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Anatomy of Firms' Margins of Adjustment: Evidence from the COVID Pandemic*

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Abstract

As a response to shocks, firms can adjust through several margins. But typically these margins are studied separately. In this paper, we jointly study firms' margins of adjustments in output, capital, labor, input markets and productivity by leveraging a rich administrative dataset from Chile. We apply the analysis to the pandemic in the wake of the shock and throughout the economy's recovery path. Importantly, we also study firms' access to public policies aimed at supporting credit and protecting employment relations. We document considerable heterogeneity in the adjustment to the pandemic across firm size and industry. We also document widespread and heterogeneous access to the aforementioned policies. A corollary of credit policies is a considerable increase in firms' leverage.

Resumen

Como respuesta a distintos shocks, las empresas se ajustan a través de distintos márgenes. Sin embargo, estos márgenes típicamente se estudian de manera separada. En este artículo estudiamos el ajuste de las empresas en un conjunto de márgenes, como producción, capital, empleo, insumos y productividad. Para esto, empleamos una extensa base de datos administrativos de Chile. Enfocamos el análisis al ajuste de las empresas a la pandemia del Covid-19, tanto en lo que respecta al impacto del shock, como a la fase de recuperación. También estudiamos el acceso de las empresas a políticas públicas desplegadas para proteger su acceso a crédito y las relaciones con sus trabajadores. Documentamos una heterogeneidad sustancial en el ajuste de las empresas a la pandemia, en dimensiones como tamaño y sector económico. También documentamos un acceso amplio y heterogéneo a las políticas previamente mencionadas. Un corolario de las políticas de crédito es el aumento considerable del apalancamiento de las empresas.

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1 Introduction

As a response to shocks, firms can adjust through several margins. But typically these margins are studied separately. In this paper, we jointly study firms' margins of adjustments in output, capital, labor, input markets and productivity by leveraging a rich administrative dataset from Chile. We apply the analysis to the pandemic in the wake of the shock and throughout the economy's recovery path. We offer micro details on the well-known macro dynamics. We emphasize the heterogeneous nature of the adjustment to the COVID shock across firm size and industry. The COVID shock generated the worst economic crisis in decades, with governments and central banks around the world responding with an array of policies to mitigate the adverse effects of the shock.

Our results point to significant adjustment by firms along several markets and margins (extensive and intensive). We find substantial heterogeneity in this adjustment, with more adverse effects centered on micro and small firms, and on firms in industries such as services, and restaurants and hotels. We document a large decline and a swift recovery in the number of firms reporting sales, as well as in sales themselves. Employment also experienced a large decline, and its recovery seems to be lagging that of sales, following a U shape rather than a V shape. Firm investment displays substantial volatility, with a larger decline and a stronger recovery than that of sales. We also find an unusually high destruction of firm linkages with suppliers, with only a partial recovery. Firm access to domestic bank credit increased during the COVID pandemic. This countercyclicality of credit marks a change with respect to previous crises in Chile, when credit contracted. The expansion of credit, however, has generated a considerable increase in firm leverage. Finally, we also find an unusual behavior of total factor productivity (TFP), which *increased* during the COVID pandemic, unlike in previous recessions, when productivity decreased.

Shortly after the crisis began, around April 2020, policymakers deployed two policies oriented at firms. The first was a credit support policy that consisted on government guarantees to small and medium-sized firms. The second was a furlough scheme designed to protect labor relations by reducing firms' employment costs. These policies were the first line of defense against the COVID shock. Other policies, such as fiscal transfers and pension-fund withdrawals, were approved in late-2020. We find that firm access to these policies was widespread, including by firms that were severely affected by the shock. In a companion paper (Albagli, Fernández, Guerra-Salas, Huneeus, and Muñoz, 2022), we study the effects of these policies at the firm level.

The paper is organized as follows. Section 2 describes the unique dataset that allows us to study firm adjustment in nearly all markets. Section 3 describes firm adjustment in the following

markets: output, labor, suppliers, physical capital, and credit. It also describes the evolution of firm-level productivity during the COVID pandemic. Section 4 studies firm access to the credit and employment policies. Section 5 concludes.

2 Related Literature

This paper is part of a literature that explores the impact of the pandemic on firms' performance. We can classify the papers in this literature into four groups, according to the source of information and/or the method used in the analysis. A first group of papers explains the evolution of firms' share prices during the pandemic. Share prices were available in real time, but they are limited in the sense that they offer insights on the smaller fraction of typically large publicly listed firms. A second group of papers uses detailed information on firms' cash flows prior to the pandemic and simulates the effect of sectoral shocks on employment, demand, and productivity to estimate the number of firms that would be forced to shut down, or the number of jobs that would be lost. The third group uses surveys to explore the effects of the pandemic on firms' employment and closures. Surveys expand our understanding of the crisis, since the extract insights on the performance of small and medium-sized firms. However, surveys elicit information on relatively few variables. The last group of papers uses administrative data on sales, value-added, credit, employment, and other variables. Administrative data have the advantage of offering excellent coverage of firms of different size and industry, but are typically difficult to access, especially datasets that merge the information from different administrative sources. This limitation has translated in very few papers using administrative data on a wide range of firm outcomes. Our paper is part of this strand of the literature.[1]

2.1 Share Prices of Listed Firms

Several studies document the unprecedented impact of the COVID pandemic on stock prices. Baker, Bloom, Davis, and Terry (2020) show that no previous infectious disease outbreak, including the Spanish Flu, has affected the stock market as forcefully as the COVID pandemic. However, the pandemic had a markedly heterogeneous impact on firms across industries, geographical location, and firm characteristics. In general, firms with higher initial liquidity, lower debt and higher profitability were less punished by markets, suggesting the important role of liquidity constraints, even in publicly listed firms.[2] Bretscher, Hsu, Simasek, and Tamoni (2020)

[1] Another limitation of administrative data is that they offer information on the universe of *formal* firms in the economy.

[2] See, for example, Ding, Levine, Lin, and Xie (2021), Fahlenbrach, Rageth, and Stulz (2020), Ramelli and Wagner (2020), Acharya and Steffen (2020), and Alfaro, Chari, Greenland, and Schott (2020b).

quantify the impact of contagion heterogeneity across space, showing that firms in U.S. counties with higher infection rates experience lower returns. Alfaro et al. (2020b) show that unexpected changes in infections predict next-day stock returns in the U.S. Pagano, Wagner, and Zechner (2020) document that stocks of firms that were less affected by social distancing measures significantly outperformed those of more exposed firms.[3]

2.2 Simulations of Structural Models

In studies based on simulations of structural models, the results depend on the magnitude of the shocks and the initial situation of firms. Firms that have low initial liquidity, are small or informal, are affected the most. Gourinchas, Kalemli-Özcan, Penciakova, and Sander (2020) use a rich model of the COVID shock, with a combination of supply, demand, aggregate, and industry-specific shocks to argue that, without policy interventions, the failure rate of small and medium-sized enterprises would have jumped by 6.15 percentage points. Kalemli-Ozcan, Cakmakli, Demiralp, Yesiltas, and Yildirim (2020) show that input-output linkages induce significant amplification of COVID-related output losses due to demand and supply shocks. Specifically, they use credit card transactions and intrinsic physical job proximity to discipline a demand and supply shock, respectively. They find that being an open economy amplifies the economic costs due to domestic and international input-output linkages.[4]

Using accounting identities and complementary information for small firms in Colombia, both formal and informal, Alfaro, Becerra, and Eslava (2020a) develop a structural model that quantifies the potential job and income losses of the crisis. Informal jobs, as well as those that are not amenable for working from home, which are also highly prevalent in emerging countries, are most at risk during a crisis such as that inflicted by the pandemic. These results point to the importance of policies aimed at maintaining formal matches, as well as supporting the informal via transfers. Buera, Fattal-Jaef, Hopenhayn, Neumeyer, and Shin (2021) simulate the propagation of a temporary lockdown through deteriorating firms' balance sheets in an environment with labor market frictions. The consequences are not persistent if workers can be recalled without passing through the frictional labor market and the government provides employment subsidies. If lockdowns lead to more permanent reallocation across industries, the recession becomes more protracted

[3]Other papers that study the effect of the COVID pandemic on firms' stock prices include Al-Awadhi, Alsaifi, Al-Awadhi, and Alhammadi (2020) and Ashraf (2020).

[4]See also Baqaee and Farhi (2022).

2.3 Surveys

Studies based on surveys show substantial adjustments in employment and firm closures, exploring how they differ according to firm size. These papers find significant effects, but results vary across countries and the policies implemented to mitigate the effects of the crisis. Bartlett III and Morse (2020) show that firm survival capabilities vary across firm size and depend on revenue resiliency, labor flexibility, and committed costs. Accordingly, optimal policy responses should depend on firm size, with the U.S. Payroll Protection Program (PPP) being effective only for firms with fewer than five employees. Nevertheless, Humphries, Neilson, and Ulyssea (2020) argue that the smallest businesses were less aware of the PPP and less likely to apply. In an early survey of small businesses, Bartik, Bertrand, Cullen, Glaeser, Luca, and Stanton (2020) found that 43% of firms reported that they were temporarily closed because of the COVID pandemic, 55% were still operational, and 2% were permanently closed. Moreover, the average firm had reduced the number of employees by 40%. Another survey by Bloom, Fletcher, and Yeh (2021) found that the adverse effect on sales peaked in the second quarter of 2020, with a decline of 29%, but with 40% of firms reporting zero or positive impact. Beck, Flynn, and Homanen (2020) surveyed 500 listed firms from emerging countries and found that, unlike in high-income countries, firms in developing countries reacted by reducing investment rather than payroll.

Bloom, Bunn, Mizen, Smietanka, and Thwaites (2020) use survey data from firms in the U.K. to study productivity. They find that, despite increasing labor productivity, Covid-19 reduced private sector total factor productivity (TFP) by up to 4% during the pandemic, with a projected 1% reduction over the medium term. This decline can be decomposed in a reduction in 'within-firm' productivity partially offset by a positive 'between-firm' effect, as less productive sectors and less productive firms within them contracted.

2.4 Administrative Data

Traditional survey data typically refer to small sample sizes and/or a limited panel extension. Administrative records, from both public and private sources, can provide novel insights by capturing dynamics on, potentially, the universe of firms operating in the economy. However, there is limited access to this type of data and, when they are available it is usually impossible to combine them with other firm characteristics necessary to study all relevant margins of firm adjustment. For example, some studies use VAT data to decompose sale losses by sector and firm size, but are unable to say anything about employment or investment at the firm level.[5] Haltiwanger (2022) finds that business creation in the U.S. fell substantially at the early stages of

[5]See, for example, Mascagni and Lees (2022) for Rwanda, Fairlie and Fossen (2021) for California, and Angelov and Waldenström (2021) for Sweden.

the pandemic, but rebounded to record levels in mid-2020. With access to a more comprehensive administrative dataset for the universe of US and Norwegian firms, Alstadsæter, Bjørkheim, Kopczuk, and Økland (2020) perform a counterfactual experiment to assess the effectiveness of policy responses implemented in Norway and the U.S. They find that policies in both countries dampened the negative effect of the crisis on profitability, liquidity, debt, and solvency by over 50%.

Andrews, Charlton, and Moore (2021) use private administrative data to study labor reallocation across firms. They show that, in surviving firms, while policy partly suppressed creative destruction and labor turnover fell, job reallocation remained connected to firm productivity. Campello, Kankanhalli, and Muthukrishnan (2020) also use private administrative data to show that during the first half of 2020, U.S. firms cut back on postings for high-skill jobs more than for low-skill jobs .[6]

Our paper uses administrative data, from different sources, on the universe of formal firms in Chile.

3 Dataset

The firm-level data used in this project comes from merging five administrative datasets.[7] The first source of information employed is a firm production dataset, which contains firm-level information used for tax purposes on sales, revenues, expenditures in intermediate goods, and investment in machinery and equipment. The dataset covers the universe of formal firms in Chile and is available since the mid 2000s. The source is Form F29 collected by the Chilean tax authority (Servicio de Impuestos Internos, SII)[8].

The second source of information employed is the Firm-to-Firm Transactions Dataset, with firm-level information on all private firm-to-firm transactions, disaggregated into value flows, prices, and products and services traded. The dataset covers the universe of formal firms in Chile and became mandatory for firms of all sizes since mid 2018. The source is the electronic

[6]However, Bonacini, Gallo, and Scicchitano (2021) use survey evidence on Italian workers to show that the option to work from home tends to favor male, older, high-educated, and high-paid employees, thus potentially exacerbating income inequality.

[7]This paper was developed within the scope of the research agenda conducted by the Central Bank of Chile (CBC) in economic and financial affairs of its competence. The CBC has access to anonymized information from various public and private entities, by virtue of collaboration agreements signed with these institutions. To secure the privacy of households and firms, the CBC mandates that the development, extraction and publication of the results should not allow the identification, directly or indirectly, of individuals or firms. The analysis was implemented by the authors and did not involve nor compromise the institutions that provide the data (Servicio de Impuestos Internos, Comisión para el Mercado Financiero, and Superintendencia de Pensiones).

[8]The information contained in the databases of the Servicio de Impuestos Internos is of a tax nature originating in self-declarations of taxpayers presented to the Service; therefore, the veracity of the data is not the responsibility of the Service

invoice collected by SII.

The third source of information employed is a firm-to-bank credit transactions dataset, which contains information on all credit transactions at the bank-firm-loan level, including the amount of the loan, interest rate, and other details of the credit contract. This credit registry also contains firm-level information on debt stocks consolidated at the banking sector. The dataset covers the universe of financial transactions between banks and firms in Chile and is available since 2012 for flows and since 2009 for stocks. The sources are forms D32 (flows) and C11 (stocks) collected by the Financial Regulatory Commission in Chile (Comisión para el Mercado Financiero, CMF).

The fourth source of information is a matched employer-employee dataset, which contains firm-level information on all formal labor contracts in Chile. This dataset registers contributions to unemployment insurance, which allows to approximate wage payments. The dataset is available since 2005 and the source is the Chilean pension regulator (Superintendencia de Pensiones).

The fifth source of information employed is the credit and employment policies dataset, which contains firm-level information on firms' access to credit support and employment protection policies in response to the COVID crisis. For the former, the information contains all credit flows to firms with sovereign guarantees as part of the FOGAPE-COVID program (explained in detail below). For the latter, the dataset contains information on the contracts that were furloughed under the Employment Protection Law. The dataset is available since march 2020 and the source is the CMF (credit flows under FOGAPE-COVID) and the Superintendencia de Pensiones (furloughed employees).

The merged dataset combining the information in these five sources provides a unique tool of analysis to quantify the effects of the credit and employment policies. Table 1 presents a set of descriptive statistics on the merged dataset for three months: January 2020, before the COVID shock hit the economy, May 2020, when the pandemic was causing significant damage to the economy and the credit and employment policies had just been deployed, and April 2021, when the economy was recovering strongly. We focus on the number of firms reporting sales (block A), the amount of sales (block B), employment (block C), and the stock of credit (block D).

Block A of the table shows the number of firms reporting sales. In January 2020, 661,427 firms reported sales. In May 2020, that number declined substantially, by 13%. By April 2021, however, the number of firms reporting sales had practically recovered the pre-COVID level of January 2020.

Block B of table 1 shows statistics on the U.S. dollar amount of sales.[9] In January 2020, the

[9]Amounts in U.S. dollars use the exchange rate of January 2020 (monthly average), so changes in these values

661,427 firms mentioned in block A had sales of nearly 50 billion. The total amount of sales had declined 20% by May 2020, but had recovered by April 2021, reaching a level 3.9% higher than that of January 2020. Across the 661,427 firms with positive sales in January 2020, average sales were nearly 75,000, whereas median sales were 3,000. The mean and median firms experienced a similar decline in May 2020 (6–7%), but by April 2020 sales were higher than in January 2020.

Block C of table 1 describes employment relations.[10] We compute descriptive statistics for the group of firms that, in addition to reporting sales in the month of analysis, report having at least one worker. Thus, in January 2020, there were 266,418 firms that reported sales and had at least one worker. The number of firms with sales and workers declined 21% by May 2020, but recovered the pre-pandemic level by April 2021. When analyzing the number of employment relations, it is useful to consider the furlough scheme. In January 2020, prior to the COVID pandemic and to the implementation of the employment policy, both categories are identical—there were about 4.5 million employment relations, with the average firm having 17 workers and the median firm having 3 workers. By May 2020, the COVID pandemic was buffeting the economy and the furlough scheme had been recently deployed. The number of employment relations declined 15% if the furloughed workers are counted and 25% if they are not. This 10 percentage point difference reflects the substantial size of the policy. By April 2021, total employment remained below its pre-pandemic level, whether furloughed workers are counted (4% lower than January 2020) or not (8%). This contrasts with the performance of sales, which had recovered their pre-pandemic level by this time. The median firm employed 3 workers in January 2020, and this statistic did not change in the other months of analysis, whether furloughed workers are counted or not. The average firm, however, employed fewer workers by April 2021.

Finally, block D of the table shows statistics on the stock of credit of firms with the domestic banking sector. We compute statistics for the group of firms that, in addition to reporting sales in the month of analysis, report a positive stock of credit. In January 2020, 227,949 firms reported sales *and* had credit outstanding with the domestic banking sector. This number declined 11% by May 2020, but was 14% higher by April 2021. The total stock of credit across these firms, which was more than 87 billion dollars in January 2020, had increased 8% by May 2020. It declined by April 2021, when it was 3% higher than in January 2020. Credit in the median firm increased substantially from its pre-pandemic level of roughly 9,000 dollars. It was 45% higher by May 2020, and 52% higher by April 2021. In the average firm, however, credit increased proportionally half as much by May 2020 (21%), while it was 9% below the pre-pandemic level

do not reflect exchange rate variation.

[10]Employment relations are not equivalent to number of workers, since a worker may have more than one job.

Table 1: Descriptive statistics of the merged dataset

	January 2020	May 2020	April 2021
A. Number of firms reporting sales	661,427	-13%	-0.1%
B. Sales			
Total (million)	49,392	-20%	3.9%
Mean	74,675	-7%	4%
Median	3,020	-6%	13%
St. dev.	3,536,719	-31%	-15%
C. Employment relations (firms with at least one worker and reporting sales)			
Number of firms	266,418	-21%	1%
Including furloughed workers			
Total	4,573,397	-15%	-4%
Mean	17.2	6%	-5%
Median	3	0%	0%
St. dev.	155	2%	1%
Excluding furloughed workers			
Total	4,573,397	-25%	-8%
Mean	17.2	-5%	-9%
Median	3	0%	0%
St. dev.	155	-2%	-1%
D. Stock of credit (firms reporting sales, includes credit under the policy)			
Number of firms	227,949	-11%	14%
Total (million)	87,326	8%	3%
Mean	383,095	21%	-9%
Median	9,333	45%	52%
St. dev.	6,514,290	16%	-15%

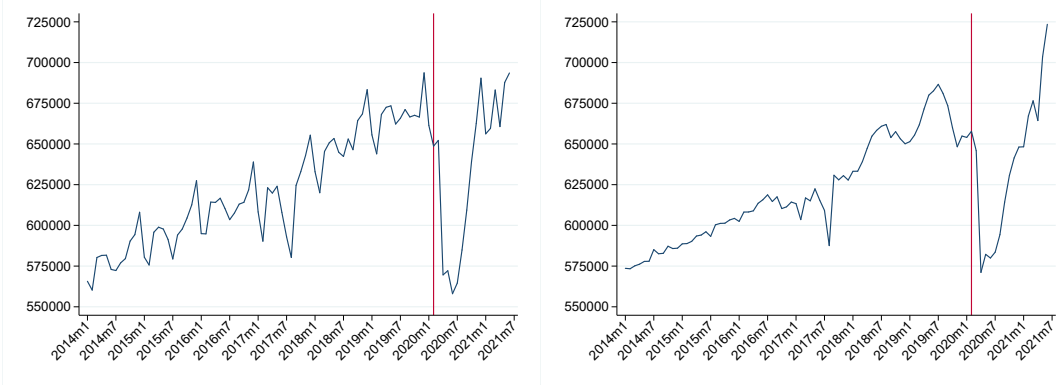
The values for May 2020 and April 2021 are expressed as percent changes with respect to January 2020. Amounts of sales and stock of credit are expressed in U.S. dollars at the exchange rate of January 2020 (monthly average), so changes in these amounts do not reflect exchange rate variation. An employment relation is not equivalent to a worker, since a worker may have more than one job.

by April 2021.

4 Firms' Adjustment to the COVID Pandemic

This section documents how firms adjusted to the COVID shock. We organize the analysis by studying the margins of firms' adjustment along five markets: output markets (firm entry/exit and sales), labor markets (employment), markets for suppliers (firm-to-firm linkages), physical capital markets (investment), and credit markets (firms' access to bank debt). We also document changes in productivity at the firm level in response to the adjustment in these markets.

Figure 1: Number of firms



(a) Raw series (b) Seasonally adjusted

Note: Red vertical line marks February 2020, the last month with no COVID cases in Chile in that year. A firm is a single tax ID with positive sales. Only firms in the National Accounts' directory of firms are considered. Source: Monthly tax form F29; and authors' own calculations.

4.1 Output Market: Entry/Exit and Sales

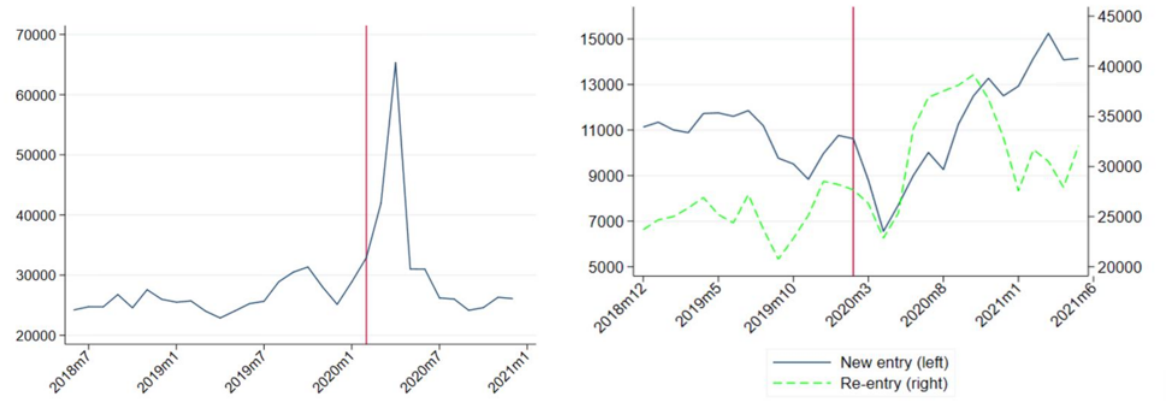
Firms adjusted substantially in the output market, both at the extensive (i.e., entry/exit) and intensive (i.e., sales) margins. We also document substantial heterogeneity in the impact of the pandemic shock across firms of different size and industry.

Figure 1 shows how the COVID shock affected the number of firms in the economy. Panels (a) and (b) plot the raw and seasonally adjusted number of firms reporting positive sales each month. The red vertical lines mark February 2020, the month prior to the arrival of COVID in Chile, since the first cases were recorded in March. From March to June 2020, the number of firms declined sharply—about 14%. Subsequently, the number of firms reporting sales recovered vigorously, so that by the end of 2020, it had recovered its pre-pandemic level. As the right panel shows, this recovery is not an artifact of seasonality in the number of firms.

The number of firms in the economy is the result of firms entering and exiting. Figure 2 documents how these gross flows evolved around the pandemic shock. Panel (a) shows the number of firms exiting each month. Our exit definition is not a legal one. Instead, we define a firm as exiting if it ceases to report sales for three or more consecutive months. Firm exit peaked in April 2020, when roughly 10% of firms had exited.[11] Panel (b) shows the evolution of the number of new entrant firms, i.e., firms that report sales for the first time, and re-entering firms, which we define as firms that report sales after an exit spell, i.e., after not reporting sales for three or more consecutive months. The green dashed line in panel (b) shows that firm re-entry increased soon after exit peaked, whereas the blue line shows that the number of new

[11] This percentage is computed with respect to the number of firms reporting sales in February 2020.

Figure 2: Firm entry and exit



(a) Exit

(b) New entry and re-entry

Note: Number of firms. Exit is computed as firms that do not report sales for three or more consecutive months. Entry is computed as new firms, i.e., firms with a tax ID that shows up in the database for the first time. Re-entrant firms are those that were classified as exiting at some point, but resume reporting of sales. Source: Monthly tax form F29, and authors' own calculations.

firms reached a trough in April 2020, but recovered swiftly, reaching record numbers in the first semester of 2021.[12]

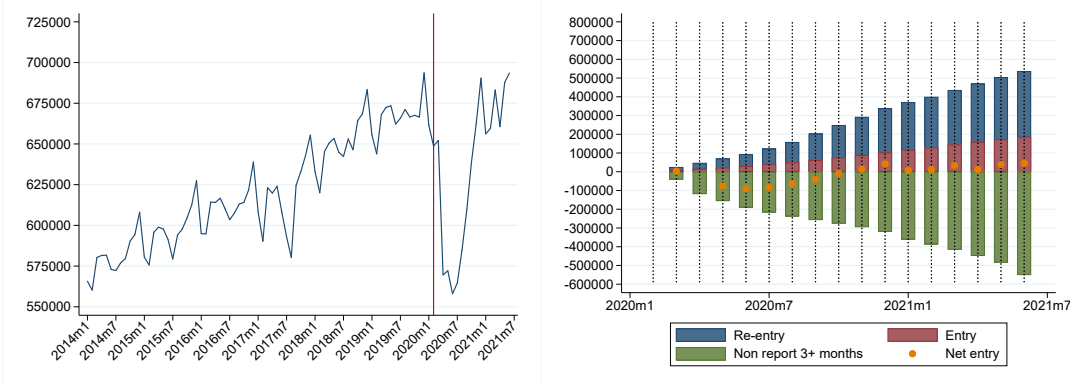
Figure 3 shows how gross flows—firm entry, re-entry and exit—interacted to determine the evolution of the number of firms, shown again in panel (a). In panel (b), black dots represent net entry of firms, expressed as the change in the number of firms with respect to February 2020, and the bars show the contribution of gross flows. Firm exit (red bars) is the main driver of net entry in the early months of the crisis, pushing down the number of firms. Around July, however, entry and re-entry begin pushing the number of firms up. The figure shows that about 2 of every 3 firms that exited re-entered at some point. The median duration of exit is 5 months in the period from March 2020 to June 2021.

Figure 4 documents heterogeneity in net entry of firms along two dimensions—industry and size. Panel (a) shows the evolution of the number of firms in four key sectors: manufacturing, commerce (wholesale and retail trade), services, and restaurants and hotels.[13] The number of firms declined in all of these industries. The decline of nearly 40% in the number of restaurants and hotels, however, dwarfs that in the other three industries. In services, the number of firms declined nearly 20%, whereas in manufacturing and commerce, the decline was about 10%. The latter two industries have led the recovery in the number of firms, while restaurants and hotels, and services, remained below their pre-pandemic level until 2021. Panel (b) shows the evolution

[12]Note that firm exit (entry) also displays an increase (decrease) in late 2019, which is linked to the violent episode of social unrest experienced in Chile after protests broke on October 18.

[13]Services groups two sectors: personal services, and business services.

Figure 3: The role of entry, exit and re-entry in firm dynamics



(a) Number of firms (not sa)

(b) Decomposition: Entry/exit/re-entry

Note: For panel (a), see the note to figure 1. In panel (b), black dots denote net entry of firms, expressed as the change in the number of firms with respect to February 2020. For the definition of gross flows (green bars refer to entry, red bars to exit, and yellow bars to re-entry), see the note to figure 2. Grey bars labeled NAT denote non-allocated turnover. These are a small fraction of firms that, given our definition of gross flows, cannot be classified as entering, re-entering, or exiting. Source: Monthly tax form F29, and authors' own calculations.

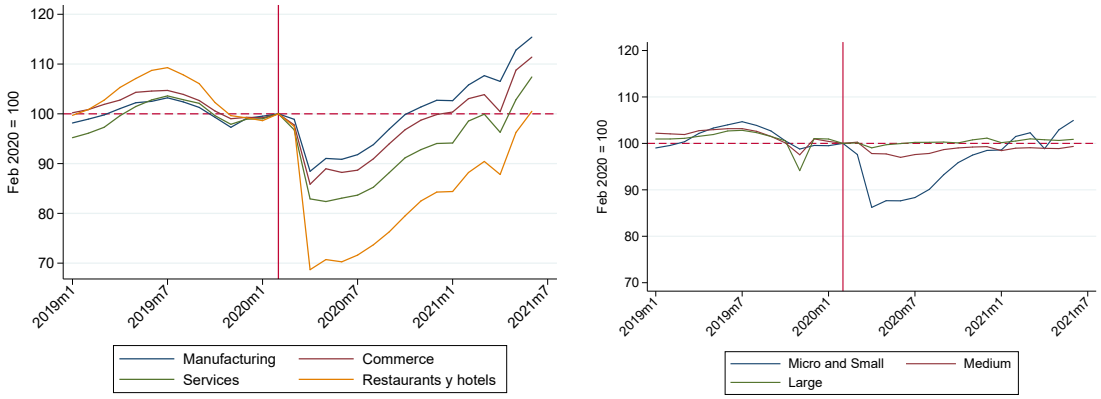
of the number of firms of different size. The decline in the number of firms is completely driven by micro and small firms (firms with sales of less than approximately USD 950,000 in the previous year), with the number of medium and large firms hovering slightly above the pre-pandemic level throughout the sample.[14] The evolution of the number of micro and small, medium, and large firms during the pandemic shock differs from the episode of social unrest that Chile experienced in October 2019, when violent protests broke across the country. In that episode, the number of firms of all sizes declined.

We now study how firms adjusted at the intensive margin in the output market, i.e., how sales evolved during the pandemic shock. Figure 5 shows two measures of total sales, both adjusted for inflation, seasonality, and expressed in levels, normalized at 100 in February 2020: the blue line shows firm-to-firm sales from the electronic invoice database, whereas the red line shows final sales from the F29 tax form. The two measures of sales are highly correlated and show a sharp decline of about 15% at the trough in May, followed by a strong recovery that put sales at the pre-pandemic level by the end of 2020.

The evolution of total sales masks substantial heterogeneity at the firm level. Figure 6 documents two dimensions of firm heterogeneity. Panel (a) shows heterogeneity across industries. The behavior of sales is qualitatively similar to that of the number of firms (panel a in figure 4): sales in restaurants and hotels declined dramatically and remain below their pre-pandemic

[14] To classify firms by size, we follow the National Accounts guidelines, which use thresholds of real annual sales based on a unit of account indexed to inflation, called *unidad de fomento* (UF). Micro firms: less than 2,400 UF. Small firms: 2,400-25,000 UF. Medium firms: 25,000-100,000 UF. Large firms: more than 100,000 UF. Based on inflation and market exchange rates at the time of writing, 25,000 UF are approximately equivalent to USD 950,000.

Figure 4: Number of firms by sector and size

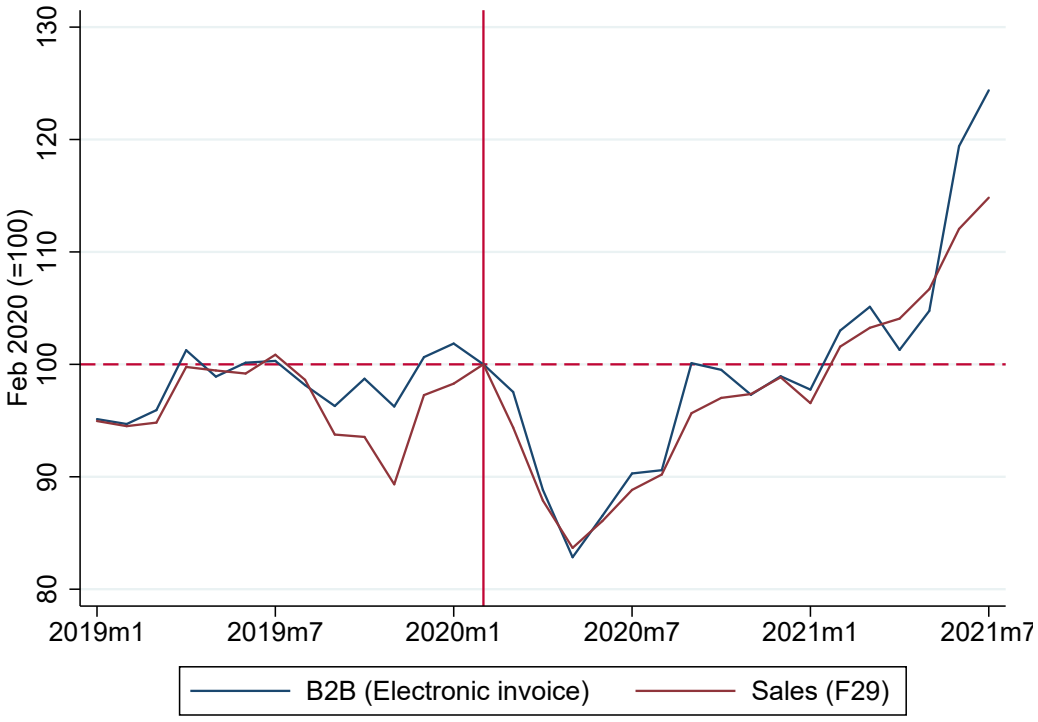


(a) By sector

(b) By size

Note: Number of firms with positive sales every period, normalized to 100 in February, 2020. Seasonally adjusted. In panel (a), the services sector includes personal services, and business services. In panel (b), the classification of firms by size considers annual real sales, following the National Accounts guidelines. The thresholds are based on yearly sales expressed in a unit of account indexed to inflation, called *unidad de fomento* (UF). Micro firms: less than 2,400 UF. Small firms: 2,400-25,000 UF. Medium firms: 25,000-100,000 UF. Large firms: more than 100,000 UF. Based on inflation and market exchange rates at the time of writing, 25,000 UF are approximately equivalent to USD 950,000. Source: Monthly tax form F29 and authors' own calculations.

Figure 5: Performance of sales



Note: Total sales from two sources: the electronic invoice, which registers firm-to-firm sales (blue line), and the F29 tax form, which registers final sales (red line). Observations above the 99.9th percentile are winsorized. The resulting series are seasonally adjusted and normalized at 100 in February 2020 (vertical line).

Figure 6: Sales: Heterogeneity by sector and size

(a) Sector (b) Size

Note: Seasonally adjusted real sales, normalized at 100 in February 2020. The service sector includes personal services and business services. For details on the classification of firms by size, see the note to figure 4. Sources: Electronic invoice; and authors' own calculations.

level up to mid 2021. Sales in services also declined substantially and remained below their pre-pandemic level throughout 2020. Sales in manufacturing and commerce, on the other hand, display swift and strong recoveries. Panel (b) shows heterogeneity in the performance of sales across firm size. Micro and small, and medium-sized firms were the hardest hit by the COVID shock, with sales dropping about 20%. However, micro and small, and medium-sized firms also experienced the strongest recovery, with sales reaching pre-pandemic levels in the second half of 2020. Large firms display less fluctuation, with sales declining and expanding less than micro and small, and medium-sized firms in the contractionary and recovery phases. It is important to note that our results on firm size are not an artifact of industry effects, e.g., that most restaurants and hotels are small firms and, since this industry was badly hit, it drives the decline we see for small firms. We have verified that micro and small firms are the most affected within each of the four industries we study.

Figure 7 studies the interaction of the extensive and intensive margins in the performance of sales. Panels (a) and (b) study the heterogeneity in the recovery of sales. They display the distribution of Davis and Haltiwanger (1992) growth rates, computed as the difference in real sales between Feb-Apr 2019 and Feb-Apr 2021 (three month averages), divided by the average across these two periods. Panel (a) plots the unweighted distribution, whereas the distribution in panel (b) weights the growth rate of each firm by its average sales across the two periods. For continuing firms, the growth rate lies in the (-2,2) interval, whereas exiting and entering firms have a value of -2 and 2, respectively. The blue distributions refer to the 2019-2021 period, which highlights the heterogeneity in the recovery of sales from the pandemic shock. As a benchmark, the orange distributions show the average distribution for the more normal periods 2016-2018,

2017-2019, and 2018-2020. Continuing firms in the 2019-2021 period display more heterogeneity than in normal times, with more mass of the growth rates in the tails of the distribution and less mass in the middle. This holds for the unweighted and weighted cases. The plots also speak about the extent of firm entry and exit. The unweighted distribution shows that more than 30% of the growth rates correspond to firms that enter and exit. Furthermore, there is more destruction and less creation in the recovery from the pandemic shock than in normal times. This result disappears in the weighed distribution, where we see little difference in entry and exit between the COVID pandemic and normal times. This result suggests that small firms account for the bulk entry and exit, which is consistent with the results in panel (b) of figure 6.

Panel (c) of figure 7 shows the contribution of the extensive margin to the year-on-year growth rate of sales (black line). Even though we documented substantial adjustment on the extensive margin in the output market, the bulk of the *fluctuation* of sales over the pandemic shock is driven by incumbent firms (blue bars). Firms that enter, exit, and re-enter contribute little to the fluctuation of the annual growth rate of sales. In particular, note the small role of firm re-entry (green bars). Although re-entry is key for the recovery of the number of firms in the economy, re-entering firms contribute little to the recovery of sales. Finally, in panel (d) we study the performance of sales in re-entering and incumbent firms. In this analysis, we track the performance of a group of firms in each category, before and after the pandemic hit the economy. Re-entrants are firms that exited (reported no sales for three or more consecutive months) after February 2020 and subsequently reported sales (blue line).[15] Total sales in re-entering firms are much more volatile than sales in incumbent firms (red line), reaching a trough nearly 60% lower than their pre-pandemic level. This decline is surely driven by many of these firms reporting no sales in the second quarter of 2020.[16] In sum, although re-entering firms are key for the evolution of the number of firms, and have highly volatile sales, they contribute little to the fluctuation of total sales, which is driven by incumbent firms.

4.2 Labor Market: Employment

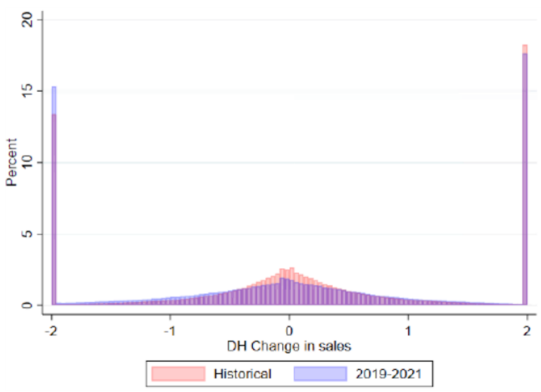
Employment is another important margin of firms' adjustment to the pandemic shock. Figure 8 shows the evolution of total real sales and total employment, in levels, both seasonally adjusted and normalized at 100 in February 2020.[17] The decline in employment is larger and more

[15] We also require re-entering firms to report sales in January 2018, so as to avoid considering firms that may have opened only a few months prior to the COVID shock.

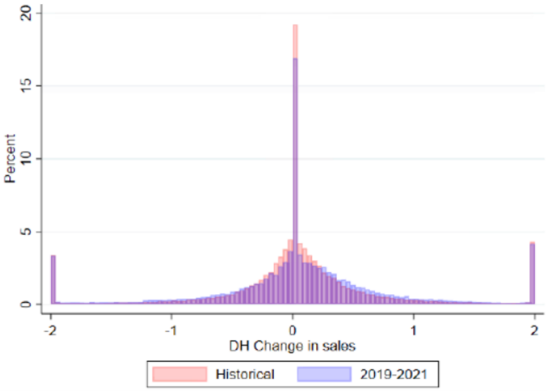
[16] We classify a firm as incumbent if, after February 2020, it does not cease to reports sales more than two consecutive months, and reported sales in January 2018.

[17] The number of firms in the computation of total sales may differ from the number of firms in the computation of total employment, because not all firms that report sales in the electronic invoice database report employment in the employer-employee database.

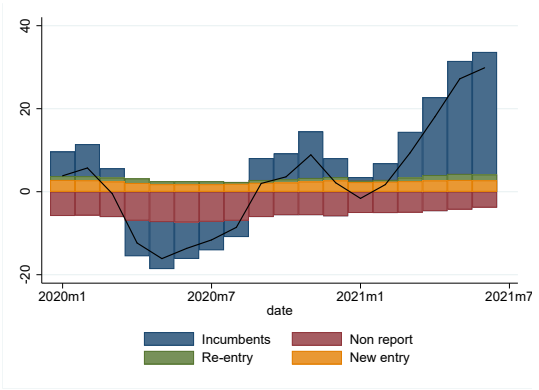
Figure 7: Sales: Extensive and intensive margins



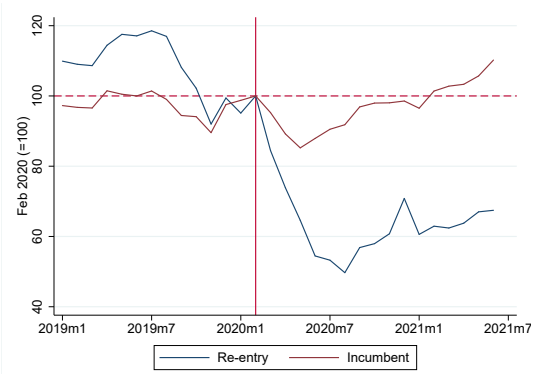
(a) Sales growth (unweighted)



(b) Sales growth (weighted)



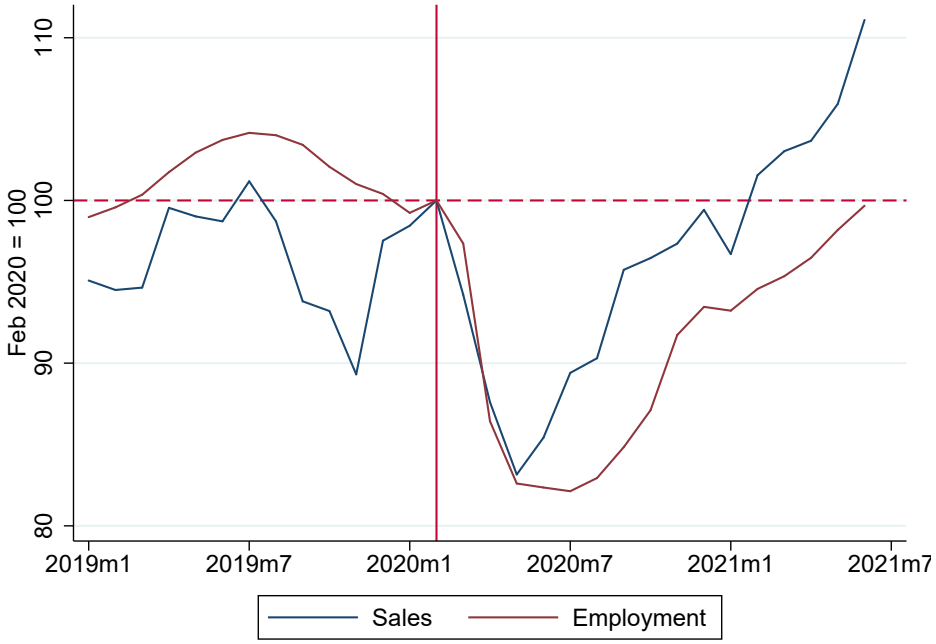
(c) Contribution of extensive margin



(d) Re-entrants and incumbents

Note: Panel (a) shows the distribution of the growth rate of average real sales in Feb-Apr 2021 with respect to Feb-Apr 2019. The growth rate is computed as in Davis and Haltiwanger (1992), i.e., as the change in real sales between the two periods divided by the average across the two periods. For continuing firms, the growth rate is bounded at $(-2, 2)$. For firms that exit and for new firms, the growth rate takes a value of -2 and 2, respectively. Panel (b) shows the distribution of the Davis-Haltiwanger growth rate weighted by average sales. Panel (c) shows the contribution of incumbent, entering (new entry), exiting (no report), and re-entering firms to the year-on-year growth rate of total real sales. Entering firms are 6-months old or younger. Exiting firms are defined as firms that have ceased to report sales for three consecutive months or more. Re-entering firms are firms that experienced an exit spell and resume reporting sales; a re-entering firm keeps that label during the first 6 months after re-entering. Incumbent firms are all others. The decomposition is computed as follows: for each category, we add up the firm-level annual change in real sales (sales in firm i in period t minus sales in firm i in period $t-12$), and divide by the group total in $t-12$. This means that the contribution of, for example, entering firms, adds up firm-level changes and divides by total sales in firms that were entrants 12 months ago. Panel (d) tracks sales of firms that at any point after the pandemic hit the economy were classified as re-entering, as well as firms that after the pandemic hit did not suffer exit spells (incumbent) Re-entering firms are those that exited (i.e., reported no sales for three or more consecutive months) after February 2020 and subsequently reported sales; and reported sales in January 2018, so as to avoid considering firms that may have opened only a few months prior to the COVID shock. Incumbent firms are those that, after February 2020, do not cease to report sales more than two consecutive months, and reported sales in January 2018. Sources: Tax form F29, and authors' own calculations.

Figure 8: Performance of employment and sales



Note: For details on sales, see the note to figure 5. Employment refers to the total number of employer-employee relations in the employer-employee dataset, excluding workers enrolled in the employment protection program (LPE). Seasonally adjusted. Sources: Tax form F29; employer-employee dataset; employment protection law (LPE) dataset; and authors' own calculations.

persistent than that of sales, so that by the end of 2020, it remained below its pre-pandemic level. It is important to note that figure 8 shows effective employment, i.e., it excludes workers enrolled in the employment protection program (*Ley de Protección del Empleo* or LPE), a furlough scheme funded by the government, which we study in detail in section 5. This implies that the decline of nearly 20% of employment in figure 8 is partly due to job separation, but also due to workers enrolling in the employment policy.

The total performance of employment masks substantial heterogeneity. Figure 9 documents two dimensions of firm heterogeneity analogous to those previously explored for the case of sales—industry and size. In terms of the four key industries (panel a), effective employment declined dramatically in restaurants and hotels. Although it exhibits signs of recovery in the second half of 2020, it remains about 30% below its pre-pandemic level by the end of the year. The decline in employment in manufacturing, commerce, and services ranged from about 10% to 20%. As in the case of sales, micro and small firms, and medium-sized firms, experienced the largest decline in effective employment, followed by large firms (panel b). Micro and small firms are also those that have experienced a stronger recovery in employment.

Figure 10 studies the interaction of the extensive and intensive margins in the performance of employment. Panels (a) and (b) show the heterogeneity in the recovery of employment, by

Figure 9: Employment: Heterogeneity by sector and size

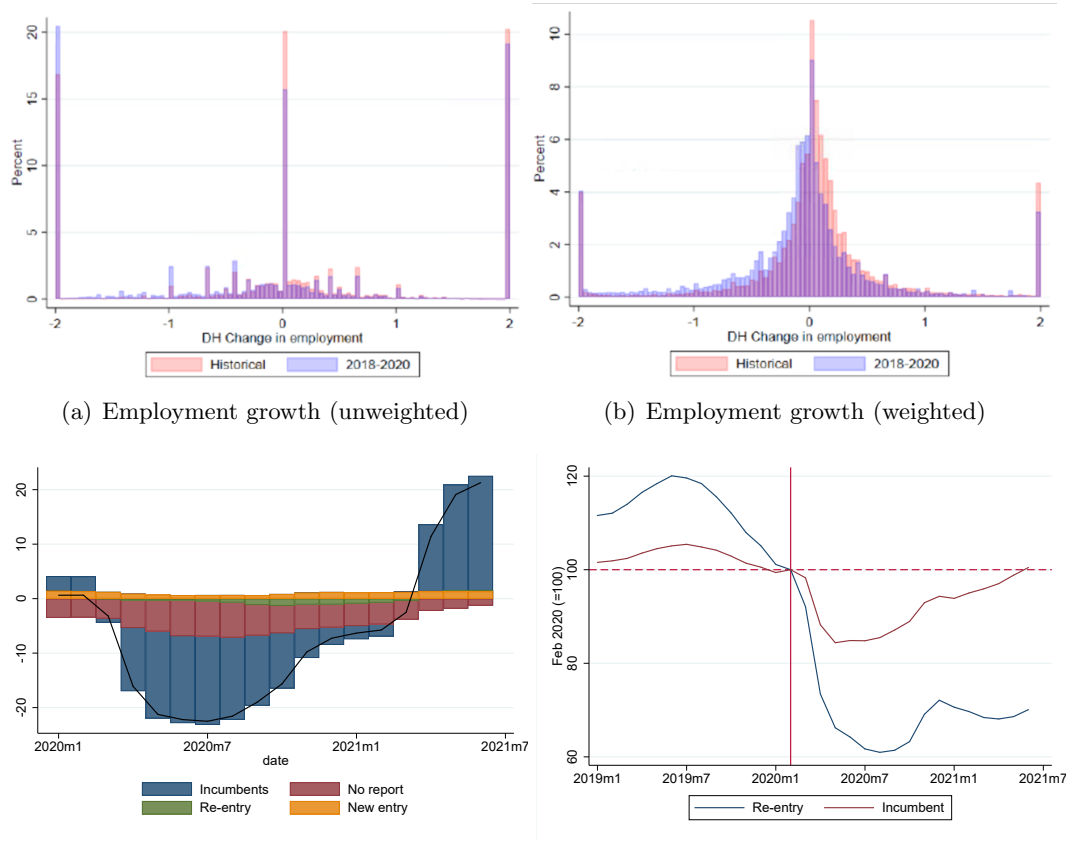
(a) Sector (b) Size

Note: Seasonally adjusted employment, excluding workers enrolled in the employment protection program (LPE), normalized at 100 in February 2020.The service sector includes personal services and business services. For details on the classification of firms by size, see the note to figure 4. Sources: Employer-employee dataset (AFC); employment protection law (LPE) dataset; and authors' own calculations.

means of the distribution of the Davis and Haltiwanger (1992) growth rates. The blue distributions compare average employment in Oct-Dec 2020 with Oct-Dec 2018, and thus, speak about heterogeneity in the recovery from the COVID pandemic. The orange distributions serve as a benchmark of "normal times." This benchmark averages the distributions of the periods 2015-2017, 2016-2018, and 2017-2019. Panel (a) displays unweighted distributions, whereas panel (b) refers to distributions in which each firm's growth rate is weighted by average employment across the two periods. For continuing firms, both panels show that in the COVID period (blue distributions), there is more mass in the left side of the distribution, i.e., a larger share of firms employs less workers than two years ago. In normal times, there is more mass on the right side of the distribution. In other words, the distribution of the growth rate of employment is shifted to the left, which is consistent with an economy where employment has not recovered its pre-pandemic level. For exiting and entering firms, in the unweighted distribution there is higher destruction and lower creation in the recovery from the COVID pandemic than in normal times. In the weighted distribution, we only see lower creation, which suggests smaller firms account for the bulk of employment destruction.

Panel (c) of figure 10 shows the contribution of the extensive margin to the year-on-year growth rate of employment (black line). As in the case of sales, the bulk of the fluctuation of employment is driven by the behavior of incumbent firms (blue bars). Exiting firms (red bars) are more important for the dynamics of employment than for the dynamics of sales, since their contribution to the decline of employment is much more visible than that of sales. Finally, panel (d) tracks the performance of employment in re-entering and incumbent firms. As in the

Figure 10: Employment: Extensive and intensive margins



(a) Employment growth (unweighted)

(b) Employment growth (weighted)

(c) Contribution of extensive margin

(d) Re-entrants and incumbents

Note: Employment excludes workers enrolled in the employment protection program (LPE). Panels (a) and (b) show the distribution of the Davis and Haltiwanger (1992) growth rate of average employment in Oct-Dec 2020 relative to Oct-Dec 2018. Panel (a) refers to the unweighted distribution, whereas panel (b) refers to the distribution weighted by average employment. Panel (c) shows the contribution of incumbent, entering (new entry), exiting (no report), and re-entering firms to the year-on-year growth rate of employment. Panel (d) tracks employment of firms that at any point after the pandemic hit the economy were classified as re-entrants, as well as firms that after the pandemic hit did not suffer exit spells (incumbents). For details on the classification of firms in panels (c) and (d), see the notes to figure 7. Sources: Employer-employee dataset (AFC); employment protection law (LPE) dataset; and authors' own calculations.

analysis of sales (panel d of figure 7), we follow a group of firms in each category. As expected, effective employment in re-entering firms fared much worse than in of incumbent firms. However, re-entering firms are much smaller, which explains why they contribute little to the fluctuation of total employment.

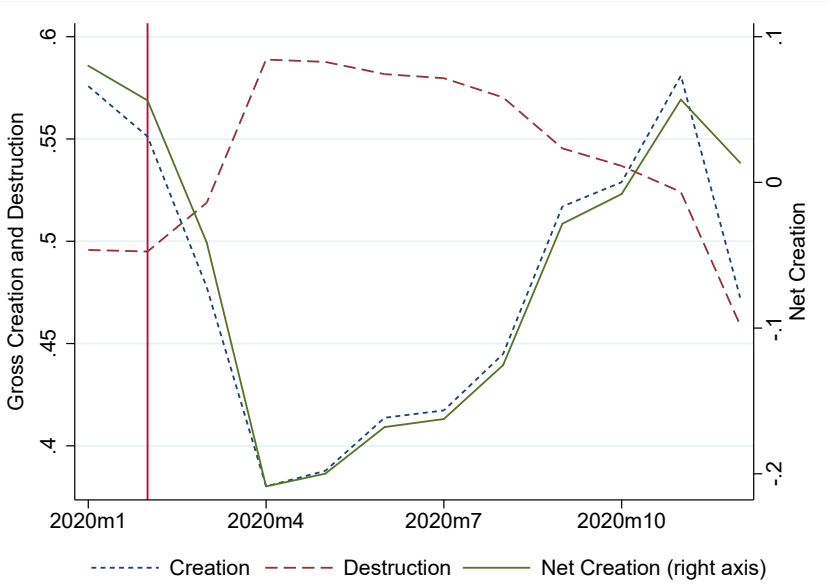
4.3 Market for Suppliers: Linkages between Firms

One important margin of adjustment of firms is the creation and destruction of relationships with suppliers.[18] Figure 11 shows the gross creation and destruction of links with suppliers over time and also the net creation, which is the gross creation minus the gross destruction.

[18]Since we show aggregate numbers, it is equivalent to show this fact for supplier or buyers, given that the intermediate input market has to clear at the aggregate level.

The gross destruction (creation) rate in a given month t is computed as the number of linkages destroyed (created) with respect to the same month in the previous year ($t-12$). It shows that the net creation was positive before the pandemic and it became negative reaching a decline of around 20 percentage points in April 2020, followed by a slow recovery back to slightly positive net creation by the end of that year. The decline in net creation is driven by both an increase in gross destruction and a decline in gross creation. Both types of flows contribute substantially to the decline in net creation of linkages with suppliers.

Figure 11: Gross Creation and Destruction of Productive Linkages between Firms



Note: This graph documents gross creation and destruction (left axis) and net creation (right axis) of productive relationships of firms with their suppliers, expressed in 12-month growth. Firms belonging to the National Accounts Directory are included, except those linked to utilities and public administration. The red vertical line marks February 2020. Source: firm-to-firm transactions dataset and authors' own calculations.

The destruction of linkages with suppliers during the COVID pandemic is high even when compared with normal times. The first three columns of table 2 show the gross destruction rate during 2020, when the COVID pandemic impacted the economy, and during 2018, a more normal year. Between April and August 2020, firms experienced destruction rates far higher than those in the same months of a normal year. In April and May, for example, the destruction rate is nearly 10 percentage points higher than in the same months of 2018.

Although the destruction of links with suppliers was unusually high during 2020, we also see that a higher proportion of destroyed linkages is eventually recovered. The last three columns of table 2 show the fraction of destroyed linkages that are recovered in the following 12 months, for the years 2020 and 2018. In a normal year, slightly more than a third of destroyed linkages are recovered. In 2020, this fraction was up to 10 percentage points higher.

Table 2: Destruction and Recovery of Links with Suppliers

	Share of Links Destroyed			Share of Links Recovered		
	2020	2018	Difference	2020	2018	Difference
January	50	50	0			
February	49	51	-2	38	37	1
March	52	51	1	39	36	3
April	59	49	10	46	36	10
May	59	50	9	46	36	10
June	58	50	8	47	36	11
July	58	50	8	47	37	10
August	57	50	7	46	36	10
September	55	51	4	44	38	6
October	54	49	5	43	35	8
November	52	51	1	42	35	7
December	46	50	-4	42	36	6

4.4 Physical Capital Market: Investment

We now study firm adjustment in the market for physical capital, i.e., investment. Panel (a) of figure 12 shows the evolution of total real investment in machinery and equipment,[19], in levels, seasonally adjusted and normalized at 100 in February 2020, and compares it to total sales. Investment displays more volatility than sales, with a contraction roughly two times larger than that of sales when the pandemic hit the economy, but also a stronger recovery over the following months.

Panels (b), (c) and (d) of figure 12 show the heterogeneity in investment along firm size, industry, and incumbent status. Large firms experienced a substantially lower decline in investment than micro and small, and medium-sized firms (panel b). The three groups of firms, however, have recovered their pre-pandemic levels, with investment in micro and small firms substantially above that level. In terms of industries (panel c), the behavior of restaurants and hotels again stands out due to size of the decline relative to the other three industries. Investment in manufacturing, commerce, and services recovered relatively quickly to pre-pandemic levels. Investment among re-entering and incumbent firms (panel d) displays less heterogeneity than in variables such as sales and employment (figures 6 and 9). Both groups of firms experienced a decline of roughly 30%, and have recovered pre-pandemic levels, with a faster recovery among incumbent firms.

[19]The source of machinery and equipment investment is the tax form F29, which does not include information on building investment.

Figure 12: Heterogeneity in investment

(a) Investment and sales

(b) Size

(c) Sector

(d) Re-entrants and incumbents

Note: The figure shows the evolution of real investment in machinery and equipment, which comes from tax form F29. Observations above the 99.9th percentile of the distribution are winsorized. Panel (a) compares total investment to total firm-to-firm sales (see the note to figure 5 for details on sales). Panels (b)-(d) show the evolution of investment according to firm size, sector, and incumbent status. The service sector includes personal services and business services. For details on the classification of firms by size, see the note to figure 4. For details on the classification of firms by incumbent status, see the note to figure 6. All the series are seasonally adjusted. Sources: Electronic invoice; tax form F29; and authors' own calculations.

4.5 Credit Market: Bank Debt

Access to financing is a key determinant of how firms adjust to shocks. This was particularly true for the COVID crisis. Panel (a) of figure 13 shows that domestic bank credit increased in the months that followed the impact of the COVID shock, with annual credit growth reaching a peak of about 10 percentage points higher than that in the month prior to the beginning of the crisis (February 2020).[20] The countercyclicality of bank credit in the COVID crisis marks a stark contrast with two previous crises—the global financial crisis of the late 2000s and the Asian financial crisis of the late 1990s, when domestic bank credit decelerated. Crucially, the countercyclical response of bank credit was driven by policies implemented by the Central Bank and the government, which we study in detail in section 5. Panel (b) of figure 13 describes how bank credit flowed to firms according to the performance of sales during the COVID pademic. It shows year-on-year bank credit growth relative to that in February 2020, expressed as a difference, in percentage points, for five groups of firms classified according to the 12-month growth rate of sales in April 2020 relative to that in February 2020. Firms with a significant decrease (increase) in sales are those that experienced declines (increases) in the growth rate of sales of 20 to 100 percentage points. Firms with a slight decrease (slight increase) in sales are those that experienced declines (increases) in the growth rate of sales of 1 to 20 percentage points. Firms classified as experiencing no change in sales growth saw changes of less than 1 percentage point.[21] The figure shows a widespread increase in credit growth and, importantly, with credit flowing to highly affected firms.

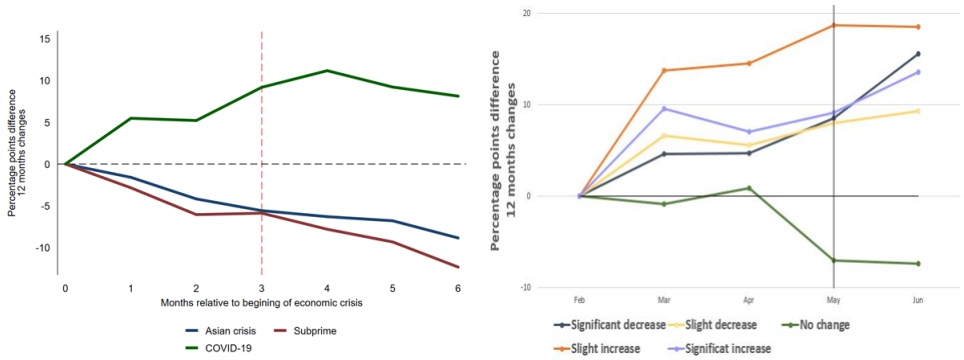
The substantial increase in domestic bank credit is, naturally, associated with higher firm leverage. Figure 14 shows the evolution of the bank debt-to-sales ratio, a common indicator of leverage. Importantly, we fix the denominator, so that changes in the ratio reflect changes in the stock of debt, rather than the sharp decline in sales due to the crisis. Specifically, we compute the stock of debt each period as a ratio of total real sales for the 12-month period covering October 2018 to September 2019, so as to avoid the social unrest episode of October 2019. Panel (a) shows the evolution of leverage in the median firm with a positive stock of bank debt. In a few months, leverage tripled, increasing by more than 9 percentage points.

Panels (b)-(d) in figure 14 show that there is less heterogeneity in the evolution of leverage across firm size, industry, and incumbent status than that found for other variables. Panel (b) shows that leverage in large firms increased less than in micro and small, and medium-sized firms. Panel (c) shows that the median firm in all four industries we study experienced the

[20] Panel a shows aggregate bank credit to firms and households.

[21] The classification of firms according to the performance of sales uses data on firm-to-firm sales from the electronic invoice. The fraction of firms that fall within each category is as follows. Significant decrease: 46%; slight decrease: 17%; no change: 3%; slight increase: 13%; significant increase: 21%.

Figure 13: Bank credit to firms



(a) Credit during crises (b) Credit and sales in 2020

Note: Panel (a) shows the total stock of bank credit to firms each month, expressed as the difference, in percentage points, of the 12-month growth rate with respect to the the growth rate in the month in which the crisis begins. For the Asian and subprime crises, t=0 is the first month of negative GDP growth, according to the monthly GDP proxy IMACEC. For the COVID crisis, t=0 is February 2020. Panel (b) compares the change in the annual growth rate of bank credit, in percentage points, relative to that in February 2020, for five groups of firms classified according to the performance of sales growth. The classification considers the difference, in percentage points, of the annual growth rate of sales in April 2020 relative to that in February 2020. Firms that experienced significant changes in sales growth (decreases or increases) are those with changes of 20 to 100 percentage points. Firms that experienced slight changes in sales growth are those with changes of 1 to 20 percentage points. Firms classified as having no change in sales growth experienced changes of less than 1 percentage point. According to this classification, 46% of firms experienced a significant decrease in sales growth, 17% experienced a slight decrease, 3% experienced no change, 13% experienced a slight increase, and 21% experienced a significant increase. Sources: Financial Regulatory Commission; electronic invoice; and authors' own calculations.

roughly tripling of leverage documented in the aggregate. This is the case even for the services sector, which displays low historical levels of leverage. Finally, panel (d) shows that incumbent firms experienced a larger increase in leverage than re-entering firms.

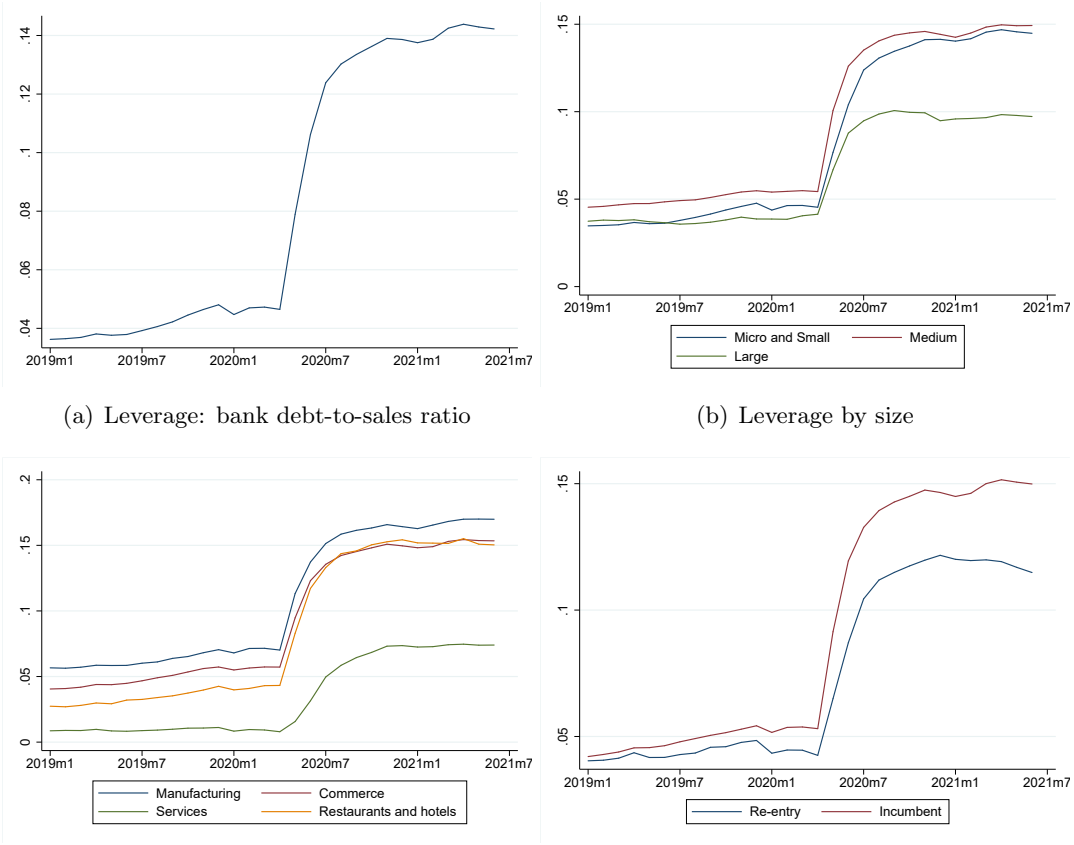
4.6 Productivity

To understand the effect of the pandemic on firm-level and aggregate productivity and its connections with the previous margins of adjustment, we estimate total factor productivity (TFP) following the procedure by Ackerberg, Caves, and Frazer (2015). In particular, we estimate the following production function:

$$\log y_{it} = \log A_{it} + \alpha^L \log l_{it} + \alpha^K \log k_{it}, \tag{1}$$

where i indexes a firm, t indexes a year, y_{it} is value added, l_{it} is number of workers, k_{it} is the stock of capital and A_{it} is firm-level TFP, which we estimate. Following Ackerberg et al. (2015), we find that $\alpha^L = 0.9$ and $\alpha^K = 0.1$, which are in line with previous estimates with Chilean data (Gandhi, Navarro, and Rivers, 2020). To aggregate firm-level TFP, we weight each firm by its value-added.

Figure 14: Leverage



(a) Leverage: bank debt-to-sales ratio

(b) Leverage by size

(c) Leverage by sector

(d) Leverage for re-entrants and incumbents

Note: Leverage is measured as the ratio of the stock of bank debt each to real sales for the 12-month period covering October 2018 to September 2019, so as to avoid the social unrest episode of October 2019. By fixing the denominator, changes in leverage reflect only changes in the stock of debt, and not the sharp decline in sales during the pandemic. Panel (a) shows the evolution of leverage in the median firm with a positive stock of bank debt. Panels (b)-(d) show the evolution of leverage by firm size, industry and incumbent status. The service sector includes personal services and business services. For details on the classification of firms by size, see the note to figure 4. For details on the classification of firms by incumbent status, see the note to figure 6. Sources: Financial Regulatory Commission; electronic invoices; and authors' own calculations.

Figure 15: Aggregate Productivity Growth in 2020

Note: This figure presents the aggregate productivity growth between 2020 and 2019 and the aggregate growth of each of the variables that are used to measure productivity. Thus, the red, green and yellow bar sum up to the blue bar. When going from firm-level variable to these aggregates, we weight with value-added of each firm. Source: authors' own calculations.

Figure 15 shows that TFP increased by 4.7% during 2020. The figure shows that all inputs declined during 2020, but value-added declined relatively less than labor, and thus measured productivity increased. This increase in productivity masks, however, substantial heterogeneity. Figure 16 shows in panel (a) that around 56% (38%) of firms saw their productivity decrease (increase) by an average of around 30% (40%). Panel (b) shows the heterogeneity across size. The productivity of small firms declined, whereas the productivity of medium and large firms increased. Finally, panel (c) shows the heterogeneity across industries. Productivity increased in commerce and manufacturing, but decreased in services, hotels and restaurants, and construction. Taking these results together, the increase in productivity during 2020 is driven by medium and large firms, and firms in commerce and manufacturing.

To further illustrate the heterogeneity in the evolution of productivity, we correlate, at the firm-level, productivity growth with growth of different observables that affect productivity. In order to isolate between-industry variation, we extract industry-level averages. For comparison, besides 2020, we show these correlations for 2019, a year marked by massive protests, and 2009 a crisis year due to the global financial crisis. Figure 17 presents the results. Panel (a) shows that the correlation between productivity and value added growth is basically the same for 2009

Figure 16: Heterogeneity of Productivity Growth in 2020

(a) Productivity Changes

(b) Size

(c) Sector

Note: This figure presents the aggregate productivity growth between 2020 and 2019 and the aggregate growth of each of the variables that are used to measure productivity, for different groups of firms. Panel (a) divides firms into three groups according to their productivity growth. If their productivity fell by more than 3% they are considered as "Fall", if it increased by more than 3%, they are considered as "Increase", otherwise they are considered as "Unchanged". Panel (b) divides firms by size, small firms are those who sell less than 25.000 UF, medium firms sell between 25.000 UF and 100.000 UF, and large firms sell more than 100.000 UF. Panel (c) divides firms by sector, between Services, Commerce, Construction, Industry and Restaurants and Hotels. The remaining sectors are included in "Others". Numbers in parenthesis represent the share of value added of each group. As in Figure 15, the aggregate measures are weighted using firm-level value added. Source: authors' own calculations.

and 2019, and very similar in 2020, except for the upper tail of productivity growth, which had a relatively weaker growth of value added. Panel (b) correlates productivity and employment growth, and shows a different pattern in each year. First, 2020 represents a downward shift of the correlation relative to 2019. This implies that for a given change in employment, productivity increased more in 2019. For the firms with negative productivity growth, there was almost no increase in employment during 2020. Finally, the shape of the correlation for 2009 is different relative to 2020. In 2009, the firms that increased productivity substantially (above 30%), did so with a larger decline in employment than firms in 2020. On the other hand, for firms with a smaller increase in productivity, employment declined less in 2020 relative to 2009. In other words, the correlation between productivity and employment growth became flatter in 2020

relative to 2009.

Panel (c) shows the correlation between productivity and investment growth. The correlation is close to zero in 2019, and even slightly negative for positive productivity growth, whereas it is positive in 2020. It is also positive in 2009, although with a downward shift, suggesting that investment had an overall better performance in 2020 relative to 2009. Finally, we explore the relation between productivity growth and the growth of linkages between firms, both with suppliers and buyers (panels d and e). We find that there is a positive correlation between productivity growth and the growth in the number of buyers and suppliers in 2020. In 2009, these correlations are almost zero. This suggests that the capability of recovering buyers and suppliers in 2020 was important for productivity growth.

5 Credit and Employment Policies Oriented to Firms

This section describes firm access to two policies that were oriented to firms in Chile at the onset of the COVID crisis, between March and May of 2020. One policy aimed at supporting credit to firms by offering government guarantees, whereas the other policy was a furlough scheme designed to protect employment by lowering firms' wage expenses avoiding permanent job separations. In addition to describing access to these policies, this section offers evidence on the performance of firms that accessed the policies. It does not, however, study their causal effect. A companion paper (Albagli et al., 2022) focuses on the issue of causality.

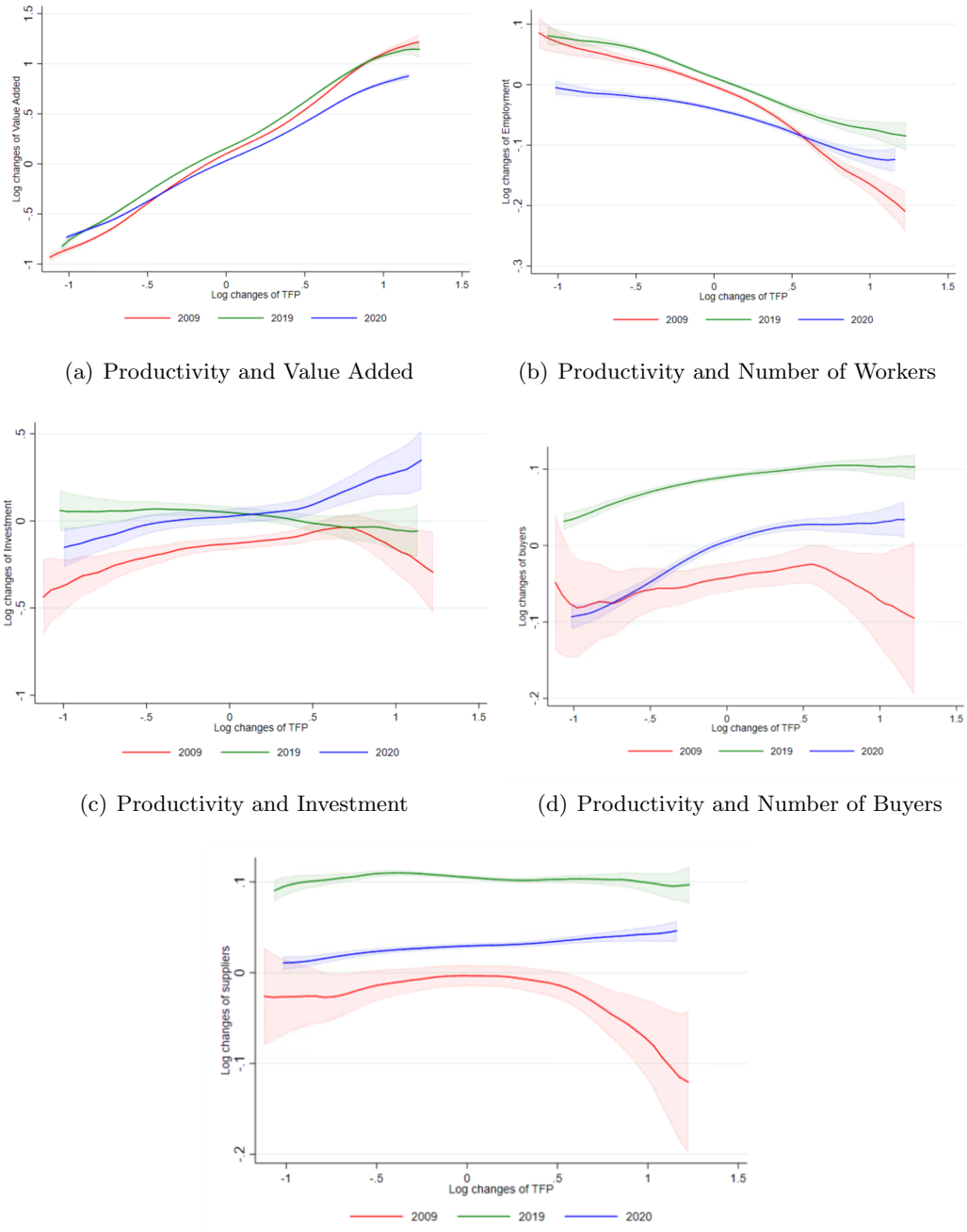
We begin by documenting access to these two policies in terms of how many firms voluntarily accessed the programs, when they did so, and the intensity with which they did it. We also continue to track the heterogeneity in access across firms' industry, size, and incumbent status. We present further evidence in terms of outcomes related to accessing these programs. The outcomes we explore are sales, employment, and investment.

While these were the two main policies implemented to support firms in Chile due to COVID, and the first line of defense as the crisis unfolded, there were other policies mostly aimed at supporting households via, e.g., fiscal transfers and early pension-fund withdrawals. Importantly, these additional policies were enacted throughout the second half of 2020, after the two policies that we study here were implemented.

5.1 Access to Credit Support

On March 16, 2020, two weeks after the first COVID case was identified in Chile, the Central Bank of Chile announced it was lowering its monetary policy rate to 50 bp, which it considered its effective lower bound. Importantly, a separate set of unconventional policies to counteract

Figure 17: Productivity and Observables Growth in 2020, 2019 and 2009



(a) Productivity and Value Added

(b) Productivity and Number of Workers

(c) Productivity and Investment

(d) Productivity and Number of Buyers

(e) Productivity and Number of Suppliers

Note: This figure presents correlations between firm-level productivity growth between 2020 and 2019 (X axis) and the growth of different observables. The correlations are shown non-parametrically with local linear regressions. Source: authors' own calculations.

the economic effects of COVID were also announced. At the core of these measures was a new credit facility (FCIC by its acronym in Spanish) aimed at providing medium-term liquidity to commercial banks at very low rates for up to 4 years, conditional on banks providing loans to small and medium-sized firms. Throughout the COVID pandemic, FCIC provided nearly 40

billion U.S. dollars in loans to banks.

A few weeks after this, in April 2020, a complementary policy to FCIC was launched by the Chilean government through FOGAPE-COVID, a state-backed fund that would provide sovereign guarantees of up to 85% of commercial bank loans to firms. The recapitalization of the fund by 3 billion U.S. dollars provided guarantees for loans of up to 24 billion.[22] The combination of these two credit support policies provided resources and incentives for banks to lend to firms affected by the COVID shock.

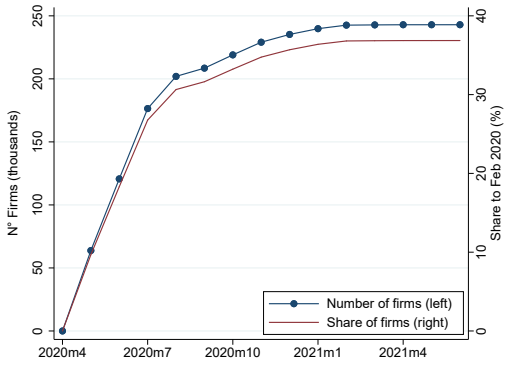
Panel (a) in figure 18 documents firm access to FOGAPE-COVID loans. There was widespread access to this program. By the end of 2020, nearly 250.000 firms (40% of firms reporting positive sales in February 2020) obtained at least one loan through this program. Importantly, access was equally strong among firms that were performing relatively well and those that were being highly impacted by the crisis. Panel (b) shows that credit flowed largely to firms with significant decreases in sales, only comparable to those with significant increases. Lastly, panel (c) shows that the lion's share of the program was provided in the first two months of the implementation of the FCIC-FOGAPE joint programs in May and June, with flows that amounted to about 3% and 2% of GDP, respectively.

Figure 19 documents the heterogeneity in access to the credit policy across firms. Loans were given relatively more to firms in commerce and manufacturing, and mostly to micro and small, incumbent firms (panels a-c). In terms of flows, FOGAPE-COVID loans were directed more to commerce and manufacturing too, and they were evenly distributed across firm sizes. Lastly, most were given to incumbent firms (panels d-f).

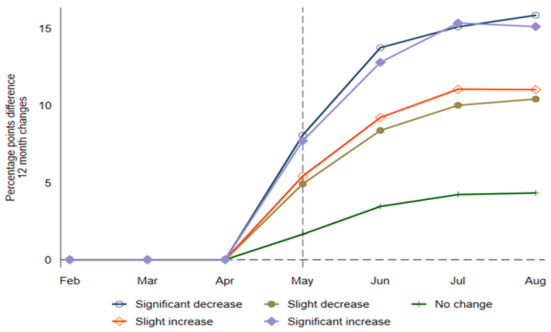
Figure 20 presents the dynamics of sales and investment by grouping firms into two groups: those that did not get FOGAPE-COVID loans and those that did. Results indicate that firms that accessed loans from the credit support program had an initial sharper decline in sales and investment of about 10 and 20 percentage points for these two variables, respectively, relative to the group that did not access the policy. Interestingly, firms that obtained FOGAPE-COVID loans recovered more rapidly in those two dimensions relative to the other group. Of course, these results should not be interpreted in causal terms, since firms that accessed the policy might be precisely those that were more exposed to the COVID shock. In a companion paper (Albagli et al., 2022), we use a matching approach to study the causal effect of this credit policy at the firm level.

[22]The sovereign credit guarantees program, FOGAPE, dates back to 1980. Before the COVID crisis and the recapitalization the fund had only 100 million U.S. dollars in capital.

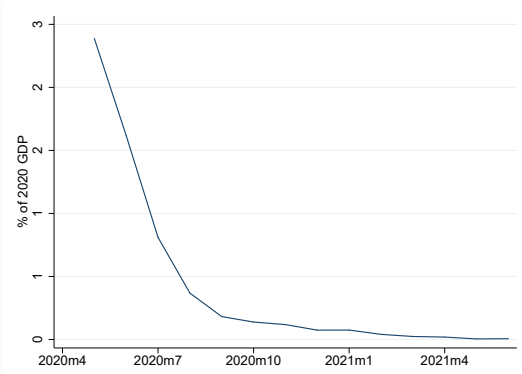
Figure 18: Firm access to bank loans under the FOGAPE program



(a) Firms with FOGAPE loans



(b) FOGAPE and sales



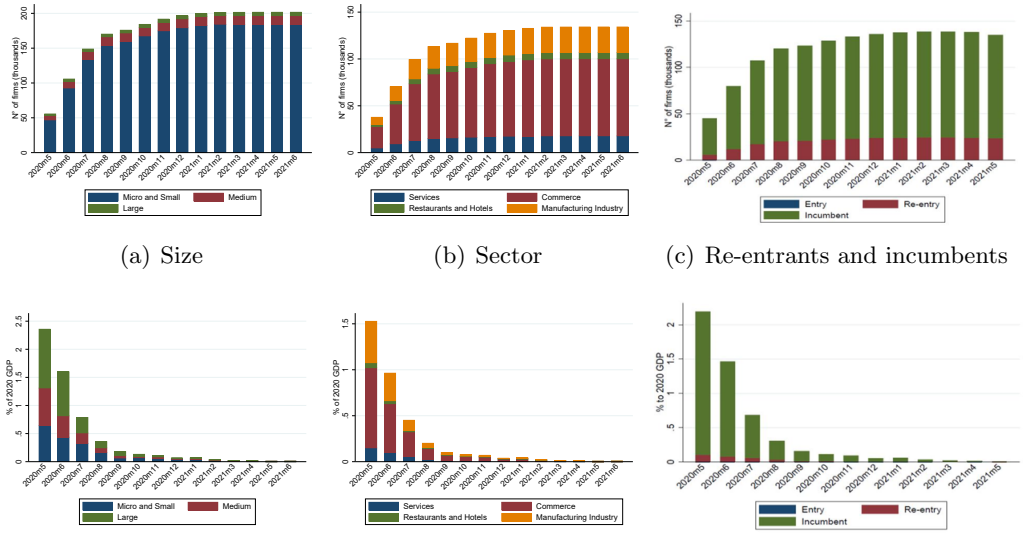
(c) FOGAPE flows

Note: Panel (a) shows the cumulative number of firms that that had received a FOGAPE loan. Panel (b) compares the change in the annual growth rate of FOGAPE loans, in percentage points, relative to that in April 2020, the month prior to implementation of FOGAPE-COVID program, for five groups of firms classified according to the performance of sales growth. The classification considers the difference, in percentage points, of the annual growth rate of sales in April 2020 relative to that in February 2020. Firms that experienced significant changes in sales growth (decreases or increases) are those with changes of 20 to 100 percentage points. Firms that experienced slight changes in sales growth are those with changes of 1 to 20 percentage points. Firms classified as having no change in sales growth experienced changes of less than 1 percentage point. Panel (c) shows the evolution of bank credit under the FOGAPE-COVID program, as a share of 2020 GDP. Sources: Financial Regulatory Commission, and tax form F29 and authors' own calculations.

5.2 Access to the Employment Protection Policy

In April 2020 the Employment Protection Law (LPE for its acronym in Spanish) was approved by Congress and became another landmark program in the set of policies aimed at supporting firms and, in particular, the relationships they have formed over time with their workers. LPE would provide firms a legal way to furlough some or all employees quickly and easily. Importantly, the program reduced firms' costs, since they had to pay only a small fraction of benefits, while the employee would continue receiving a fraction of her salary from the unemployment insurance fund. Fully reinstating employees back to work was also a fast and costless process. Thus, LPE gave firms important room to maneuver and scale back production without incurring in costly

Figure 19: Heterogeneity in firm access to FOGAPE loans

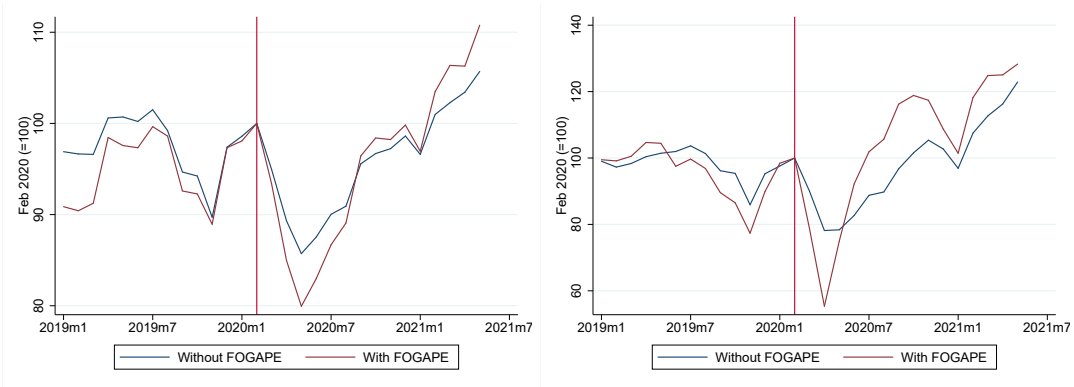


(a) Size (b) Sector (c) Re-entrants and incumbents

(d) Size (e) Sector (f) Re-entrants and incumbents

Note: Panels (a)-(c) show the cumulative number of firms that had accessed a loan under the FOGAPE-COVID program, by firm size, sector, and incumbent status, respectively. Panels (d)-(f) show the evolution of bank credit under the FOGAPE-COVID program, as a share of 2020 GDP, by firm size, sector, and incumbent status. For details on the classification of firms by size, see the note to figure 4. The services sector includes personal services and business services. For details on the classification of firms by incumbent status, see the note to figure 6. Source: Financial Regulatory Commission and authors' own calculations.

Figure 20: Performance of sales and investment in firms that accessed FOGAPE loans



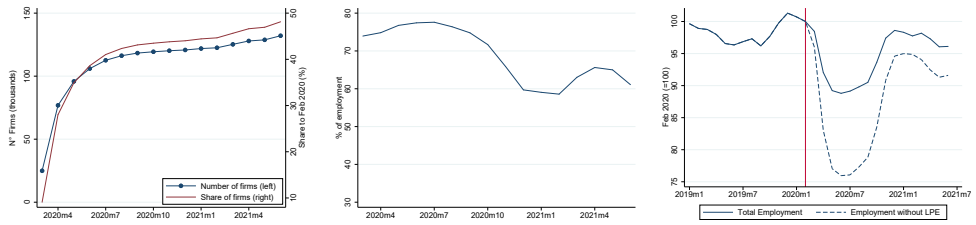
(a) FOGAPE-COVID and sales (b) FOGAPE-COVID and investment

Note: The two groups presented split Sales and investment of firms that, on one hand, accessed bank credit under the FOGAPE-COVID program in any month starting in May 2020, when the FOGAPE-COVID program began ("With FOGAPE") and those that never accessed loans through this program ("Without FOGAPE"). All series are seasonally adjusted. Sources: Financial Regulatory Commission, tax form F29, and authors' own calculations.

layoffs, while giving them also the chance to scale up quickly and without incurring in hiring costs once the economy recovered.

The employment policy also received widespread access by firms. Panel (a) of figure 21 shows that the month of highest take-up was April 2020. Throughout the program, nearly 120,000

Figure 21: Firm access to employment protection program (LPE)



(a) Firms in LPE (b) Intensity in use of LPE (c) Employment and LPE

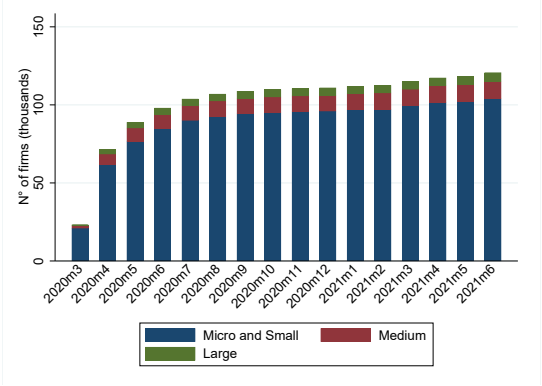
Note: In panel (a) we consider the cumulative number of firms that at one point had at least one worker enrolled in LPE. Panel (b) shows the fraction of the payroll enrolled in LPE among firms that accessed the policy. In panel (c) the blue line refers to total employment relations in the employer-employee database; the red line computes effective employment by excluding workers enrolled in LPE. Both series are not seasonally adjusted. Sources: Employer-employee dataset, employment protection program (LPE) dataset, and authors' own calculations.

firms enrolled at least one worker. This number represents about 45% of firms that had at least one worker in February 2020. Conditional on accessing the program, the high intensity in its use was also a distinctive characteristic. Panel (b) shows that, for an average firm that accessed LPE, the share of employees enrolled in the program reached nearly 80% by mid 2020 and stayed higher than 60% throughout the period of analysis. Importantly, LPE contributed to mitigating the decline in aggregate employment due to the COVID shock. Panel (c) presents the evolution of employment relations, in levels and normalized at 100 in February 2020, when workers enrolled in the employment policy are included (solid line), and when they are excluded (dashed line). Recall that we excluded these workers when we described the evolution of *effective* employment previously. At the trough of the crisis, about 10% of employment relations were destroyed, and 15% were enrolled in the policy, which suggests LPE mitigated the decline in employment.

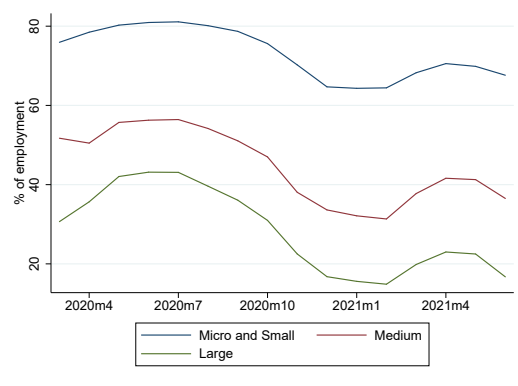
Figure 22 documents heterogeneity in access to the employment policy. It was largely concentrated in micro and small firms where, conditional on accessing this program, the typical firm had more than 80% of workers furloughed in LPE. Access to LPE has been largely concentrated in commerce and manufacturing firms. Among the firms that accessed LPE, those in the restaurants and hotels industry enrolled a larger fraction of their payroll, close to 90% of the labor force in the average firm in this industry.

In Figure 23 we identify firms that accessed LPE from March to December 2020, and those that did not access it in this period, and track their performance before and after the crisis in terms of sales and employment. Among firms that accessed LPE, the level of sales dropped substantially more, with a trough in May 2020 of about 30% less sales than in February 2020, while sales of firms that did not enroll employees in LPE saw their sales fall by about 10% with

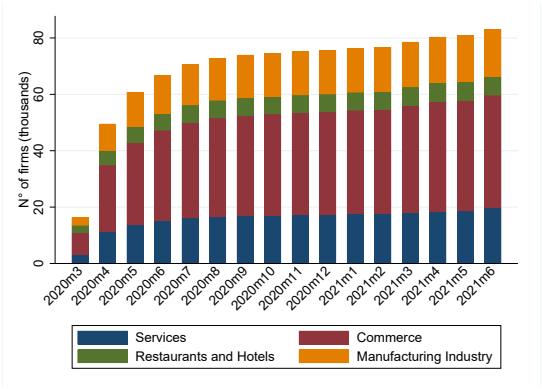
Figure 22: Heterogeneity in access to employment protection (LPE)



(a) N° of firms in LPE by size



(b) Intensity in access of LPE by size



(c) N° of firms in LPE by sector

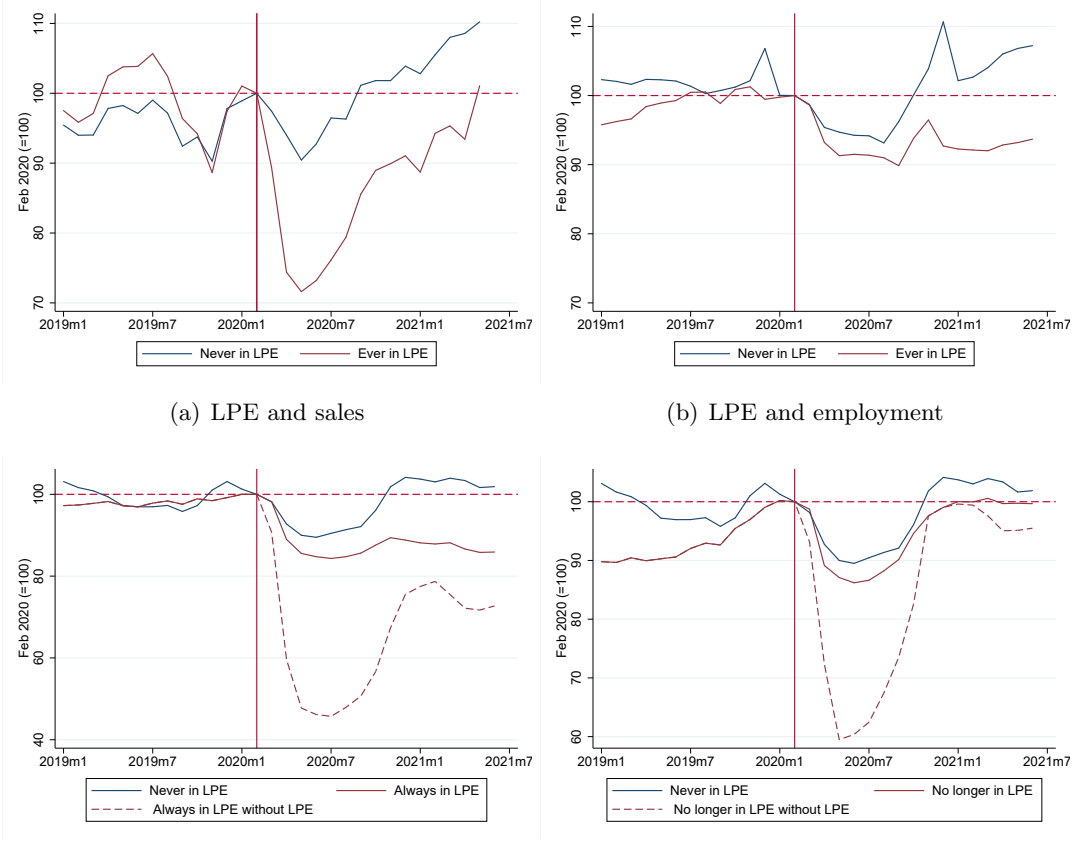
(d) Intensity in access of LPE by sector

Note: Panels (a) and (c) show the cumulative number of firms with at least one worker enrolled in LPE at any point in time by firm size and sector, respectively. Panels (b) and (d) show the fraction of the payroll enrolled in LPE among firms that accessed the policy, by firm size and sector, respectively. For details on the classification of firms by size, see the note to figure 4. The services sector includes personal services and business services. Source: Employer-employee dataset, employment protection program (LPE) dataset, and authors' own calculations.

respect to their pre-COVID levels, and displayed a relatively faster recovery. Indeed, recovery of sales in firms that did access the policy lagged behind those that did not. In contrast, the decline in total employment (including workers enrolled in the policy) across the two types of firms was much more similar, as documented in panel (b), suggesting that LPE did help absorb some of the effects on employment from the large shock in sales.

A caveat in the analysis of panel (b) comes from the fact that, among the group of firms that accessed LPE at the onset of the program, we do not differentiate between firms that continued in LPE throughout 2020 and those that terminated access to the program before the end of the year. The lower panels in figure 23 focus on firms that accessed LPE at the start of the crisis (Mar-May 2020). While panel (c) looks at employment in firms that continously have workers enrolled in the policy throughout the year, those in panel (d) no longer have workers

Figure 23: Performance of firms that accessed employment protection (LPE)



(a) LPE and sales

(b) LPE and employment

(c) Employment in firms that stayed in LPE

(d) Employment in firms that left LPE

Note: Panels (a) and (b) show the evolution of sales and total employment, respectively, in firms that accessed LPE in any month during the period March-December 2020. Total employment includes workers enrolled in LPE, and the series in both panels are seasonally adjusted. Panel (c) shows the evolution of employment in firms that enrolled workers in LPE in March, April or May 2020 and had at least one worker enrolled each month until December. Solid and dashed red lines refer to total employment, and employment excluding workers enrolled in LPE, respectively, in these firms, whereas the blue line considers total employment in firms that did not access the LPE program at any point during 2020. Panel (d) shows the evolution of employment in firms that enrolled workers in March, April or May 2020 and had no workers enrolled by November, at the latest; and have positive sales in Nov and Dec. All figures in panels (c) and (d) are not seasonally adjusted. Sources: tax form F29, employer-employee dataset, employment protection program (LPE) dataset, and authors' own calculations.

enrolled in the policy by November 2020 at the latest. As a benchmark, panels (c) and (d) also show the evolution of employment in firms that did not enroll workers in the policy (blue line). In both cases, effective employment (excluding workers enrolled in LPE) has recovered considerably. For firms in panel (c), which have workers enrolled throughout the year, effective employment declined by nearly 60% at the trough, and had recovered by nearly half with respect to pre-pandemic levels. For the case of firms in panel (d), which no longer had workers enrolled in the policy, effective employment declined by 40% at the trough, and had nearly recovered pre-pandemic levels by early 2021.

We now focus on worker transitions from LPE to non-LPE. Table 3 documents the status

of workers that had enrolled in LPE from March to May 2020. It reports the share of these employees that continued enrolled in LPE, those that had already been reinstated in the same firm, and those that had left the firm. It is remarkable to see that, by December 2020, more than 75% of employees were still with the firm they worked for at the time they enrolled in LPE, with 53% back to work, and the remaining 23% still enrolled in the program.[23]

Table 3: Transition of workers that enrolled in LPE in March-May 2020

	2020						
	June	July	August	September	October	November	December
In LPE	94.1%	89.5%	82.1%	75.3%	65.2%	40.5%	23.5%
Back to work in the same firm	4.4%	7.1%	11.3%	15.8%	22.4%	41.1%	52.6%
Other	1.5%	3.4%	6.6%	8.9%	12.5%	18.4%	23.9%

Note: We track the status of the pool of workers whose firm enrolled them in LPE between March and May 2020 throughout the rest of the year. "In LPE": workers enrolled in LPE; "Bach to work in the same firm": workers recalled to the firm they worked for in Mar-May; "Other": workers that may be out of the labor force, unemployed, or working for a firm other than the one they were working for when they enrolled in LPE. Source: Employer-employee dataset, and authors' own calculations.

Table 4 completes the analysis by considering the extent to which firms accessed LPE and FOGAPE-COVID policies simultaneously. Among firms that accessed any of the two policies in March-June 2020 (second row), 31% accessed LPE only, 41% accessed FOGAPE-COVID only, and 28% accessed both policies. For each of these three sets of firms, we compute the median year-on-year growth rate of sales at the start of the crisis (Mar-Apr). Firms that suffered the sharpest decline in sales growth (49%) accessed LPE only, while those that were relatively less affected (16% median decline in sales growth) accessed FOGAPE-COVID only. The median firm that accessed both programs experienced an initial decline of sales growth of about 39%. These results hold when we consider access to these policies throughout 2020 (first row).

Table 4 also provides information in terms of size and industries. Micro and small firms were the most affected in terms of sales, in all three categories—firms that accessed the employment policy only, firms that accessed the credit policy only, and firms that accessed both policies. Across all firm sizes, the performance of sales is qualitatively similar than in the aggregate, i.e., firms that accessed only the employment policy were the most affected, firms that accessed only the credit policy were the least affected, and firms that accessed both policies lie between these two groups. These results are also qualitatively similar across industries.

[23]Employees that neither continue in LPE nor are back to work in the same firm are either unemployed or have started working at another firm.

Table 4: Firm access to employment protection (LPE) and credit guarantee (FOGAPE) policies

	Employment protection (LPE) only			Credits guarantee (FOGAPE) only			LPE and FOGAPE		
	Number of firms	Share of firms	Median sales growth	Number of firms	Share of firms	Median sales growth	Number of firms	Share of firms	Median sales growth
2020	50566	25.6%	-45.4%	106324	53.9%	-17.6%	40552	20.5%	-37.8%
Mar-Jun 2020	42488	30.9%	-49.2%	56290	40.9%	-16.3%	38723	28.2%	-38.9%
Micro and Small	38435	32.1%	-52.0%	49560	41.4%	-21.0%	31709	26.5%	-45.0%
Medium	2531	20.4%	-23.6%	4962	39.9%	9.1%	4933	39.7%	-16.3%
Large	1522	28.3%	-14.5%	1767	32.9%	9.7%	2081	38.8%	-12.7%
Services	6373	42.4%	-44.5%	4308	28.6%	-24.6%	4366	29.0%	-35.6%
Commerce	14163	27.4%	-51.8%	23769	46.0%	-14.8%	13710	26.5%	-40.4%
RRHH	4967	42.4%	-68.3%	2280	19.5%	-56.5%	4469	38.1%	-67.9%
Manufacturing Industry	5486	28.2%	-39.6%	7682	39.5%	-15.3%	6303	32.4%	-31.0%

Note: The first row considers firm access to these policies throughout 2020. The second row focuses on access in March-June 2020, the period when most firm accessed these policies. Rows 3-5 show access in March-June 2020 by firm size. For details on the classification of firms by size, see the note to figure 4. Rows 6-9 show access in March-June 2020 by firm sector. Services include personal services and business services. Median sales growth refers to March-April 2020, the initial period of the COVID shock. To compute median sales growth in Mar-Apr of each group of firms, we begin by computing, for each firm, average annual sales growth in March-April; we then compute the median across firms. Source: Electronic invoice, employer-employee dataset, employment protection law (LPE) dataset, Financial Regulatory Commission, and FOGAPE credits dataset.

6 Conclusion

This paper offers a complete and detailed account of how firms adjust to shocks. We apply the analysis to the COVID pandemic, adding substance to the standard macro view of the shock. Our analysis exploits a rich administrative dataset for Chile that allows us to trace the real effects of the shock on firm-level output, employment, investment, links with suppliers, access to credit, and productivity. We also find that credit support and employment protection policies were widely accessed by firms, which probably contributed to mitigating the adverse effects of the COVID pandemic.

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