quarrying and Basic metals, with around 80% of the total in 2014). Natural resource-based sectors also account for most other intermediates with a significant participation in Chile's forward linkages.

In terms of partner countries, Chile's forward insertion in GVCs has increasingly concentrated in China (nearly one third of the total in 2014, compared to only 2% in 1995) (see figure 9). The European Union and, to a lesser extent, other Asia-Pacific countries have, in contrast, lost participation. Intra-regional forward linkages remain limited, and concentrate in the two largest countries (Brazil and Mexico).¹⁹

¹⁹ The six Latin American countries covered in the OECD's ICIO tables accounted for around 7% of Chile's gross forward linkages in 2014. The aggregate Rest of the World, where the rest of Latin America and the Caribbean is included, represented only 2% of the total.

Figure 7
Chile: Gross forward participation in GVCs by exporting sector, 1995 and 2014^a
(Percentages of gross exports)

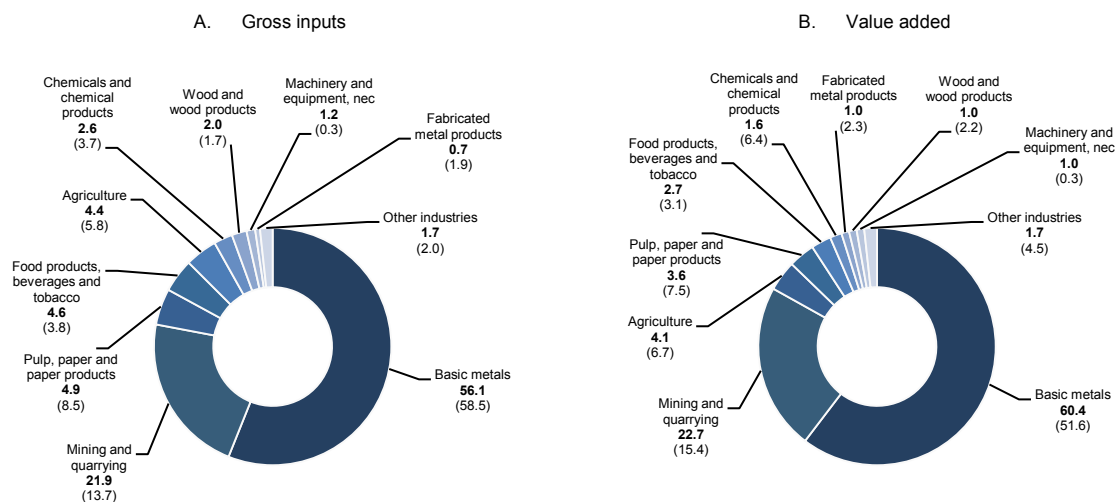


Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each sector in total goods exports in 2014.

The composition by source sector shows that, although common to all partners, the concentration in the mining and metals sectors is more accentuated in Chile's forward linkages with China and the rest of the Asia-Pacific region (see figure 10). Linkages with the United States, Latin America (6 countries) and, to a lesser extent, the European Union are more diversified in terms of origin sectors. Within Latin America (6 countries), Chile's participation as a source of intermediate goods for Argentina, Colombia, Mexico and Peru's exports shows a lower sector concentration (see figure A.1 in the annex). Particularly, it is worth mentioning Chile's forward linkages with Peru in the technology-intensive sector Machinery and equipment, n.e.c., as well as its linkages with Argentina and Mexico in Machinery and equipment, n.e.c. and Motor vehicles.

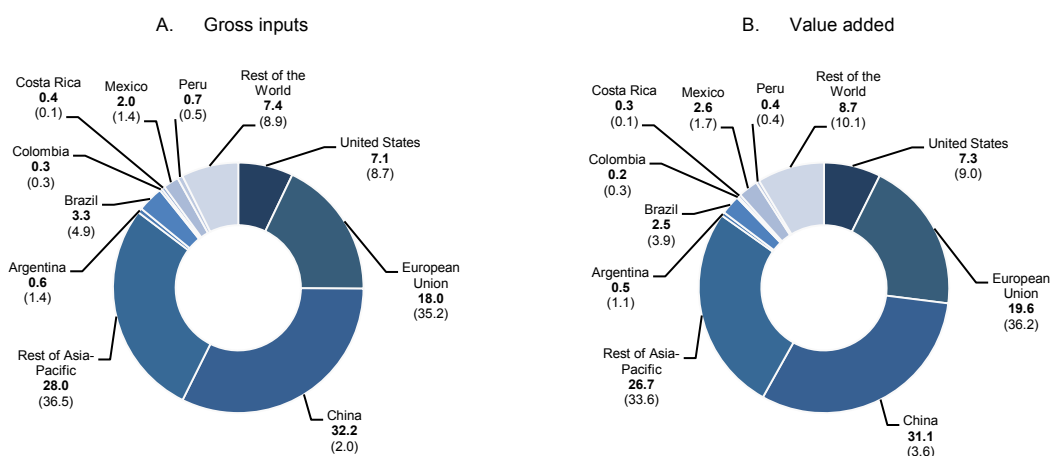
Figure 8
Chile: Domestic intermediate goods embodied in other countries' exports by source sector, 1995 and 2014^a
(Percentages of the total)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each source sector in 1995. Fuels are excluded.

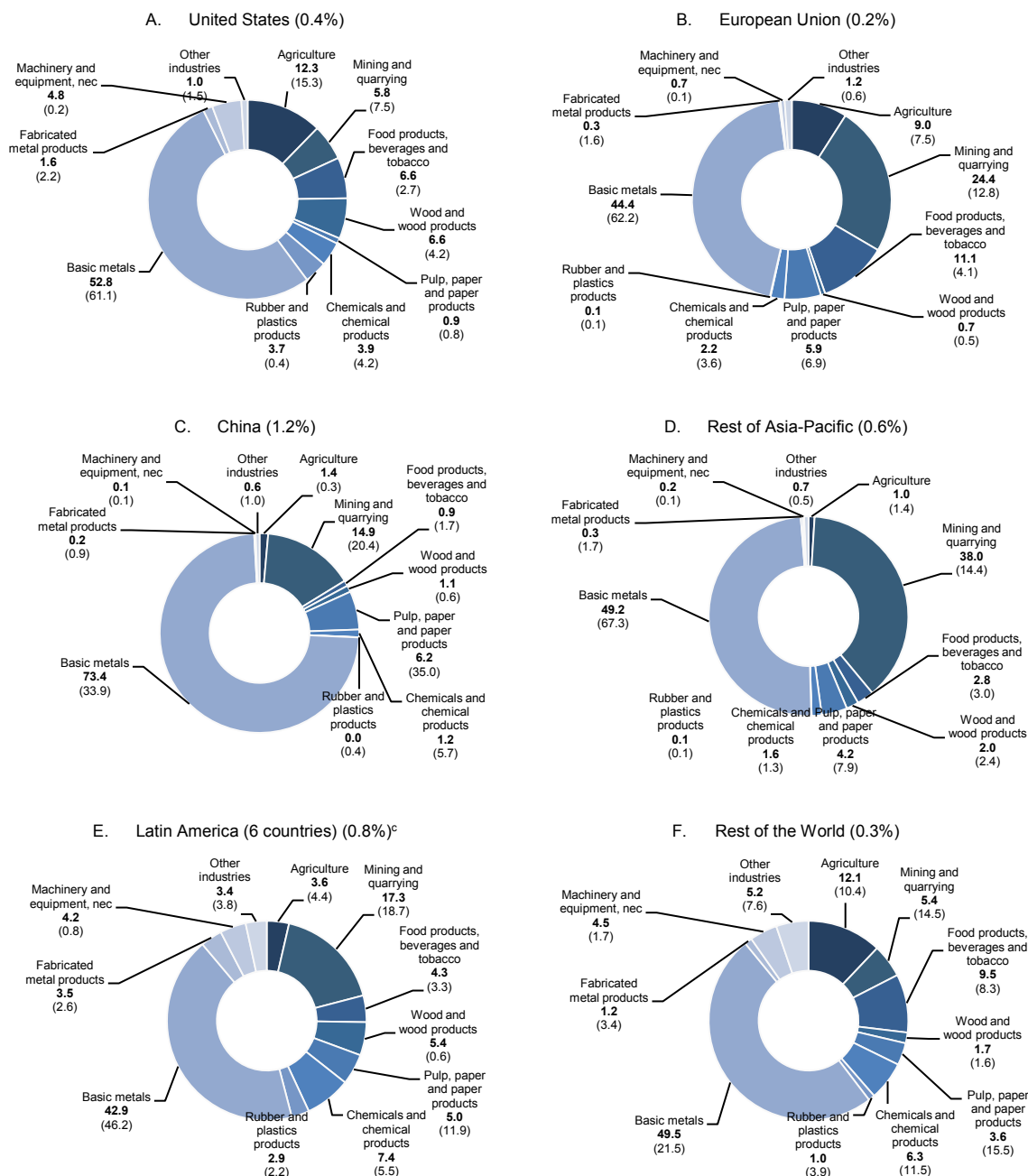
Figure 9
Chile: Domestic intermediate goods embodied in other countries' exports by importing country/region, 1995 and 2014^a
(Percentages of the total)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each importing country/region in 1995.

Figure 10
Selected regions and countries: Chilean intermediate goods embodied in other countries' exports by source sector, 1995 and 2014^{a,b}
(Percentages of the total)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each source sector in 1995.

^b Percentages in brackets next to the name of each importing country/region indicate the share of Chile as a source of foreign intermediate goods in 2014.

^c Latin America (6 countries) includes Argentina, Brazil, Colombia, Costa Rica, Mexico and Peru.

II. A firm-level perspective of Chile's forward engagement in international value chains

As shown by the aggregate measures analysed in section I, Chile's forward participation in international value chains is highly concentrated in the mining and metals sectors, where the country has the strongest comparative advantages. However, other sectors account for a significant share of the intermediate goods supplied by Chile to other countries' exports (particularly, the natural resource-based Pulp, paper and paper products, Food products, beverages and tobacco, and Agriculture). With the aim of providing a more complete description of Chile's gross forward engagement in GVC activities, the above aggregate analysis is complemented here with a characterization based on firm-level export data from the national customs office.²⁰

Customs data reveal that Chile's forward linkages are also concentrated in terms of exporting firms. As shown in figure 11, firms exporting intermediate goods from the mining and metals sectors, which account for nearly 80% of gross forward linkages, represent less than 10% of the total. In contrast, sectors with a low participation in Chile's forward linkages account for a relatively large proportion of firms (particularly, Machinery and equipment, n.e.c., Fabricated metal products, and Rubber and plastics products).

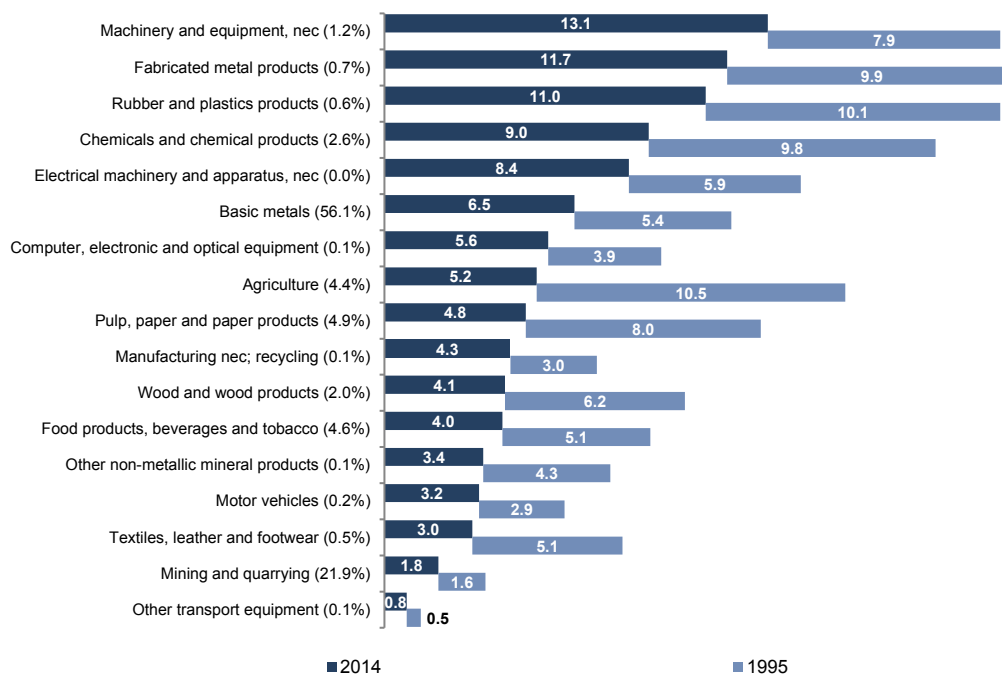
The Herfindahl-Hirschman (HH) index of export concentration shows, however, higher (and increasing) values for industries like Pulp, paper and paper products and Rubber and plastics products, than for the mining and metals sectors (indicating that, within these last two sectors, exports are more evenly distributed across firms) (see figure 12).²¹ Yet, the lowest levels of export concentration are found in the more technology-intensive industries Machinery and equipment, n.e.c. and Computer, electronic and optical equipment (which account for a low share of Chile's forward linkages), and the natural resource-based Agriculture and Food products, beverages and tobacco.

On the product dimension, the mining and metals sectors show, in contrast, the highest concentration levels (see figure 12). This is explained by the large participation of —mostly raw and semi-processed— copper products, accentuated in the 2000s by the boom in these products' prices. Other sectors accounting for a significant share of Chile's forward linkages are considerably more diversified in terms of exported products (including Agriculture, Food products, beverages and tobacco, and Pulp, paper and paper products). However, the lowest concentration levels are again found in the technology-intensive industries Machinery and equipment, n.e.c. and Computer, electronic and optical equipment.

²⁰ The dataset provides information on firms' export values at the product (10-digit national tariff line)-destination country-year level. The analysis performed here is based on 6-digit Harmonized System (HS) level data.

²¹ The normalized HH index ranges between 0 and 1. The higher the index, the more concentrated exports are in a few firms (an extreme value of 1 would indicate that one firm accounts for the sector's total exports).

Figure 11
Chile: Firms by exporting sector, 1995 and 2014^{a,b}
(Percentages of the total)



Source: Author's calculations on the basis of data from Chile's customs office.

^a Firms may export intermediate goods from more than one sector.

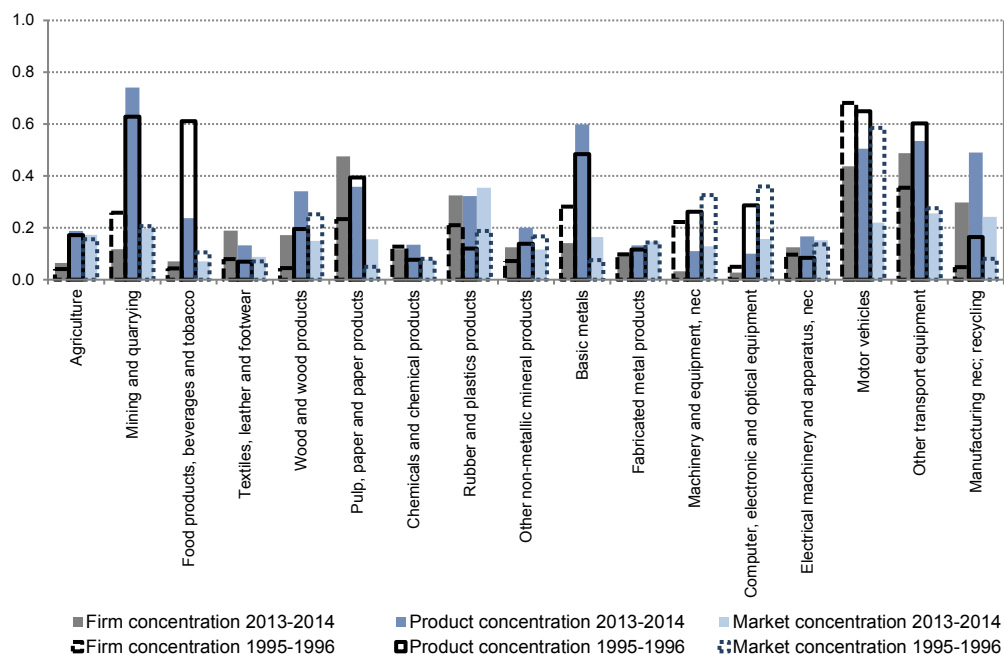
^b Percentages in brackets next to the name of each exporting sector indicate the sector's share in Chile's gross forward linkages in 2014.

In terms of destination markets, all sectors show moderate concentration levels. Despite their low participation in Chile's forward linkages, it is worth mentioning the large decline experienced between 1995 and 2014 by Motor vehicles and, to a lesser extent, Machinery and equipment, n.e.c. and Computer, electronic and optical equipment. In contrast, Rubber and plastics products, Pulp, paper and paper products and Basic metals show increasing concentration levels.

For many sectors, intra-regional intermediate exports are more diversified at the firm level than those oriented to extra-regional markets (see figure 13). However, this is not the case of the primary agriculture and mining sectors, and some of the most technology-intensive industries. The largest concentration levels are generally found, in all destination markets, in sectors with a low participation in Chile's forward linkages (the main exception is Pulp, paper and paper products).

Chile's intermediate exports to other Latin American and Caribbean countries are also generally less concentrated in terms of products than its extra-regional exports. Within the latter, exports to China tend to be less diversified than those oriented to other extra-regional markets.

Figure 12
Chile: Herfindahl-Hirschman indices of export concentration, 1995-1996 and 2013-2014
 (Normalized indices)



Source: Author's calculations on the basis of data from Chile's customs office.

When the size of firms exporting intermediates is considered (as measured by export sales), customs data show that large exporters account for a higher share of the total in the mining and metals sectors, Food products, beverages and tobacco, Wood and wood products, and Pulp, paper and paper products (see figure 14).²² For most sectors, the proportion of large exporters is considerably lower among firms selling intermediates to other Latin American and Caribbean countries than among those exporting to extra-regional markets (see table A.3 in the annex).

²² Firms are classified as small and medium-sized exporters or large exporters on the basis of their total export sales (i.e., considering both intermediate and final goods). The classification criterion follows that established by the Chilean government for manufacturing firms, according to which small and medium-sized enterprises (SMEs) are those firms with total annual sales (i.e., domestic sales plus export sales) not exceeding 100,000 *unidades de fomento* (UF, for its Spanish acronym, currently equivalent to around 4 million US dollars). It should thus be noted that, while firms classified here as large exporters can also be considered large firms, small and medium-sized exporters may not be as well SMEs (as their—unobserved— total sales may exceed the 100,000 UF threshold).

Figure 13
Selected countries and regions: Herfindahl-Hirschman concentration indices of Chile's intermediate exports, 1995-1996 and 2013-2014^a
(Normalized indices)

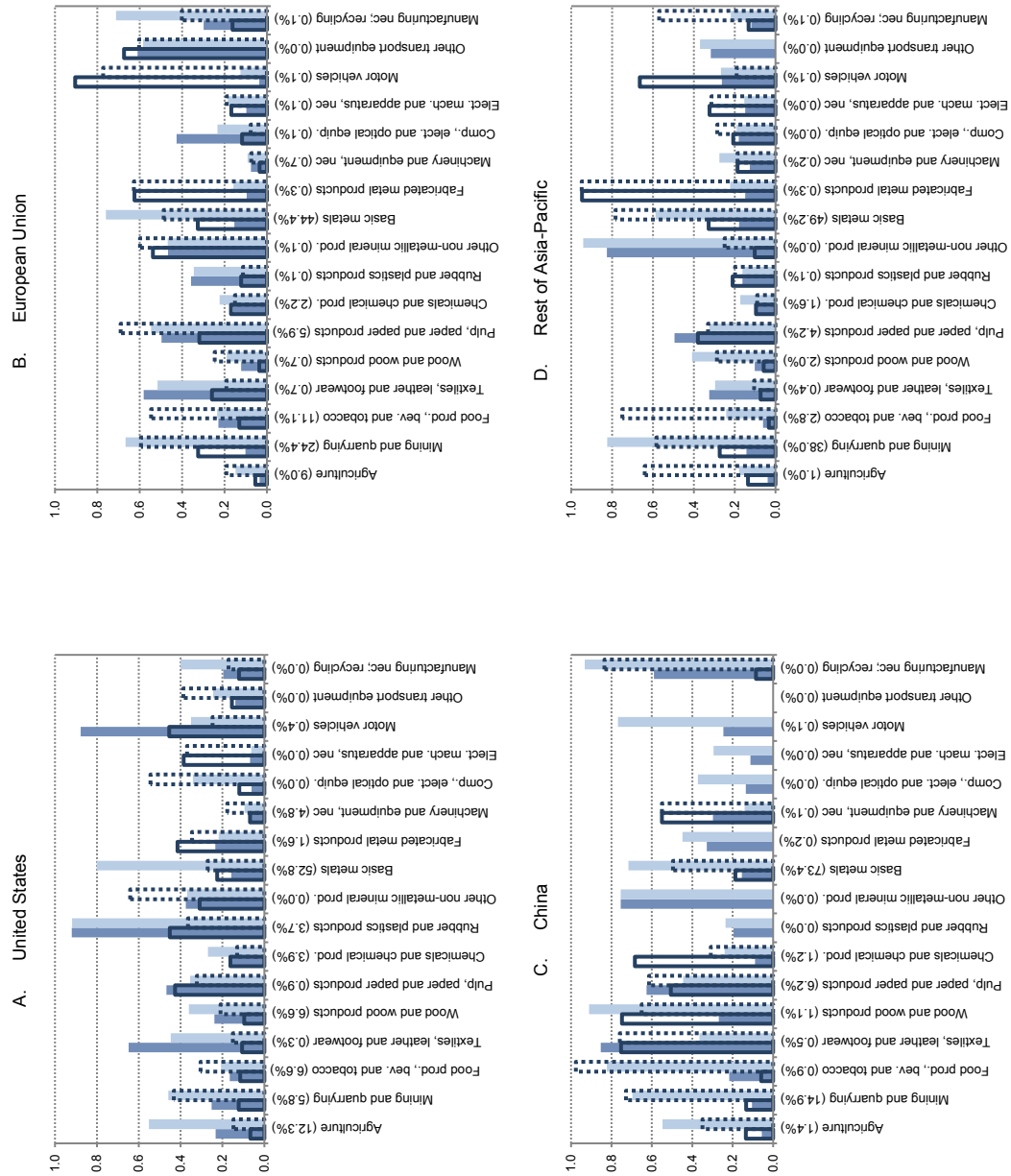
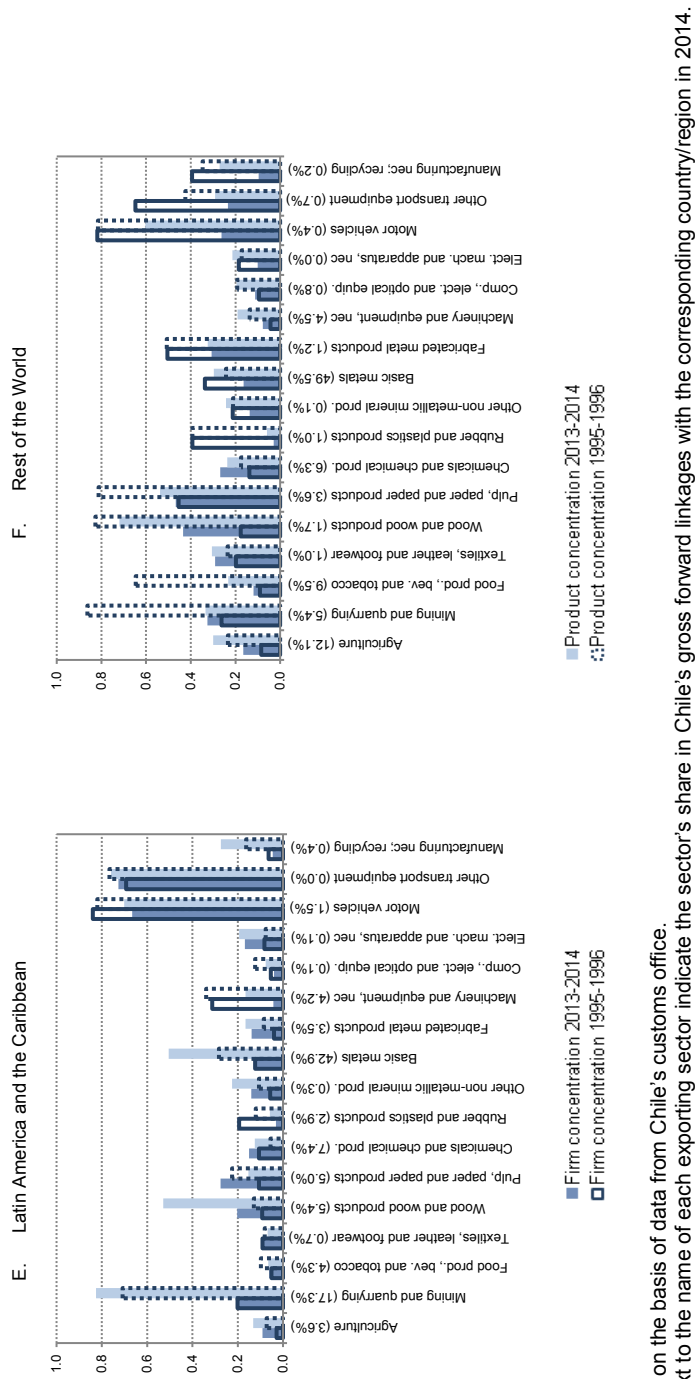


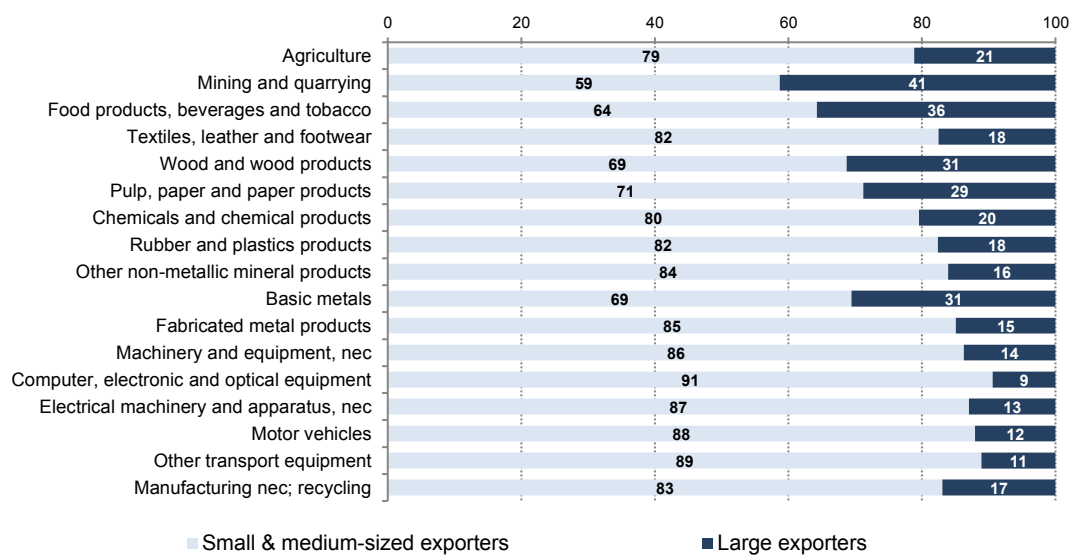
Figure 13 (concluded)



Source: Author's calculations on the basis of data from Chile's customs office.

^a Percentages in brackets next to the name of each exporting sector indicate the sector's share in Chile's gross forward linkages with the corresponding country/region in 2014.

Figure 14
Chile: Firm size composition by exporting sector, 2014
(Percentages of the total)



Source: Author's calculations on the basis of data from Chile's customs office.

III. Concluding remarks

Although international trade has been a major driver of Chile's economic growth in the last decades, exports remain highly concentrated in the mining and metals sectors (which capture copper products at different levels of processing). The aggregate data analysed in this document show that this export specialization pattern reflects in a relatively low level of backward participation in international production networks. In contrast, Chile's forward linkages are relatively high, revealing an upstream position in GVCs.

The analysis of forward linkages shows that the bulk of the intermediate inputs supplied by Chile to other countries' exports are natural resource-based goods (including those originated in the mining and metals sectors, Pulp, paper and paper products, Food products, beverages and tobacco, and Agriculture). However, some more technology-intensive industries have a significant participation in Chile's intra-regional forward linkages (particularly, those with Argentina, Mexico and Peru). In terms of partner countries, China has accounted for an increasing share of the total, in detriment of the European Union and, to a lesser extent, other Asia-Pacific countries. Intra-regional linkages remain limited, and concentrate in the two largest countries (Brazil and Mexico).

The concentration of Chile's forward linkages in the mining and metals sectors entails a high concentration in terms of exporting firms, as revealed by the customs data analysed in this document. Also, the mining and metals sectors show the highest concentration levels in the product dimension. Other sectors accounting for a significant share of Chile's forward linkages are considerably more diversified in terms of exported products (including Agriculture, Food products, beverages and tobacco, and Pulp, paper and paper products). For many sectors, intra-regional intermediate exports are less concentrated at the firm and product level than those oriented to extra-regional markets (particularly, China). Also, the proportion of small and medium-sized exporters tends to be significantly higher among firms selling intermediates to other Latin American and Caribbean countries.

Integration into international value chains offers opportunities for deeper specialization and greater export and production diversification, enabling countries to exploit finer comparative advantage niches and benefit from economies of scale and scope. GVC activities can generate significant positive spillovers in the domestic economy, in terms of productivity gains, creation of high-quality jobs, skills and technology transfer to local firms, and greater integration of small and medium-sized enterprises (SMEs). To better reap these benefits, Chile needs to upgrade and diversify its participation in GVCs.

Upgrading in GVCs implies gaining competitiveness in more technology-intensive and higher value-added products (product upgrading), tasks (functional upgrading) and/or sectors (inter-sector upgrading). This could be achieved by improving the skills and know-how of the workforce (skills

upgrading), improving firms' absorptive capacity and technology (capital upgrading), or increasing productivity in existing tasks (process upgrading) (Taglioni and Winkler, 2016).

Adding further manufacturing processing to copper products could be a way to increase the sophistication and diversification of Chile's insertion in GVCs. This would allow to capture more value and create more employment around the mining and metals sectors (OECD, 2015). Notwithstanding this, Chile should loosen its dependence on the copper sector by increasing other sectors' participation in GVCs. As shown in this document, non-copper sectors account for the bulk of exporting firms and are more diversified in terms of exported products. Although Chile's comparative advantages in intermediate goods concentrate in natural resource-based sectors (particularly, Agriculture, Food products, beverages and tobacco, Wood and wood products, Pulp, paper and paper products, along with the mining and metals sectors) (Zaclicever, 2017), there is potential for some more technology-intensive industries in intra-regional markets.

Innovation is a key determinant of countries' competitive advantages, playing a central role in their ability to enhance the upgrading opportunities within international value chains. Despite the progress made in recent years, Chile's innovation performance (e.g., firms' propensity to innovate, aggregate R&D expenditure, innovation outputs such as patents) is below other comparable economies (including resource-intensive countries and countries at a similar level of development).²³ This is associated with Chile's lack of sufficient skilled human capital, as well as the relatively small size of its manufacturing sector. Increasing the efficiency of current government innovation promotion programmes (e.g., those offered by the Production Development Corporation (CORFO), the National Commission for Scientific and Technological Research (CONICYT), and ProChile) will contribute to address firms (particularly, SMEs)' barriers to innovate and add value to products and services in which Chile enjoys a comparative advantage (OECD, 2015).

Increasing regional integration can also contribute to diversify and upgrade Chile's participation in GVCs. Chilean intermediate exports to other Latin American and Caribbean countries are significantly less concentrated, in terms of firms and products, than those oriented to extra-regional markets. However, intra-regional forward linkages represent a low share of the total. For most Latin American and Caribbean partners, specialization in natural resources plays an important role in their low backward integration with Chile (and other countries). Another explanatory factor is the relatively low level of trade openness in the region.²⁴ Deeper intra-regional agreements (covering topics such as rules of origin, investment protection, non-tariffs measures, intellectual property rights, trade facilitation and customs cooperation, competition policy, and free movement of people) would contribute to promote production integration within the region, at least partly compensating for the high transport costs implied by long distances across the continent and the low quality of the logistics infrastructure.

²³ See OECD (2015) for an analysis based on the OECD Science Technology and Innovation (STI) Outlook.

²⁴ Chile's trade agreements with developed countries are considerably deeper than those signed with Latin American countries (which usually aim to promote and regulate trade among member countries without the goal of free trade) (OECD, 2015).

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Annex

Additional tables and figures

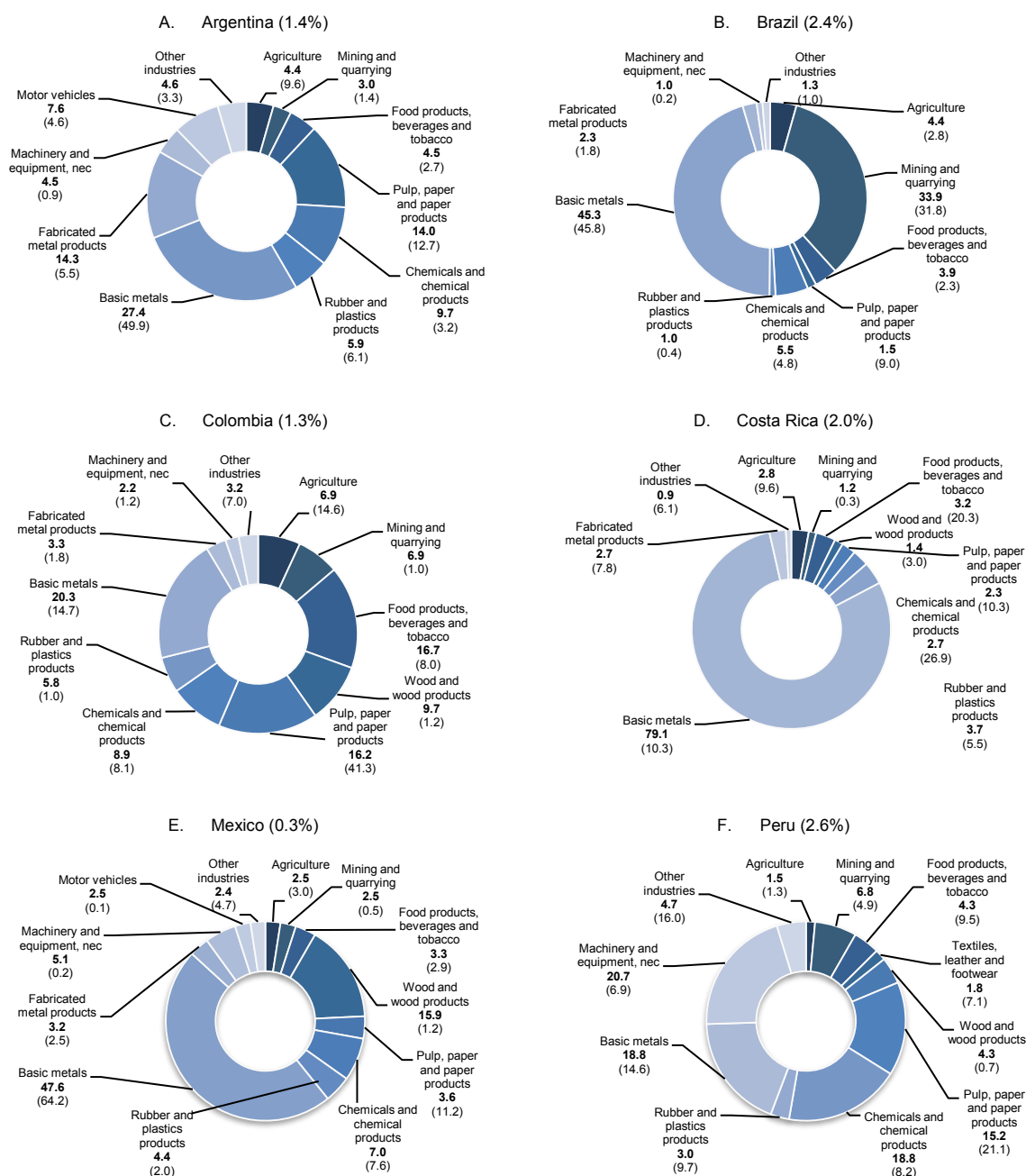
Table A.1
Industry breakdown of OECD's ICIO tables

Group	Code	Description
Primary	C01T05	Agriculture, hunting, forestry and fishing
	C10T14	Mining and quarrying
Manufacturing	C15T16	Food products, beverages and tobacco
	C17T19	Textiles, textile products, leather and footwear
	C20	Wood and products of wood and cork
	C21T22	Pulp, paper, paper products, printing and publishing
	C23	Coke, refined petroleum products and nuclear fuel
	C24	Chemicals and chemical products
	C25	Rubber and plastics products
	C26	Other non-metallic mineral products
	C27	Basic metals
	C28	Fabricated metal products
	C29	Machinery and equipment, n.e.c.
	C30.32.33	Computer, Electronic and optical equipment
	C31	Electrical machinery and apparatus, n.e.c.
	C34	Motor vehicles, trailers and semi-trailers
	C35	Other transport equipment
	C36T37	Manufacturing n.e.c.; recycling
Services	C40T41	Electricity, gas and water supply
	C45	Construction
	C50T52	Wholesale and retail trade; repairs
	C55	Hotels and restaurants
	C60T63	Transport and storage
	C64	Post and telecommunications
	C65T67	Financial intermediation
	C70	Real estate activities
	C71	Renting of machinery and equipment
	C72	Computer and related activities
	C73T74	R&D and other business activities
	C75	Public admin. and defence; compulsory social security
	C80	Education
	C85	Health and social work
	C90T93	Other community, social and personal services
C95	Private households with employed persons	

Table A.2
List of countries covered in the OECD's ICIO tables

Region	Countries
North America	Canada, United States
Latin America	Argentina, Brazil, Chile, Colombia, Costa Rica, Mexico, Peru
European Union	Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Poland, Portugal, Romania, Slovak Republic, Slovenia, Spain, Sweden, United Kingdom
Rest of Europe	Iceland, Norway, Russian Federation, Switzerland
Asia-Pacific	Australia, Brunei Darussalam, Cambodia, China, Hong Kong (Special Administrative Region of China), India, Indonesia, Japan, Malaysia, New Zealand, Philippines, Republic of Korea, Singapore, Thailand, Taiwan (Province of China), Viet Nam
Rest of Asia	Israel, Saudi Arabia, Turkey
Africa	Morocco, South Africa, Tunisia

Figure A.1
Latin America (6 countries): Chilean intermediate goods embodied in other countries' exports by source sector, 1995 and 2014^{a,b}
(Percentages of the total)



Source: Author's calculations on the basis of current-price input-output data from the Organisation for Economic Cooperation and Development (OECD)'s ICIO tables.

^a Percentages in brackets indicate the share of each source sector in 1995.

^b Percentages in brackets next to the name of each importing country indicate the share of Chile as a source of foreign intermediate goods in 2014.

Table A.3
Chile: Proportion of large exporters by destination market, 2014
(Percentages of the total)

Sector	United States	European Union	China	Rest of Asia-Pacific	Latin America and the Caribbean	Rest of the World
Agriculture	34.1	33.3	27.3	29.8	26.7	39.3
Mining and quarrying	72.2	79.3	85.7	85.3	33.8	61.5
Food products, beverages and tobacco	59.6	49.2	70.0	60.2	37.5	50.0
Textiles, leather and footwear	33.3	25.0	100.0	22.2	17.8	30.0
Wood and wood products	55.9	44.3	43.8	48.1	29.0	52.4
Pulp, paper and paper products	51.4	52.9	100.0	54.5	27.4	47.4
Chemicals and chemical products	47.9	51.4	62.5	54.9	18.7	56.5
Rubber and plastics products	43.9	36.5	37.5	48.1	16.1	44.4
Other non-metallic mineral products	33.3	6.5	0.0	30.0	19.1	23.1
Basic metals	72.2	67.2	86.5	81.5	24.4	58.7
Fabricated metal products	31.8	23.8	72.7	46.2	14.9	34.5
Machinery and equipment, n.e.c.	26.2	26.9	46.2	25.8	11.4	31.0
Computer, electronic and optical equipment	13.6	7.4	28.6	3.8	10.8	13.0
Electrical machinery and apparatus, n.e.c.	24.4	15.8	39.1	33.3	11.9	32.3
Motor vehicles	22.5	7.1	66.7	27.3	13.4	41.7
Other transport equipment	7.4	11.1	0.0	0.0	17.6	12.5
Manufacturing n.e.c.; recycling	41.2	35.4	26.8	17.9	17.2	14.3

Source: Author's calculations on the basis of data from Chile's customs office.



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