International sourcing during Covid-19: How did chilean firms fared?*

PRELIMINARY DRAFT

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Abstract

Covid-19 has proven to be a unique an complex shock for firms. In a relatively short time span, firms have faced dramatic demand declines, and from the production side, have faced labor shortages, the need to re-organize their tasks to keep up with health restrictions, supply disruptions in their input materials leading to interruptions in their activity, causing to bottlenecks in production, etc. And possibly all this will lead to an increase in production costs. In this paper we analyze the performance of individual Chilean firms during this episode, drawing on administrative datasets, to evaluate their performance. In particular we focus on the sample of firms participating in international trade. We document several empirical findings. Importer firms, specially in the manufacturing sector have faced changes in the extensive margin, importing less product varieties and at initially at higher costs. On the contrary, exporter firms seem to have faced less changes .

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1 Introduction

In the current pandemic context, where there have been multiple shocks, it is of great interest to understand the impact on international trade and the behavior of firms in light of weak demand, supply disruptions from overseas, increasing costs, etc. It is also of great interest to understand their potential reaction to increasing costs and its potential pass-through to prices. Armed with very granular data at product and firm level we explore in great detail the reaction of Chilean firms.

Since the start of the pandemia international trade has faced several challenges with different degrees of intensity along 2020 and 2021. The closure of production plants or ports, from main global suppliers, with different degrees of intensity during the last months. Higher transport costs, longer delivery times, the difficulties to find key intermediate inputs are making that some firms are not able to keep up with production targets to couple with a swift demand recovery, once the vaccination rates are relatively high and efficacy against variants are performing well. In addition the shortage of finished/consumer goods could lead to price pressures.

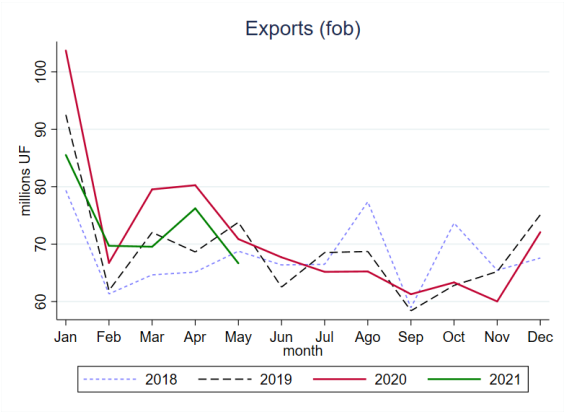
By analyzing monthly data and highly detailed firm-level micro trade data to disentangle the channels through which the crisis initially affected macro trade outcomes in Chile. From a policy point of view, the question arises of what trade margins are driving these aggregate developments. As the aggregate can hinder developments driven by the number of trading firms, the number of traded products, and the number of trade transactions or associated shipments (extensive margin), a collapse of trading values for certain trading firms, products and transactions (intensive margin)?, or both?

An additional question is whether the firms will transfer the observed increases in input materialcosts, in transport freights to their prices? We also exploit firm level variation in the usage of inputs. As firms have strongly heterogeneous production functions and their sourcing decisions make them unequally exposed to foreign shocks. The simple idea is that firms/sectors that are more dependent on inputs imported, specially from China, should also be more affected by supply chain disruptions stemming from the initial Covid-19 crisis in China or Asia in general.

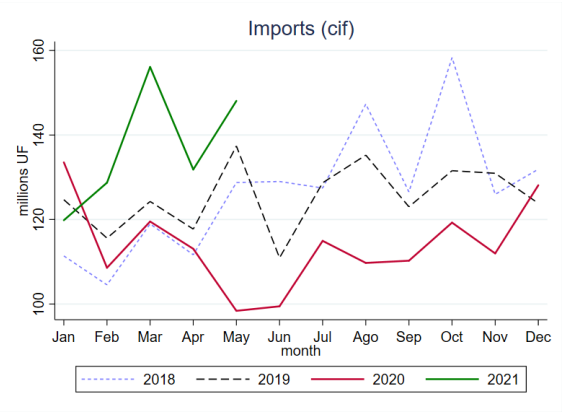
How we do it.– We make use of three different administrative dataset. First, the "Factura" which contains balance sheet information on the total sales, employment, material purchases and capital stock... on a monthly basis. Second, the "Factura Electrónica" (FE) that contains firm to firm data on sales, only to domestic clients. And finally, we use "Customs data" with information on imports and exports at a very disaggregated level in terms of products HS-8digit, country of origin or destination. In **figure 1** we show the evolution of trade flows based on our firm-

Figure 1: Aggregate Trade

(a) Exports



(b) Imports



Notes: **Panel (a)** compares the export volumes in each year. In terms of volumes, ... In **Panel (b)** volumen importado.

Sources: Chilean Customs and own calculations.

level sample. In value terms, exports have performed in 2020-21 relatively similar to previous years. While imports show a noticeable different pattern. A sharp decline in 2020 followed by a strong recovery in 2021. While domestic factors could have pushed this sharp recovery, in a context of supply shortages is of utmost interest to exploit the granular data to understand the drivers and macroeconomic implications of this recovery.

Representativeness of the dataset.– It is crucial to assess the representativeness and coverage of the microdatasets. So, in line with other institutions we first check the representativeness of the dataset as Kalemli-Ozcan et al. (2015) and Almunia et al. (2018). As we also make use of customs data we need to check its representativeness, we base the checks on Bergounhon et al. (2018). Using official statistics from the Central Bank of Chile and Instituto Nacional de Estadísticas, we show that: the resulting dataset covers more than 80% of firms registered in the census over the years 2018-2020. The firm level data can replicate the growth rates of output, employment and wage bill (see **figure 9**). The merge with Customs data covers between 80% and 90% of imports and exports of the official data.

Results.– We compare performance of 2019, 2020 and the first seven months of 2021, these data reveal: During the beginning of the pandemic, exports were less affected than imports, however, since the end of 2020, imports showed a dynamics that exceeded the performance shown at least during the study period. This recovery in imports has been broadbased in terms of the type of good: intermediate goods,

consumption, capital, etc. perhaps influenced by the liquidity that occurred in Chile within the support programs to face the pandemic. At the aggregate level, the intensive margin was reduced for both imports and exports during the onset of the pandemic. Within imports, firms in the distribution sector, that comprises wholesale firms, recovered their intensive margin faster than manufacturing firms. It also worth to highlight the increase by distribution firms of the new products margin, which again, all categories have registered sharp increases consumer, intermediate and capital goods.

Related literature.– This work relates on different strands of the literature. First, this paper is related with (the prolific) literature on the impact of Covid-19, in particular on international trade, the exposure to China and the consequences of supply disruptions. From a sectorial perspective Cerdeiro and Komaromi (2020) find strong but short-lived supply spillovers of lockdowns through international trade. Moreover, the evidence is suggestive of the downstream propagation of countries' lockdowns through global supply chains. Meier and Pinto (2020) showed that highly exposed sectors suffered larger declines in production, employment, imports, and exports. From a product perspective Jaravel and Mejean (2021) find that in France, vulnerabilities are highly concentrated in products of the chemical sector, which includes imports of active ingredients (inputs) for medicines. The highest percentage of these inputs is purchased in the United States and China.

Second, this paper is also related with firm-level literature to explore firm-dynamics during covid-19. In de Lucio et al. (2020), by combining Spanish firm-level monthly trade data with country-level Covid-19 containment measures over February-July 2020, they show that the value of exports decreased more in destinations that introduced strict containment measures, whereas the value of imports remained unaffected. Strict containment measures in a partner country increased the probability of a firm ceasing to trade with it. Negative effects were concentrated between March and May 2020. The detrimental effect of containment on exports was larger for goods consumed outside the household, for wholesalers and retailers, and for manufacturers not participating in global value chains.

Our paper connects with the literature that focuses on the impact of cost shocks on prices. The pass-through of costs such as tariffs have been analyzed by Cavallo et al. (2019) and they find that the degree of pass-through is higher at the border than at retail level. Exchange rate pass-through Giuliano and Luttini (2019). Ganapati et al. (2020), Duprez and Magerman (2018) and Amiti et al. (2014) document how firms change their prices in response to cost shocks and other price changes and their relationship to buyers and suppliers in a production network. Finally, we also rely on the literature on the role of production networks. Huneuus (2018).

This paper contributes to the micro literature that evaluates the performance or response of firms in times of Covid-19, considering recent information (until August 2021), taking advantage of the heterogeneity that we can explore with micro data.

This paper is organized as follows. After this introduction, in **section 1**. In **section 2** we describe with more detail the data used for the analysis. In **section 3** we report the main results on extensive and intensive margins and behavior of firms according to size and economic sector where they work. In section **section 4** we approximate the impact on prices that firms have faced using unit values. Finally, in **section 6** we conclude with the preliminary results drawn so far.

2 Datasets

In this section, we introduce the data used in the analysis. Our monthly panel dataset consists of different administrative sources that compile information on Chilean firms from 2017 to 2021. The usage of a common identifier allows to merge all the datasets.

Servicio de Impuestos Internos.– database contains income statements (Form 22) which details information across 2013-2016 at firm level on the value of total operating revenues, costs, wages and capital stock, among others.

Xxx.– This database corresponds to wage statements (Form 1887) that provide the number of salaried employees for each firm. Then, following the OECD Structural Business Statistics, firms are classified in SMEs (1-249 employees) and large enterprises (more than 249 employees).

Xxx.– This database contains the value added tax (VAT) statements that report gross exports and imported costs at firm level. In addition, an industry classification – following the ISIC REV.4 - was added to the previous forms using the business register from National Accounts.

Customs data.– The dataset provides information at the firm level on a monthly basis on the universe of international transactions, both exports and imports, at very dis-aggregated level in terms of country -as of its destination/origin- and in term of product -at HS8-. The dataset provides information as regards the value of the transaction in USD (which is converted into CLP) and the quantity. We aggregate the data up to the 6-digit level. The dataset contains a firm identifier. As working at the six-digit classification can be noisy, we aggregate the data to the four-digit level (HS4). In the rest of the paper we use the terms "product" and "good" to refer to a HS4 category. We make use of Broad Economic Categories (BEC) classification as we are interested in the classification of goods as intermediate goods, industrial supplies, or capital good parts.

We work with two samples.The sample of firms after applying the basic cleaning steps, we label as *full sample* and a *permanent sample*, where we keep the information of those firms that report every month. Although this implies loosing information, we avoid the issue of results driven by compositional changes.

3 Stylized facts

In this section we will provide the basic evidence at the firm level of our dataset and its coverage with respect official data. Then we will show some stylized facts of the Chilean firms.[1]

3.1 Data at a glance

In **table 1** we report the main characteristic of the firms used in the analysis, with the total sample and considering only those firms that are reporting purchase or sale information at customs on a monthly basis.

- **Number of employees**.– Importing firms have more employees than those that do not buy inputs directly from abroad.
- **Turnover**. On average, the sales performance of importing firms surpasses those that do not directly buy their products abroad, although it is possible that some firms buy that do not import, buy indirectly abroad by sourcing from distributors.
- **Capital deepening**.– Importer firms more capital usage.
- **Import shares**.– The propensity of firms to purchase inputs within the firm boundaries can account for 50% of total materials and account for 30% of sales. [2]
- **Exports**.– Firms export 50% of their output.

[1] In Appendix B we report the coverage of the dataset see **figure 7**.

[2] In Cravino (2014) "I start by providing some indirect evidence that imported inputs are not a large share of the total production costs of Chilean exporters." There are two ways to check this. First, over total costs and over total revenues.

Table 1: Summary Statistics

	Total					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	15.0	145.4	13.6	120.9	20.5	216.6
Sales (thousands)	1.5	118.4	1.1	107.4	2.5	144.1
Capital per worker (thousands)	0.3	0.5	0.2	0.5	0.4	0.7
Sales per worker (thousands)	0.1	0.1	0.1	0.1	0.3	0.2
Export (thousands)	15.5	152.3	8.0	126.6	36.5	206.3
Export share in output	0.5	0.4	0.6	0.4	0.2	0.3
Imports (thousands)	9.6	117.9	.	.	9.6	117.9
Import share in sales	0.3	0.3	.	.	0.3	0.3
Import share in materials	0.5	0.4	.	.	0.5	0.4
	Permanent sample					
	Full Sample		***non-Importers***		***Importers***	
	Mean	std.dev	Mean	std.dev	Mean	std.dev
Employment	17.83	149.75	15.00	104.57	31.92	281.66
Sales (thousands)	3.16	168.24	1.67	125.36	46.02	623.76
Capital per worker (thousands)	0.28	0.56	0.26	0.52	0.42	0.71
Sales per worker (thousands)	0.15	0.17	0.15	0.16	0.31	0.22
Export (thousands)	18.48	164.29	9.78	138.86	37.90	208.94
Export share in output	0.47	0.39	0.57	0.39	0.24	0.31
Imports (thousands)	10.94	127.32	.	.	10.94	127.32
Import share in sales	0.34	0.27	.	.	0.34	0.27
Import share in materials	0.47	0.38	.	.	0.47	0.38

Note: Based on dataset after basic cleaning. EGW, Mining and Public Administration sectors have been excluded. Monetary values are in Unidades de Fomento (UF).

3.2 A focus on trade dynamics

Constructed from our firm-level sample in **figure 2** we show the aggregate trends in imports over time by breaking the sample into imports by manufacturing firms and imports from distributors, both wholesalers and retailers. We do so as we expect a differentiated behavior of manufacturing firms acting as direct importers of intermediate goods.[3]

We decompose growth in imports into a within-firm intensive component (blue) and three different net extensive margins: net new firms[4], net new importers and net new products. We can observe that import dynamics is mainly driven by the intensive margin. Notwithstanding the extensive margins have played an important role during the lockdown period and along the recovery initiated at the beginning of 2021, led mainly by wholesalers and retailers. The large magnitude of the extensive margin calls for an explicit analysis on the decision to enter additional import markets, that is, whether it is a reflection of recovering the pre-pandemia trading links or new links.

Export and Import shares.– To capture the differentiated dependency on imports for each firm, we compute the import share over total materials as in Blaum (2018). And then we decompose into the within, between component and the covariance to check to what extent firms increased their import share within or whether firms that grew in size are the ones with higher import shares.

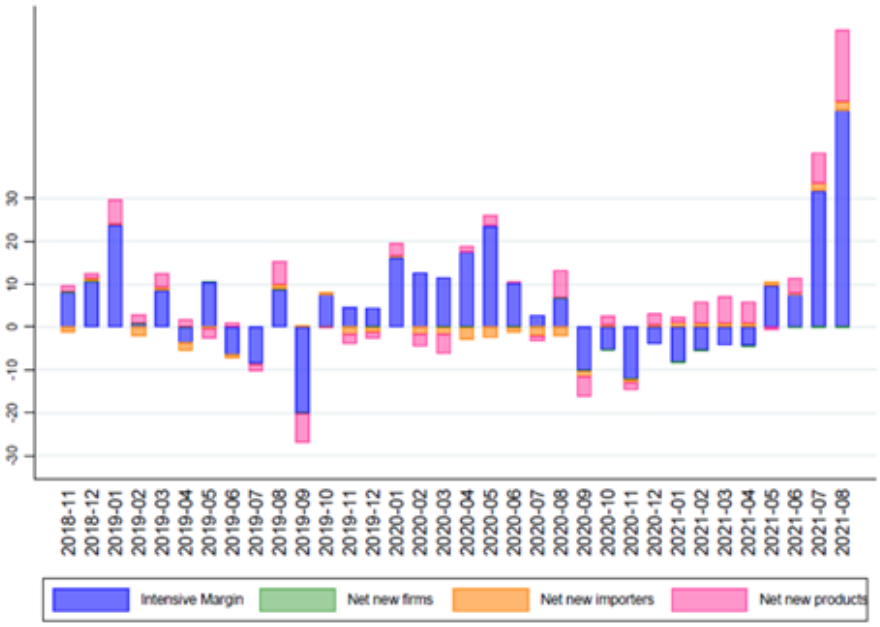
Firm level exported and imported varieties.– Given the observed contribution of the extensive margin on products in **figure 2** we exploit at the firm level the information on imported products. In **figure 3** we plot the time dummies at the firm-level of the average (ln) number of varieties (product# destination) both in terms of products and the number countries of origin, being quite abrupt at the start of the pandemic but recovering to pre-crisis levels. When looking the behavior of exporter firms we can observe that, on average, firms reduced the number of varieties, but to a lesser extent, and mainly driven by the number of destination countries.

[3]In **graph 11** we show that the main type of imported goods according to BEC are intermediates. A further breakdown shows that a limited fraction of firms act as direct importers and that firms have access to imported inputs through distributors. Indirect importers could be flagged by using the information on "Factura Electrónica" in the same vein as indirect exporters as in Marcel and Vivanco (2021) (TBC).

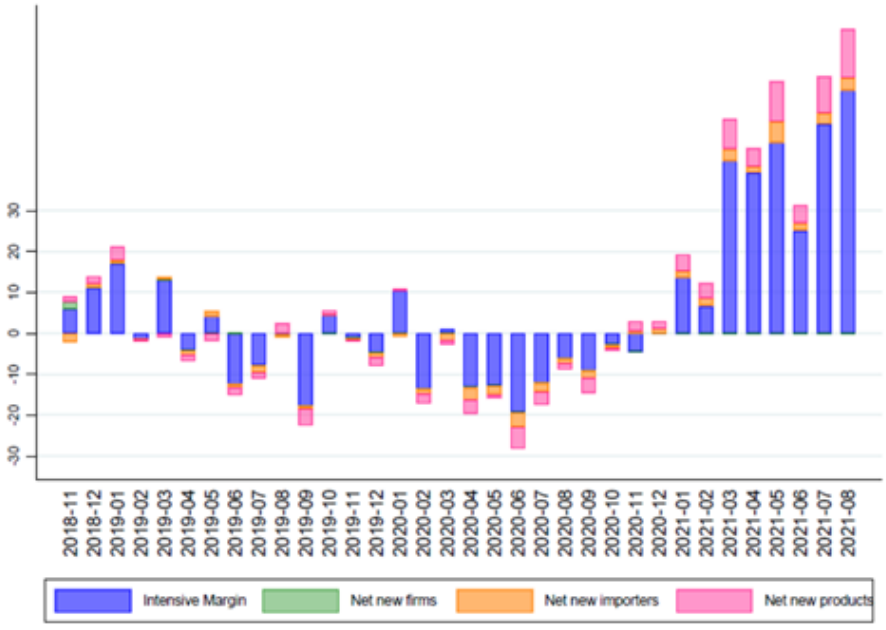
[4]Note that given the monthly frequency of the data it is difficult to capture this margin as it is normal for a recent born firm to start import activities, this margin is captured in annual data.

Figure 2: Import Dynamics

(a) Imports by Manufacturing firms



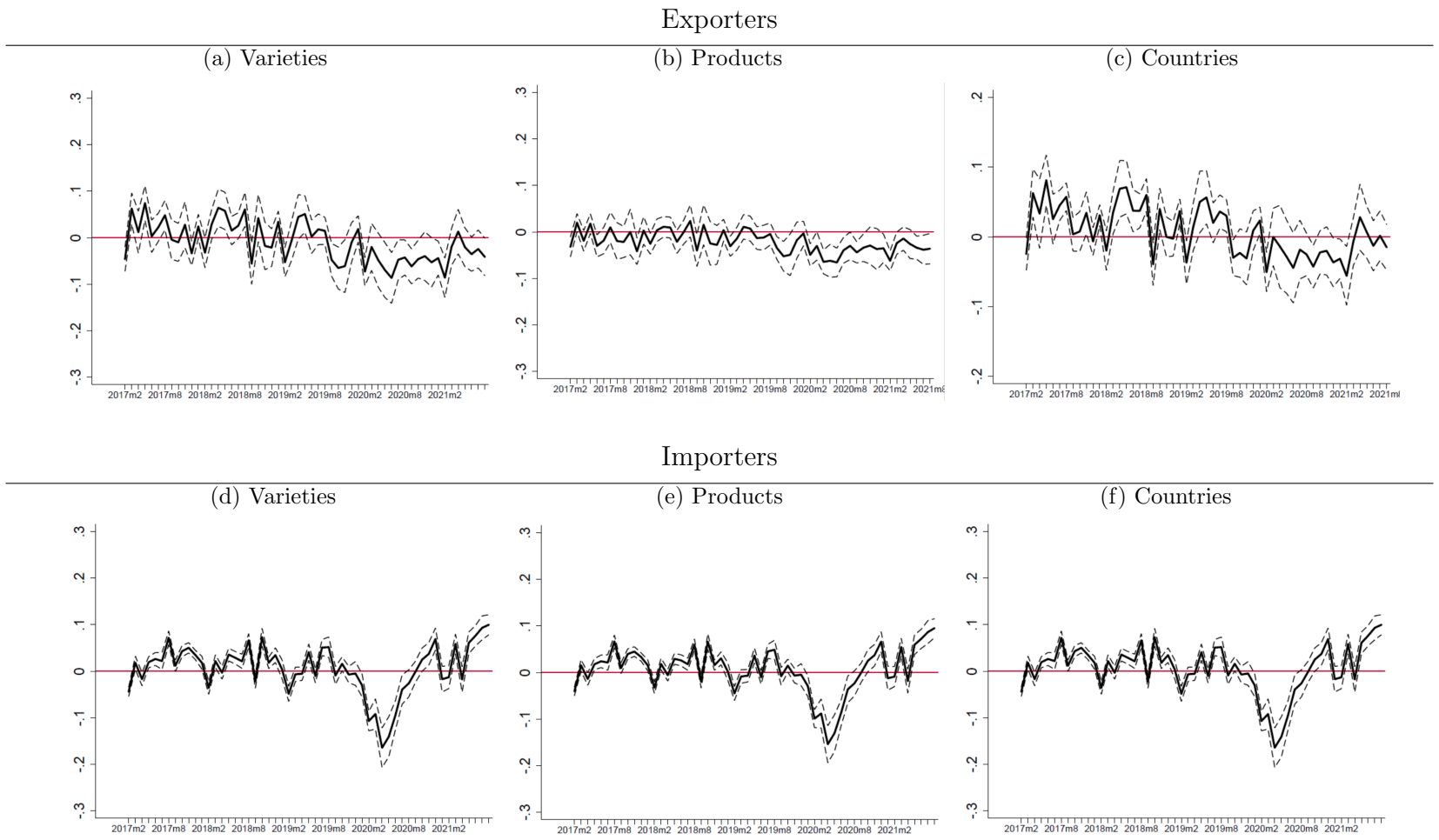
(b) Imports by Distribution firms



Notes: Growth decomposition exports and imports growth rates. The contributions measure in pp increase attributable to different mechanisms. The intensive margin measures (net) growth in imports of products that the firm also imported in the previous period (the previous year, and at the beginning of the sample period analyzed). New firms are firms that did not exist in the previous period. New importers are firms that did exist in the previous period but did not import. And finally, New products are newly imported products. In *unidades de fomento*.

Sources: Chile's National Custom Data.

Figure 3: Number of exported/imported varieties

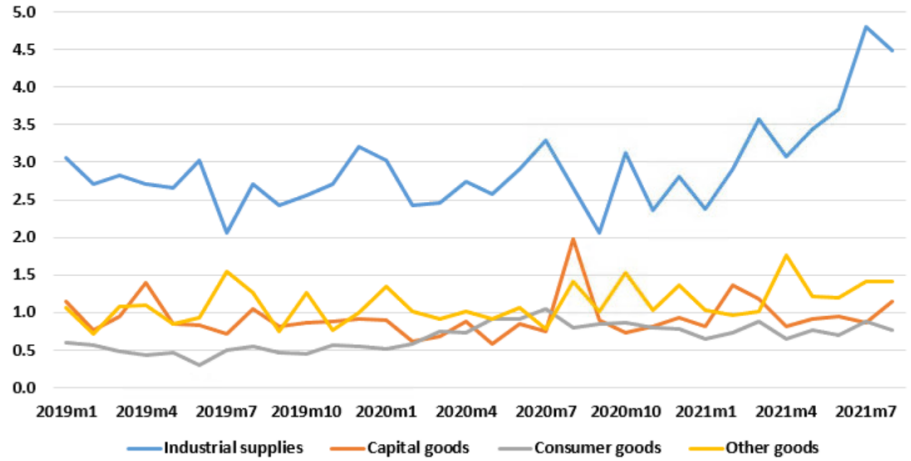


Notes: Coefficient β_t in a regression of number of varieties exported or imported. **Exports** small decline in the average number of products exported, mainly driven by the number of destinations. **Imports** sharp decline in the number of products. Dashed lines indicate 95% confidence intervals.

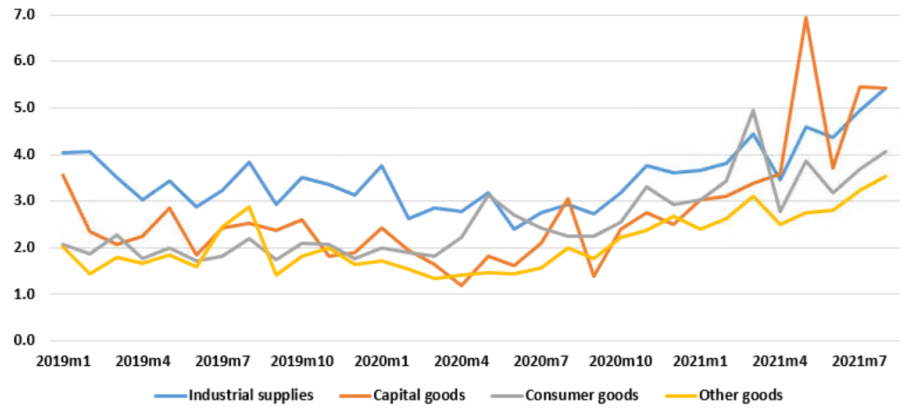
Sources: Own calculations.

Figure 4: Net new products

(a) Imports by Manufacturing firms - New products by BEC



(b) Imports by Distributor firms - New products by BEC



Notes:
In *unidades de fomento*.

Sources: Chile's National Custom Data.

4 Unit values

Now we turn to analyze the behaviour of prices during this period. Import prices can be used to proxy import costs. In a first step we compute the unit values for each transaction.

$$\mathrm{p}_{i,j,t}^{(m,x)} \approx \mathrm{uv}_{i,j,t}^{(m,x)} = \frac{\mathrm{value}_{i,j,t}}{\mathrm{quantity}_{i,j,t}}$$

Where $p^x(^m)$ stands for the export price of product i to destination (origin) j at time t.

For each firm we compute each firm marginal cost using the unit values :

$$\Delta mc_{f,t} == \sum_{j \in J_{f,t}} \sum_{m \in M_{f,t}} \omega_{f,j,m,t} \delta uv_{f,j,m,t} \tag{1}$$

from all source countries weighted by respective expenditure shares as in Amiti et al. (2014). where $uv_{f,j,m,t}$ is the euro price (unit value) of firm f's imports of intermediate good j from country m at time t, the weights $\omega_{f,j,m,t}$ are the average of period t and $t1$ shares of respective import values in the firm's total variable costs, and $J_{f,t}$ and $M_{f,t}$ denote the set of all imported goods and import source countries for the firm at a given time. Note that this measure of the marginal cost is still a proxy since it does not reflect the costs of domestic inputs and firm productivity.

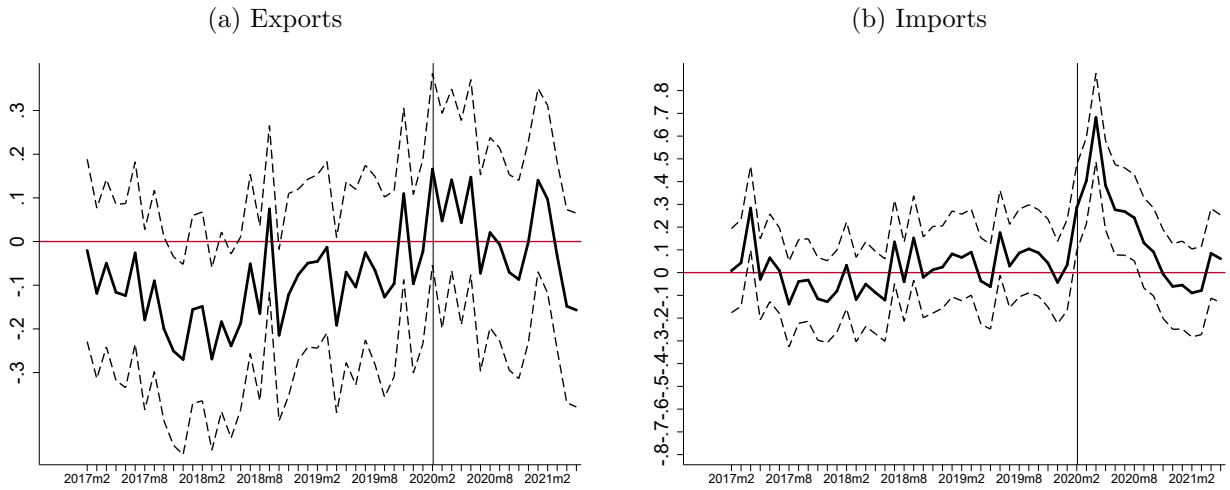
How we construct the cost shock at the firm level.

$$\Delta log P_{it}^{I} = \sum s_{ik,0} \Delta p_{k,t}$$

Where k is the source market.

where $U_{f,j,m,t}$ is the euro price (unit value) of firm f's imports of intermediate good j from country m at time t, the weights $\omega_{f,j,m,t}$ are the average of period t and $t1$ shares of respective import values in the firm's total variable costs, and $J_{f,t}$ and $M_{f,t}$ denote the set of all imported goods and import source countries (including inside the euro zone) for the firm at a given time. Note that this measure of the marginal cost is still a proxy since it does not reflect the costs of domestic inputs and firm productivity. We control separately for estimated firm productivity and average firm wage rate, however, detailed data on the prices and values of domestic inputs are not available. Nonetheless, controlling for our measure of the firm-level marginal cost is a substantial improvement over previous pass-through studies that typically control only for the aggregate manufacturing wage rate or producer price level.

Figure 5: Impact on (average) Unit Values



Notes: **Panel (a)** and **panel (b)** shows the impact on unit values of exports and imports. It can be observed that before the Covid-19 crisis, the β_t coefficients are consistently close to zero and statistically indistinguishable from zero. At the start of the crisis, average unit values faced by firms increased substantiall.

Sources: Own estimations.

Similarly yo the exercise made on the number of imported/exported varieties. We explore the average unit values faced by firms. In **figure 5** we plot the time dummies from firm level regressions.[5] It can be observed a sharp increase in the average cost of imports at the start of the lockdowns at the beginning on 2021, a xxx recovery to pre-pandemic levels, and in the last observed months an increase. Possibly a reflection of the new supply disruptions.

[5]We apply fixed effects, and errors are clustered at the industry level.

5 Empirical analysis

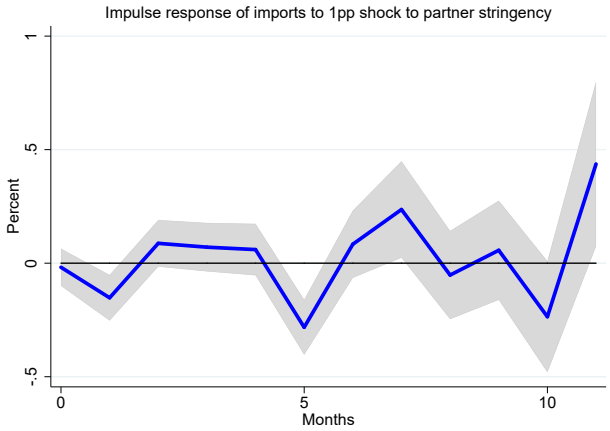
[Very Preliminary and incomplete] Given the observed facts by making used of the administrative data we want to explore the role of some possible explanatory variables. We have explored the following:

- Whether health situation or stringency measures taken by partner countries has affected exports an imports growth or prices. Until now, regressions have not proven to be very successful. It seems that trading developments are not driven by this. We use local projection models to allow for time lags between the stringency measures and possible delayed impact in Chile, given its distance.
-

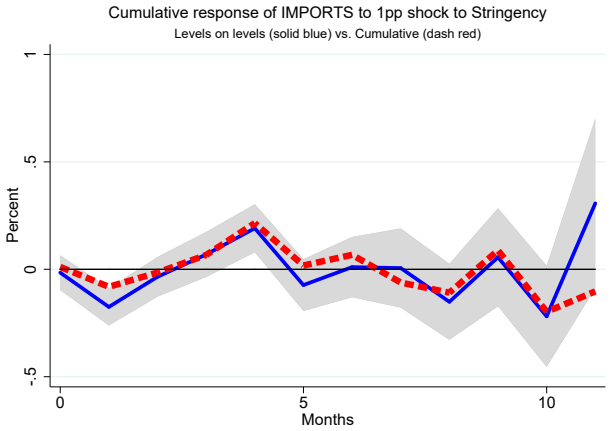
$$\Delta lnX_{it} = \nu + \alpha \text{containment}_{it} + \beta \mathbf{cases}_{it} + \gamma_{jk} + \gamma_{jt} + \theta Z_{i,t-1} + \eta_i + \delta t + \epsilon_{ijkt} \quad (2)$$

Figure 6: Impact on Imports

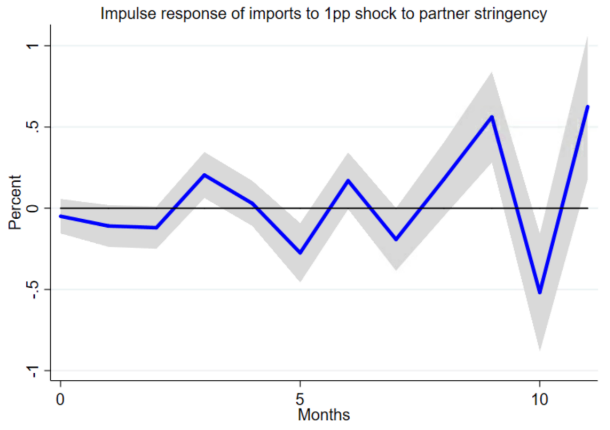
(a) Intermediate-levels



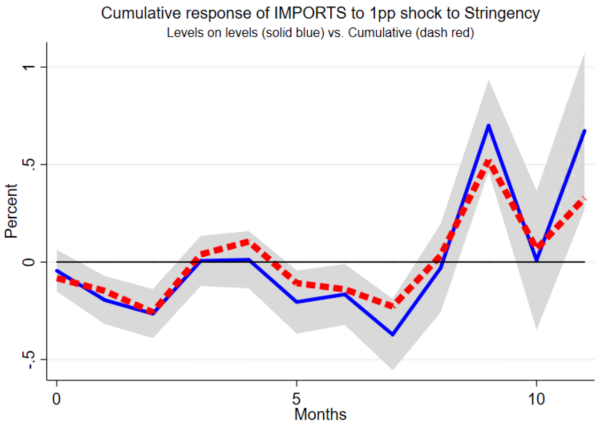
(b) cumulated



(c) Consumption-levels



(d) cumulated



Notes: Impact of lockdowns in trading partner countries.

Sources: Own estimations.

6 Conclusions

[Very Preliminary and incomplete]

In short, COVID-19 has generated a massive negative which was evident in Chile during the first months of the Pandemic and affecting imports more intensely than exports...

Notwithstanding, in the second half of 2020, there was a sharp recovery in imports, both in terms of volume and products...

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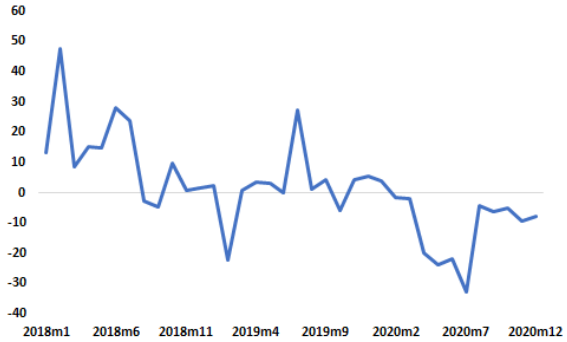
A Data cleaning steps

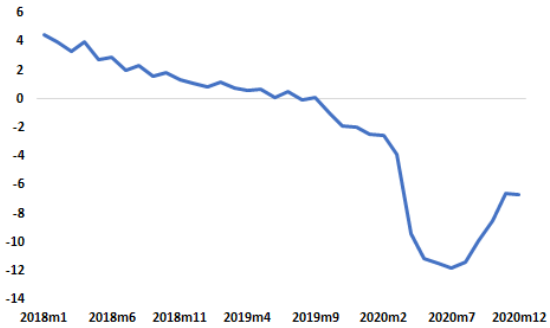
B Data coverage

Figure 7: Turnover and employment coverage

(a) Turnover growth



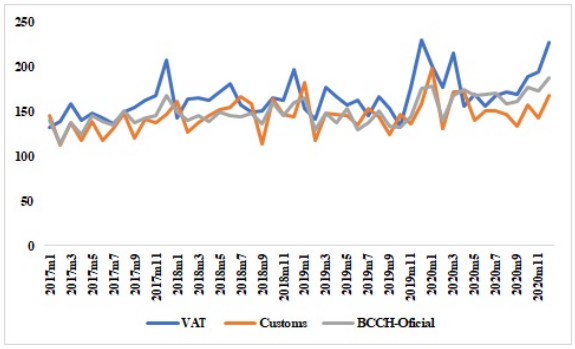
(b) Employment growth



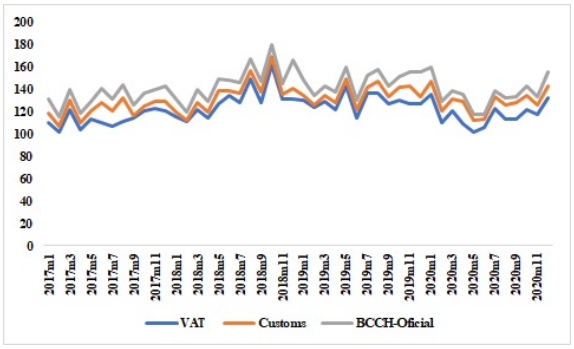
Notes: Based on cleaned sample, in **panel (a)** shows the aggregate evolution of turnover growth by manufacturing firms, after the basic cleaning and keeping the information of those firms that report along the whole sample period. In **panel (b)** the number of employees.
Sources: SII.

Figure 8: Trade dynamics and Coverage (before cleaning)

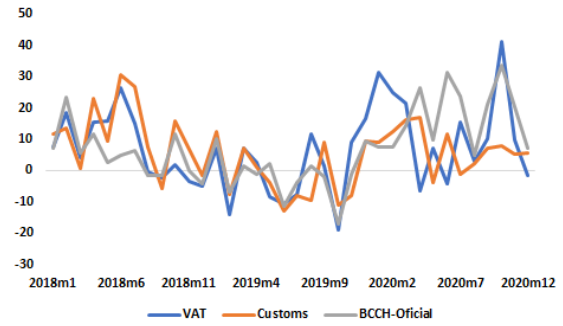
(a) Exported volume (Millions CLP-UF)



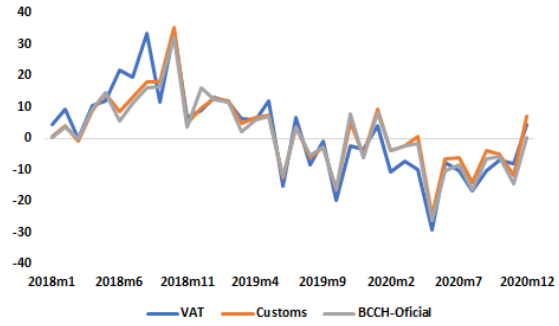
(b) Imported volume (Millions CLP-UF)



(c) Exports growth (percentage)



(d) Imports growth (percentage)

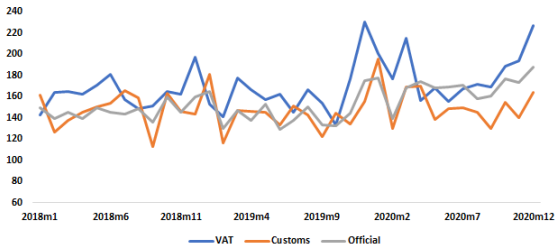


Notes: **Panels (a)** and **b** shows the aggregate evolution of exports and imports in million of CLP in constant terms by Chilean firms, before the basic cleaning, compared with the official data sources. In **panels (c)** and **d** we compute year on year growth rates.

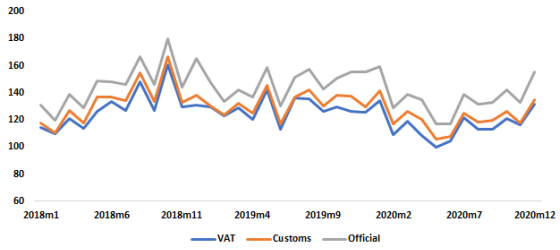
Sources: Chile's National Custom Data.

Figure 9: Trade dynamics and Coverage (after cleaning)

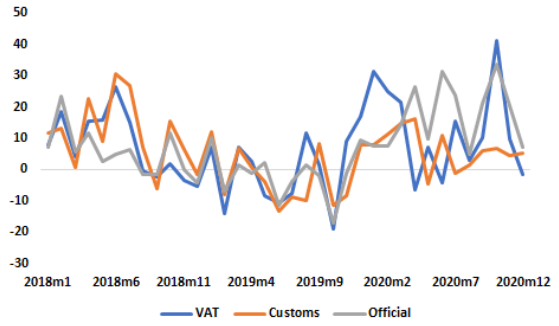
(a) Exported volume (Millions CLP-UF)



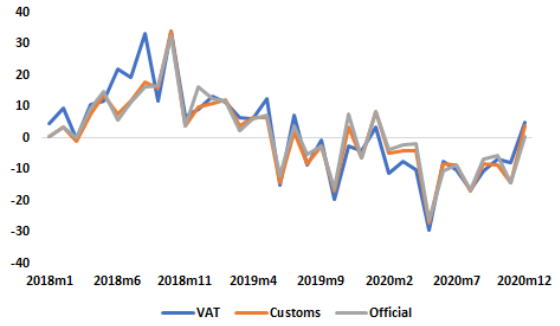
(b) Imported volume (Millions CLP-UF)



(c) Exports growth (percentage)



(d) Imports growth (percentage)



Notes: **Panels (a)** and **b** shows the aggregate evolution of exports and imports in million of CLP in constant terms by Chilean firms, after the basic cleaning, compared with the official data sources. In **panels (c)** and **d** we compute year on year growth rates.

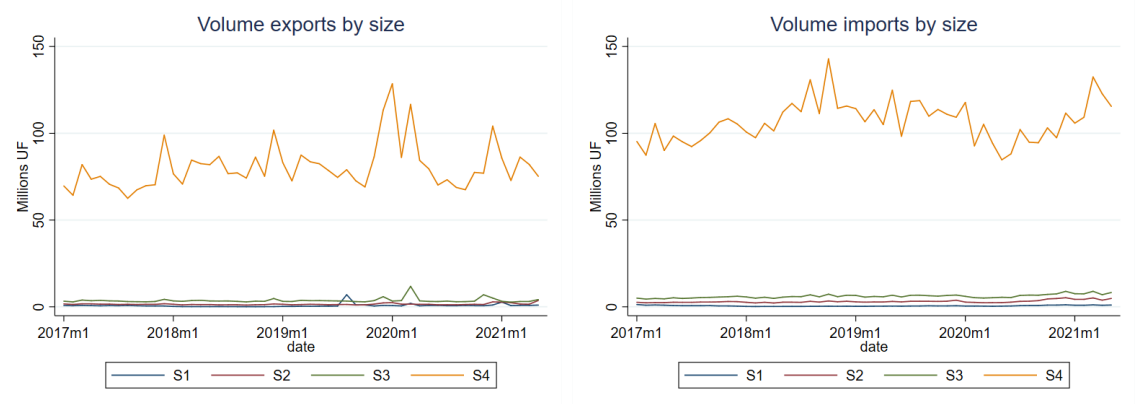
Sources: Chile's National Custom Data.

C Additional graphs

Figure 10: Ex/Import Volumes of Firms by size

(a) Exporters

(b) Importers

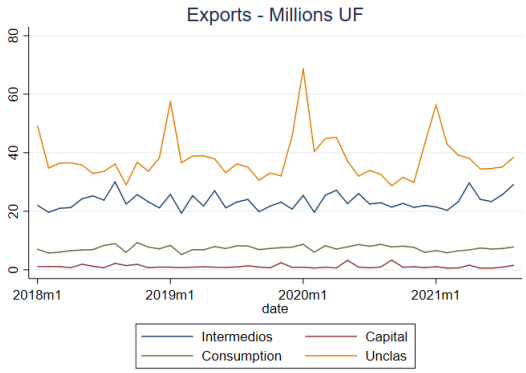


Notes: **Panel (a)** and **Panel (b)** shows that trade volumes are mainly concentrated in big firms in stratified according the number of employees and turnover. .

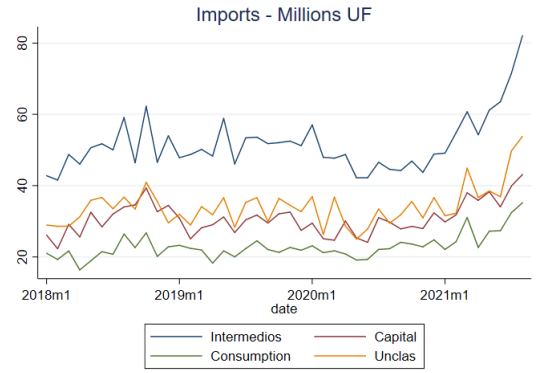
Sources: Chilean Customs.

Figure 11: Exports and Imports by Type BEC

(a) Exports



(b) Imports

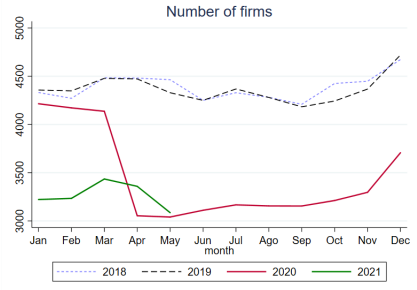


Notes: Based on Broad Economic Categories (BEC). Imports in **Panel (b)** show that the higher share of imports are on intermediate goods.

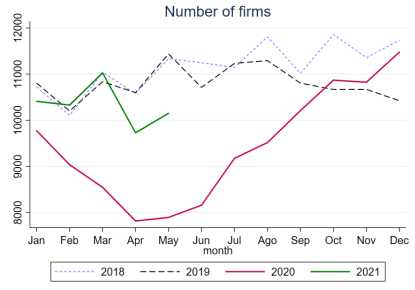
Sources: Chilean Customs.

Figure 12: Number of Firms

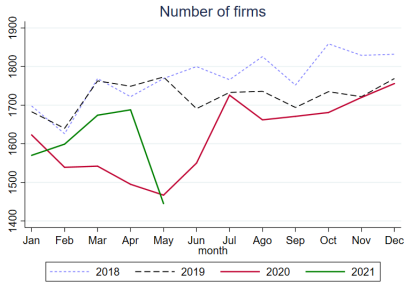
(a) Only exporters



(b) Only importers



(c) Two-way traders

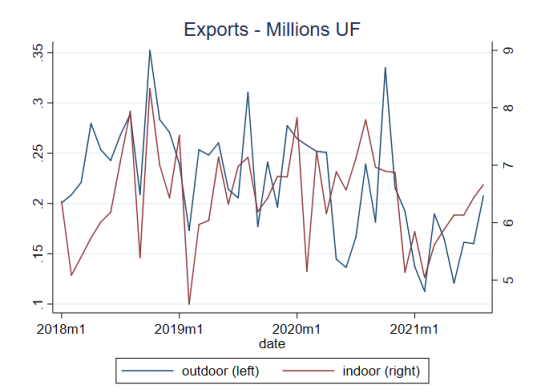


Notes: **Panel (a)** shows the impact on imports conditioned on the stringency index of trading partners.

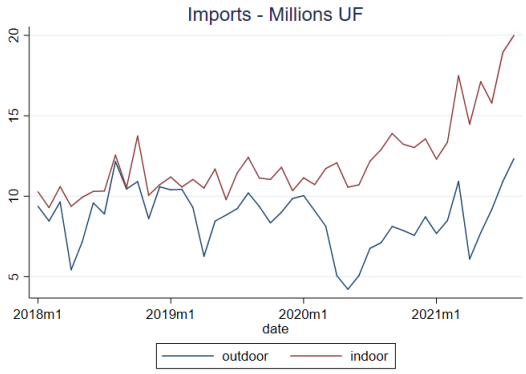
Sources: Chilean Customs.

Figure 13: Consumer goods by Type (outdoor - Indoor)

(a) Exports



(b) Imports

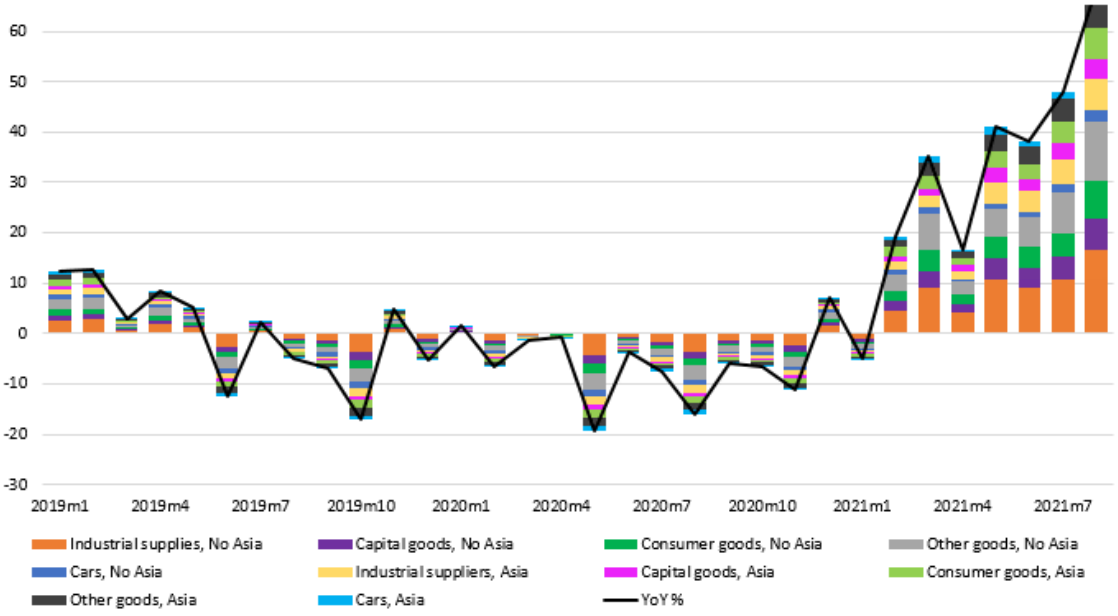


Notes: Based on the classification of de Lucio et al. (2020) imports of goods classified as indoor.

Sources: Chilean Customs.

Figure 14: Import trade dynamics - Chile: Contributions, by types of goods and Asia/No Asia. Contributions to year-over-year percent change, percentage points, based to values in Unidad Fomento

(a)

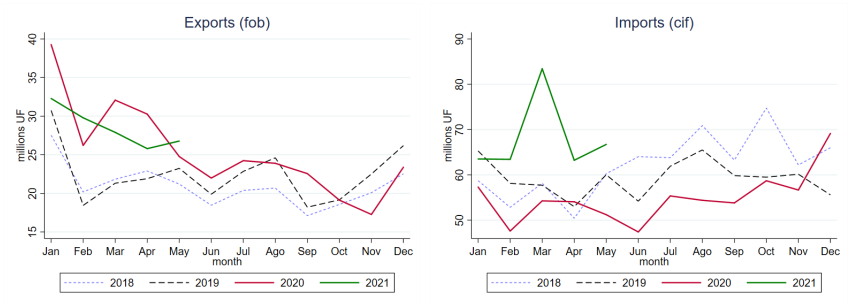


Notes: Xxx.

Figure 15: Exported/imported Volumes by type of firm

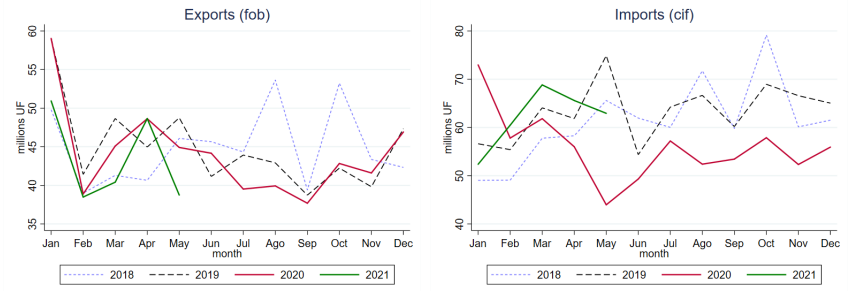
(a) Only exporters

(b) Only importers



(c) Two-way traders

(d) Two-way traders



Notes: **Panel (a)** shows the impact on imports conditioned on the stringency index of trading partners.

Sources: Chilean Customs.

D Decomposition

Given that many of the aggregates shown in this work are a result of weighted averages. In this appendix we show the decomposition used. This decomposition is based on Blaum (2018).

Import shares.– The goal is to distinguish within firm increases in the import share from compositional effects associated with the changes between the firms increasing their total share:

Import of product k from country j.

$$\frac{\text{import\_share}_t^T - \text{import\_share}_{t-12}^T}{\text{import\_share}_{t-12}^T} =$$

$$\underbrace{\left[\sum_{Cjk \in JK} (\text{import\_share}_{jk,t} - \text{import\_share}_{jk,t-12}) \text{firm\_share}_{jk,t-12}^T\right]}_{\text{[1] Variation due to the change in the within margin}} +$$

$$\underbrace{\left[\sum_{Cjk \in JK} \text{import\_share}_{jk,t-12}^T (\text{firm\_share}_{jk,t} - \text{firm\_share}_{jk,t-12})\right]}_{\text{[1] Variation due to the change in the between margin}} +$$

$$\underbrace{\left[\sum_{Cjk \in JK} (\text{firm\_share}_{jk,t} - \text{firm\_share}_{jk,t-12})(\text{import\_share}_{jk,t} - \text{import\_share}_{jk,t-12})\right]}_{\text{[3] Covariance}} +$$

$$\underbrace{\left[\sum_{Njk \in JK} (\text{import\_share}_{jk,t})(\text{firm\_share}_{jk,t}) + \sum_{Ojk \in JK} (\text{import\_share}_{jk,t-12})(\text{firm\_share}_{jk,t-12})\right]}_{\text{[4] Net entry}} +$$

- **Within**.– Captures the contribution of changes in import intensities keeping the share of the firm constant.
- **Between**.– Captures the contribution of changes in firms weights keeping the import share constant. This shows whether firms are substituting across varieties.

- **Covariance**.– measures the covariance between changes in firm share and the imported share.
- **Net entry**.– measures the contribution of entrants and of exiters.