FIRMS' FINANCIAL VULNERABILITIES DURING COVID-19: WAS THE FRENCH SUPPORT PACKAGE TOO GENEROUS?

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ABSTRACT

We exploit detailed and comprehensive data from France, combining firms' balance sheet information and trade records, to uncover the role of firm characteristics in their exposure to the COVID-19 pandemic. Next, we study the impact of three governmental support policies on firms' liquidity position in 2020: the wage subsidy scheme (AP), the solidarity fund (FSE) and the loan guarantee (PGE). We highlight four dimensions of heterogeneity for policy efficiency in our analysis: the type of liquidity shock, sector and size groups and labor productivity deciles. Our microsimulation exercise shows that aggregate policy support matches very well total liquidity losses. Yet, the compensation scheme was not perfect as these aggregate figures hide heterogeneous policy efficiency across firms and policies. Nearly one fourth of firms were over-compensated, which allowed them to improve their liquidity position, but those that suffered the highest liquidity losses did not receive enough support. Our simulation shows that 7.4 billion (bn) euros of subsidies were given to firms in excess of their liquidity loss. The share of overcompensated firms rises to 39% when we account for the guaranteed loans. We locate them mostly in the wholesale and retail, manufacturing and culture and leisure sectors. Yet, most firms were not fully compensated. This was especially the case for those that became illiquid in 2020, very large firms, highly productive firms, and firms in the hospitality and construction sectors.

KEYWORDS: COVID, Liquidity, Firm level data, State support, Micro-simulation, Policy effectiveness.

JEL: D22, G32, G33, G38.

RÉSUMÉ

Cette étude évalue l'impact des aides publiques allouées aux entreprises pour lutter contre les effets négatifs de la crise du COVID-19 pendant l'année 2020 sur leur liquidité. Nous exploitons les données comptables 2019 des entreprises françaises ainsi que les données officielles de trois aides majeures : le financement de l'activité partielle (AP), la subvention pour compenser la perte d'activité du fonds de solidarité des entreprises (FSE) et le prêt garanti par l'Etat (PGE). Notre évaluation repose sur une microsimulation de la variation de liquidité par entreprise à la suite du choc d'activité de 2020 ainsi que du niveau des aides obtenues par entreprise selon leur caractéristique et dans le respect des montants totaux observés par secteur. Il apparaît que les montants agrégés de perte simulée de liquidité (132 milliards d'euros) sont plutôt bien couverts par les aides publiques (138 milliards d'euros) mais qu'ils cachent de fortes disparités selon les caractéristiques retenues des entreprises mais aussi à l'intérieur des groupes. En effet, nos résultats montrent que 24,5 % des entreprises ont été sur-compensées par les aides de type subvention (AP et FSE) et qu'un montant de 7,4 milliards d'euros aurait pu ainsi être épargné. La part des entreprises sur-compensées est réhaussée à près de 39 % quand on tient compte de l'effet des PGE. Nous les situons principalement dans les secteurs du commerce, de l'industrie manufacturière et de la culture et des loisirs. Il n'en reste pas moins qu'un certain nombre d'entreprises n'ont pas pu totalement compenser leur perte de liquidité. C'est notamment le cas pour celles devenues illiquides en 2020, les très grandes entreprises, les entreprises hautement productives et les entreprises dans les secteurs de l'hôtellerie et de la construction.

MOTS CLÉS : COVID, Liquidité, Données au niveau de l'entreprise, Soutien de l'État, Micro-simulation, Politique efficacité.

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Firms' financial vulnerabilities during COVID-19 : Was the French support package too generous ?

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Abstract

We exploit detailed and comprehensive data from France, combining firms' balance sheet information and trade records, to uncover the role of firm characteristics in their exposure to the COVID-19 pandemic. Next, we study the impact of three governmental support policies on firms' liquidity position in 2020: the wage subsidy scheme (AP), the solidarity fund (FSE) and the loan guarantee (PGE). We highlight four dimensions of heterogeneity for policy efficiency in our analysis: the type of liquidity shock, sector and size groups and labor productivity deciles. Our microsimulation exercise shows that aggregate policy support matches very well total liquidity losses. Yet, the compensation scheme was not perfect as these aggregate figures hide heterogeneous policy efficiency across firms and policies. Nearly one fourth of firms were over-compensated, which allowed them to improve their liquidity position, but those that suffered the highest liquidity losses did not receive enough support. Our simulation shows that €7.4 billion (bn) of subsidies were given to firms in excess of their liquidity loss. The share of overcompensated firms rises to 39% when we account for the guaranteed loans. We locate them mostly in the wholesale and retail, manufacturing and culture and leisure sectors. Yet, most firms were not fully compensated. This was especially the case for those that became illiquid in 2020, very large firms, highly productive firms, and firms in the hospitality and construction sectors.

Résumé

Cette étude évalue l'impact des aides publiques allouées aux entreprises pour lutter contre les effets négatifs de la crise du COVID-19 pendant l'année 2020 sur leur liquidité. Nous exploitons les données comptables 2019 des entreprises françaises ainsi que les données officielles de trois aides majeures : le financement de l'activité partielle (AP), la subvention pour compenser la perte d'activité du fonds de solidarité des entreprises (FSE) et le prêt garanti par l'Etat (PGE). Notre évaluation repose sur une microsimulation de la variation de liquidité par entreprise à la suite du choc d'activité de 2020 ainsi que du niveau des aides obtenues par entreprise. Il apparaît que les montants agrégés de pertes simulées de liquidité sont plutôt bien couverts par les aides publiques, mais qu'ils cachent de fortes disparités selon les groups d'entreprises (e.g. taille, secteur, etc...) mais aussi à l'intérieur de ces groupes. En effet, nos résultats montrent que 24,5% des entreprises ont été sur-compensées par les aides de type subvention (AP et FSE) et qu'un montant de 7,4 milliards d'euros aurait pu ainsi être épargné. La part des entreprises sur-compensées est rehaussée à près de 39% quand on tient compte de l'effet des PGE. Nous les situons principalement dans les secteurs du commerce, de l'industrie manufacturière et de la culture et des loisirs. Pourtant, la plupart des entreprises n'ont pas été entièrement compensées. Il n'en reste pas moins qu'un certain nombre d'entreprises n'ont pas pu totalement compenser leur perte de liquidité. C'est notamment le cas pour celles devenues illiquides en 2020, les très grandes entreprises, les entreprises hautement productives et les entreprises dans les secteurs de l'hôtellerie et de la construction.

JEL-Classification : D22 ; G32 ; G33 ; G38

Keywords : COVID - Liquidity - Firm level data - State support - Micro-simulation - Policy effectiveness

1 Introduction

Large waves of firm bankruptcies have adverse effects on production capacity, employment levels, as well as human and fixed capital investment in a country. Even if firms protect themselves against bankruptcy, negative liquidity shocks can depress economic activity, as they constrain their cash flow and thereby their investment and hiring plans (Hoshi et al., 1991; Bond and Van Reenen, 2007). Hence, major liquidity losses are not only a risk for already vulnerable firms, but also for economic dynamism in general. The Schumpeterian view that only the east productive firms are affected by recessionary shocks (i.e. creative destruction) does not necessarily apply, especially when the nature of the shock is not economic, as was the case for the COVID-19 pandemic.

One reason for government intervention in liberal economies is, therefore, to assist firms in coping with major market disruptions and safeguard their transition to better economic circumstances, avoiding excessive liquidity shortfalls and bankruptcies. Implemented policies should be efficient, however, and prevent resource misallocation by offering support only if it is actually needed. Moreover, policies should be effective and deliver their intended outcomes. The COVID-19 pandemic poses a challenge with regard to these principles, as the complexity of the shock interacts with a variety of different characteristics among sectors and firms that ultimately determine their need for assistance.

The present paper investigates to what extent the French government's support policies during the first year of the pandemic have been successful in safeguarding firms by alleviating their burden of sudden liquidity shortfalls and increased bankruptcy risk. Economic support to French firms was provided via three major government initiatives: a wage subsidy scheme ("Activité Partielle", AP in what follows), a loan guarantee ("Prêts Garantis par l'Etat", PGE) and the so-called solidarity fund ("Fonds de solidarité pour les entreprises' - FSE). The latter represents a support scheme that is explicitly targeted at the smallest firms. We conduct a micro-simulation study that estimates how individual firms were affected by the pandemic and how their differential access to the three support policies has compensated their liquidity shortfalls.

Our analysis is based on detailed and comprehensive data that combines French firms' balance sheet information and trade records to infer their exposure and response to the crisis. Using a balance-sheet approach, we evaluate how economic disruptions resulting from foreign and domestic lockdowns have impacted firms' liquidity via expected changes in their free and operating cashflow. We match these predictions with the eligibility criteria of three important support policies to compute the expected amount of government support a firm should have received. Comparing these outcomes we are able to identify whether a firm has likely been granted more or less support than it needed.

Various attributes can result in a differential vulnerability and exposure of firms to the pandemic.[1] For example, two firms facing the same shock might require different support policies, depending on the amount of cash and liquid assets they hold to cover their short-term expenses. Another characteristic relates to firms' customer base. Exporting can help firms diversifying their risk and hedge against idiosyncratic shocks hitting their sales (Esposito, 2022). To the extent that the spread of the pandemic induced aggregate and sector-specific demand shocks, their differential timing and severity across countries implies heterogeneous exposure of firms to the crisis.

We find that the total simulated liquidity loss matches very well with the total amount of support extended by the government in 2020, and that it effectively helped firms improve their liquidity position. Yet, this aggregate result masks heterogeneous policy efficiency across firms. Comparing simulated liquidity shortfalls with support allocation rules, we conclude that firms with very large losses might have received too little support, while others may have received more than they needed. While productivity and size differences across firms do not explain these discrepancies, different initial liquidity positions across firms are the main driver behind it. We confirm that the FSE scheme mainly benefited the smallest firms (in terms of employment numbers), which is in line with its objectives. Larger and less productive firms benefited the most from the PGE, suggesting a potential misalignment with regard to the latter group of firms. Overall, the simulation results highlight that the combined aids was rather generous, first because it nearly covers the €132 billion loss in liquidity, and second because 24.5% of firms were over-compensated relative to their loss by the subsidies provisions, and the rate rises to 39% when we include the guaranteed loan scheme. In consequence, most firms were not fully compensated and among them especially those that became illiquid, very large or highly productive firms, and firms in the hospitality and construction sectors.

The observation that some firms are significantly less impacted by the crisis than others underscores the importance of a careful assessment of firm-level shock exposure and policy effectiveness (Bureau et al., 2022a). Given that firm-level datasets covering the COVID-19 crisis are often not yet available or incomplete, we rely on microsimulations of pre-pandemic balance-sheet information to evaluate the impact of policies on (financial) variables such as liquidity. Doing so, we join a growing literature on firm liquidity and bankruptcy risks that has emerged quickly since the onset of the pandemic. While several early studies relied on (semi-)structural approaches to simulate the impact of the crisis on firms and industries, as well as their evolution over time (e.g. Guerini et al., 2020; Schivardi and Romano, 2020;

1. Throughout the paper, we refer to the COVID-19 pandemic simply as "the pandemic" or "the crisis".

Gourinchas et al., 2022), more recent ones have used balance sheet information by measuring the shock indirectly, relying on certain sector-specific characteristics (e.g. Demmou et al., 2022; Ebeke et al., 2021). Some studies have also been able to access information on firms' turnover in monthly VAT records for 2020, as well as their use of certain support schemes in France (e.g. Hadjibeyli et al., 2021; Bureau et al., 2022b). While these studies benefit from observing actual changes in firm revenues, they deliver reasonably comparable results at the aggregate level while being able to disentangle the underlying transmission channels and mechanisms.

Our paper is most closely related to Bureau et al. (2022b). However, in contrast to their study, we infer the magnitude of the shock based on sector-level value-added growth statistics, while taking into account that exporting firms might be differently affected through their sales abroad. The advantage of doing so is to create heterogeneous exposure to the shock within sectors. Our inferred exposure and ex-ante need for support is also not biased by any potentially endogenous adjustments that we can neither observe nor reasonably explain until additional balance sheet information becomes available. Besides this methodological difference, we consider the latest pre-pandemic balance sheet information (FARE-2019) and a much larger set of firms, including a large number of very small companies. Many small firms received government support, especially via the solidarity fund (FSE), so observing them enables us to calibrate aggregate support allocation at the industry level and investigate how each of the different measures contributed to alleviating the overall liquidity shortfall of firms. We also explicitly take into account the French government's loan-guarantee (PGE), which has been intensively used by many firms especially at the beginning of the crisis and was found to reduce the risk of bankruptcies (Bach et al., 2021a,b). Our study is therefore the first to evaluate both the combined and individual effect of all three major policies implemented by the French government to support firms during the crisis.

The paper is organised as follows. Section 2 presents some background information on the French experience during the COVID-19 pandemic and describes the three main government support policies on which our study focuses. Section 3 describes the data sources and variables, and section 4 explains the model we use for our micro-simulations. Our simulation results are presented and discussed in section 5. Section 6 concludes.

2 The French context and support policies

2.1 Economic performance in France during the Covid-19 pandemic

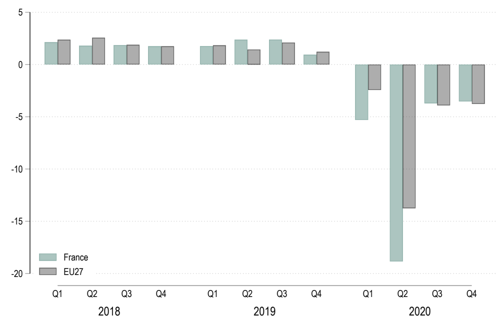
The French and European early experience with the COVID-19 pandemic can be sketched in a number of statistics that feature two "waves" in 2020. Figure A1 in the appendix shows reported and confirmed contraction and death rates in France, in other European countries and in the rest of the world. After a first peak around April and May 2020, the second followed in the fall, where incidence rates dwarfed earlier cases. While the "second wave" was evident in France and throughout Europe, the rest of the World appears to have suffered less from it. The first wave appears to be more lethal in the shown figures, when comparing death rates to incidence rates within the respective periods. Due to a lack of medical treatment and vaccination possibilities, the pandemic entailed noticeable disruptions to economic activity throughout the year 2020.

Figure 1 depicts macroeconomic performance indicators for France and other EU economies at quarterly frequency during the years 2018-2020. Panels (a) and (b) show the evolution of GDP growth rates and industry production volumes. Both indicators are fairly stable during 2018 and 2019, but turn significantly negative in the first six months of 2020. They mainly remain negative also in the following quarters. Panels (c) and (d) depict employment figures for both industry and services, suggesting a similar pattern with positive growth rates during 2018-19 and persistently negative ones in 2020. The contraction of economic activity is however only partly reflected in reported business registrations and bankruptcy filings. As shown in panel (e), growth rates of new business registrations are negative in the first two quarters of 2020 but return to pre-pandemic levels in the second half of that year. Growth rates in bankruptcy filings, shown in panel (f), indicate a substantial reduction instead of an increase during the first 12 months of the Covid-19 pandemic. This anomaly could be explained by the (temporary) pandemic-related suspension of court rulings, but also indicate potential effects of concerted government action to prevent excessive firm failures. Comparing the French experience to that of the rest of the EU, we observe more pronounced contractions in GDP growth, industry production and bankruptcies while the relative decline in employment and business registrations was smaller.

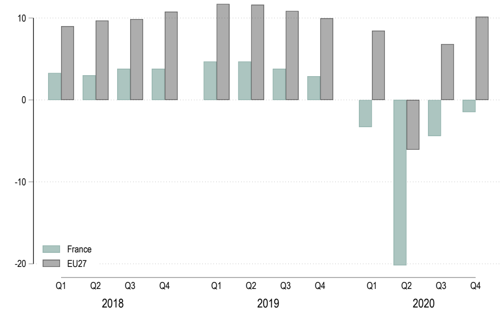
Based on this background information, our aim is (i) to assess the pandemic-induced liquidity losses of French firms operating in different industry sectors in greater detail, and (ii) to evaluate the policy actions taken by the French government to mitigate these disruptions. In the following subsection we present a summary of the main patterns and general

Figure 1: Economic performance indicators in France and the EU27, yoy %-changes

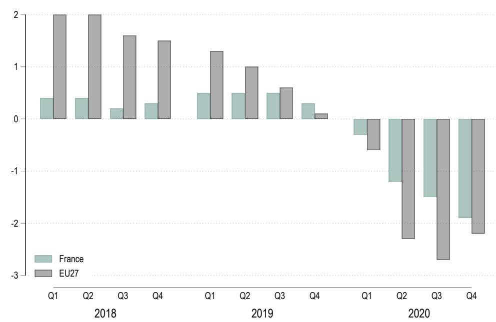
(a) GDP growth



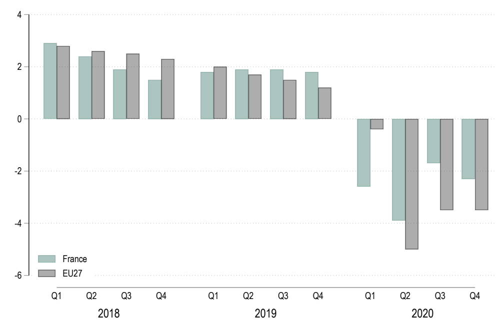
(b) Industry Production



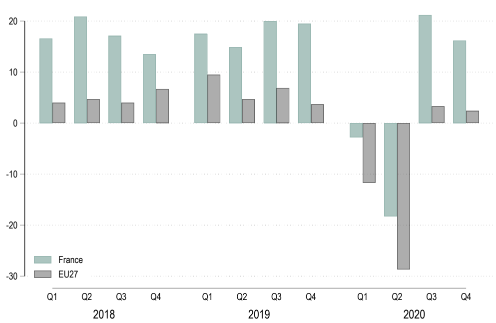
(c) Employment: Industry



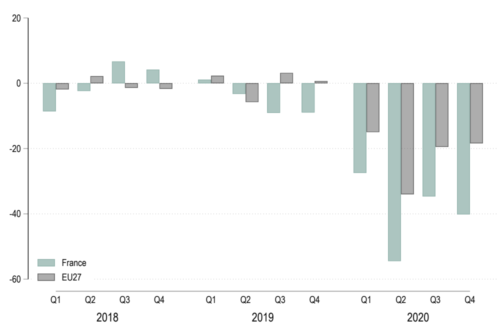
(d) Employment: Services



(e) Business registrations



(f) Bankruptcy filings



Note: Authors' calculations based on Eurostat data 'sts_rb_q', 'sts_inlb_q', sts_selb_q (accessed 07-07-2021), and 'namq_10_gdp' and 'sts_inpr_q' (accessed 18-08-2021). Panel (f) denotes percentage deviation from base year (2015) of seasonally and calendar adjusted data; all other data denote percentage changes compared to the same quarter of the previous year. EU27 refers to its composition at the time of writing (i.e. EU28 excl. the United Kingdom).

information on the government's response to the pandemic.

2.2 Policy responses of the French Government

2.2.1 General responses in a cross-country context

While the first cases of the novel respiratory disease (i.e., COVID-19) became known in China, in late 2019, failed attempts to prevent the spread of the virus led to subsequent outbreaks in different parts of the world. Consequently, the World Health Organization (WHO) declared the status of a pandemic in early March 2020, after which many countries imposed strict sanitary and social distancing guidelines. In France, the first COVID-19 related lockdown was ordered on March 17, 2020, in a famous speech by President Emmanuel Macron, declaring "the war against the pandemic".

Figure A2 in the appendix illustrates government responses to the pandemic in France, the rest of the EU and the rest of the World, as documented in the *Oxford Covid-19 Government Response Tracker* (OxCGRT, Hale et al., 2020). Panel (a) describes a lockdown stringency index, which reflects the stringency of various social distancing measures imposed by governments, such as school or workplace closings, cancellation of public events and suspension of transport services, or restrictions on local, national and international mobility. Panel (b) indicates an economic support index, which informs about the amount and generosity of government measures taken to cushion the economic damage created by lockdowns and other impacts of the pandemic. Comparing France to the rest of the EU, it is evident that lockdown stringency typically ranged above average, which might be explained by the relatively high number of reported COVID-19 contractions and deaths the country experienced during the first and second waves in 2020. Regarding the economic support index, the French pattern reveals a radical and forceful level of economic support right after the onset of its most restrictive lockdown measures in March 2020. Subsequently, the index decreased stepwise, first in June 2020 and again in October 2020 after which it ranged below the EU-average. In the following, we describe the most important economic support measures that were extended to French firms and businesses, on which we also focus our subsequent analysis.

2.2.2 Economic support extended to firms

The economic policy response to the COVID-19 crisis in France is represented by three major initiatives: (i) a wage subsidy program, (ii) a loan-guarantee scheme, and (iii) direct conditional transfers to small firms to compensate their losses. [2]

2. These and similar actions were also taken by governments in other countries, as documented in Demmou et al. (2022).

Wage subsidy (AP, Activité Partielle). Activité Partielle constitutes the scheme and implementation of a wage subsidy program, aimed at securing jobs and wage incomes (to sustain demand) while reducing the costs for firms who had to (temporarily) close or reduce their business activities and sales. Even firms authorised to remain open faced a slowdown of their activity and had to deal with an excess of workers. [3] To prevent layoffs and preserve jobs, skills and household incomes, the French Government implemented a part-time work scheme starting in March 2020, allowing more than 8 million workers to benefit from a compensation of 70% of their gross wage (with a floor equivalent to the minimum wage). Firms had to apply to the scheme in order to receive the compensation amount and pay it to their temporarily non-working employees. The spending for this scheme peaked in April 2020, after which the eligibility conditions were re-calibrated to target the sectors most impacted by the crisis. Public support was then conditioned on signing a collective agreement and limited to 40% of working hours. Compensation in the common regime has been, since January 2021, at a rate of 60% of gross wage (90% for minimum wage workers).

Loan guarantee scheme (PGE, Prêt Garanti par l'État). The second type of policy response targeted firms' liquidity and risk of insolvency, and comprised several measures. The most immediate one and the only one offered to all firms was the loan guarantee scheme (PGE). As part of this scheme a total target of €300 billion was set in April 2020 for loans granted until 30 June 2021. The end date was later extended to December 2021. The loan can amount to up to three months of sales or roughly 25% of annual sales, using 2019 as a reference. For young or innovative firms established after January 2019, the maximum was set to two years of their wage bill.

The PGE facilitates access to external finance. The interest rate is set by the banks within a pre-determined range of 1-1.5% for full reimbursement achieved in 2022 or 2023 and 2-2.5% for full reimbursement achieved in 2024 to 2026. The loan guarantee covers both capital and interests payments, and decreases with firm size, ranging from 90% for firms with less than 5,000 employees and domestic sales below €1.5 billion, to 70% for the largest companies. The guarantee lasts up to 5 years. Bach et al. (2021a,b) report that 30-40% of companies made use of the PGE in 2020. It was used more intensively in sectors affected more by lockdown restrictions and other prophylactic measures, such as the hospitality and transportation equipment industries. By May 2021, €140.3 bn of loans have been issued by

3. While it is also true that many workers were constrained to stay home due to school closures and other circumstances, resulting labor supply shortages were not seen as a major obstacle to business operations according to the *Enquête Activité et Conditions d'Emploi de la Main d'Œuvre* (Acemo). This is a monthly survey commissioned by the French Ministry of Labor and conducted by the *Direction de l'animation de la recherche, des études statistiques* (Dares) to monitor the experience and adjustments of French enterprises during the Covid-19 pandemic.

banks under the PGE.

Solidarity fund (FSE, Fonds de Solidarité pour les Entreprises). The FSE amounted to a total of €20 bn in 2020 and offered direct financial support to firms in sectors affected by the lockdowns, in proportion to their losses. Eligibility criteria changed throughout 2020 and 2021 according to the lockdown decisions and targets. Initially only constrained firms with fewer than 11 employees and 1 million euros of sales were eligible. Subsequently, to clarify eligibility, two groups of sectors were defined. The first group consisted of firms belonging to a set of eligible sectors, $S1$, and with losses amounting to at least 50% of their previous-year sales. The subsidy was however capped at €10,000. A second group concerned firms belonging to sectors of list $S1bis$ and having experienced at least 80% of losses relative to their previous-year sales. Those firms received the amount of their loss up to €10,000. Other firms, outside sectors of the $S1$ and $S1bis$ lists, received a subsidy equal to their loss up to €1,500. [4] The observed total number of individual beneficiaries in 2020 was close to 1,6 million enterprises across all French regions.

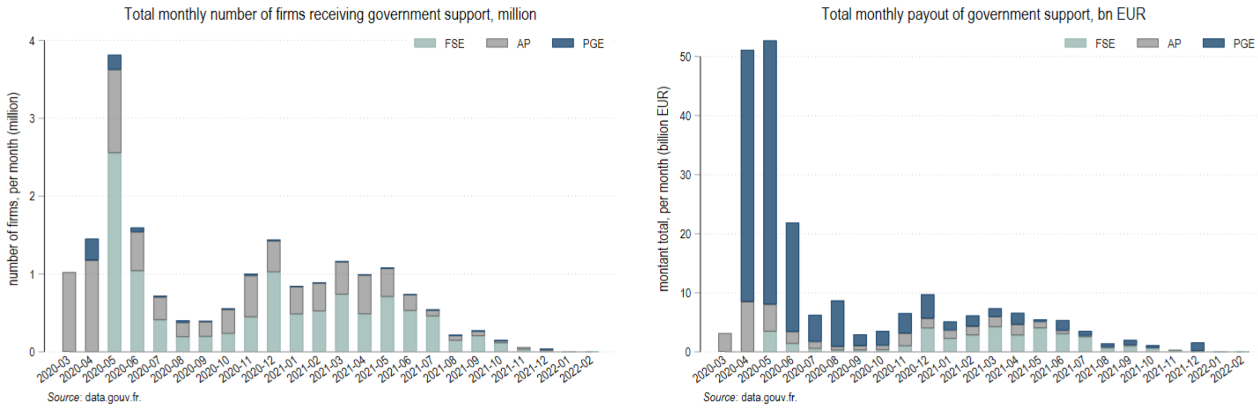
Combined volume and other support measures. Figure 2 reports the number of monthly support transactions and the amounts paid out that correspond to each of the three measures of interest in our study (i.e. AP, PGE and FSE) since March 2020. As observed in our description above, the policy response was very strong in the first months of the crisis, but also relatively large towards the end of the year 2020. We can also see that AP and FSE were widely and frequently used in terms of transactions, while most of the support in terms of its monetary value was extended via the state's loan guarantee scheme (PGE).

All three policies intend to ease the liquidity constraint which the crisis enhanced. From a government budget's perspective, the impact of the PGE is much smaller than the amounts provided to firms via AP and FSE, because it becomes an expense only if firms are unable to pay back their loan. At the same time, the PGE is the costliest support measure for firms, and it impacts their future balance sheet positions. The loans not only need to be repaid, it will also increase their debt and potential future creditworthiness. Our subsequent analysis elaborates further on the characteristics of firms that benefit from each of the measures pre-

4. The actual criteria were even more complex since the support scheme distinguishes firms conditional on their location in a zone submitted to the curfew or not. Moreover, the criteria changed throughout 2020 and 2021 and become less generous over time. Decree No 2020-371, issued in March, 30, 2020, gives the list of sectors, $S1$ and $S1bis$, targeted by the solidarity fund. The $S1$ list includes Hotels & Restaurants, Transport but also travel agencies and entertainment companies. The $S1bis$ list concerns retailers and some agricultural producers. See https://www.urssaf.fr/portail/files/live/sites/urssaf/files/documents/liste-secteurs-pour-infographie.pdf.

Figure 2: Support to French firms by policy tool during the COVID-19 pandemic

(a) Number transactions (b) Amount paid



Note: Authors' calculations using data from the Etalab - Enterprise Support Dashboard (https://github.com/etalab/dashboard-aides-entreprises/tree/master/published-data).

sented above, which constitute the most immediate and widely used French policies targeted at safeguarding firms' financial situation during the the pandemic. [5]

3 Data and variables

3.1 Data

Data sources. Our analysis combines firm-level, sectoral and macroeconomic data. We use balance sheet information from the FARE dataset provided by the French statistical office INSEE. The dataset contains information from tax statements and balance sheets and therefore covers the universe of non-financial, non agricultural French firms. Next to firms' sectoral affiliation and other basic information, the data features detailed balance-sheet and revenue accounts variables, which we will use to measure domestic sales, wages, employment, productivity and financial performance (see the description of firm variables below). Next to this, we use export value information at firm-destination level from the French customs

5. Additional measures, not included in our analysis, consist of (i) postponements of social security contribution payments and advanced reimbursement of tax credits; and (ii) specific sectors such as aerospace, airlines, tourism, culture, and retail were also supported with measures mixing equity and loan support. Finally, the recovery plan, designed at the end of 2020, established participatory and subordinated loans to SMEs and mid-size companies. This scheme aimed to support corporate investment by providing firms up to €20 bn of quasi-equity. Other reforms included in the recovery plan are expected to have a long-term impact on firms' financial performance, via cuts in production taxes worth €10 million per year.

office (Direction Générale des Douanes et des Droits Indirects, DGDDI) to compute the part of the demand shock that is driven by foreign market conditions. The FARE and DGDDI datasets are then merged at the firm level using their unique identifier (SIREN code).

Besides these firm-level data sources, we need data on aggregate demand changes at the sector level in France and at the national level in foreign markets to construct our demand shock measure. For the domestic component of the shock, we distinguish the impact across sectors via the sectoral (2-digit) fall in value added in 2020. The rate of change in value added, retrieved from the INSEE website, embeds the international exposure of the sector to the foreign demand shock as well as all supply impediments which occurred during the year. [6] For what concerns the international component, we retrieve information on GDP growth in the different destination markets from OECD and EUROSTAT databases, as well as in the IMF World Economic Outlook reports. The OECD data provides us with quarterly GDP growth rates for 48 economies, while EUROSTAT data adds another 9 countries (Eastern and Southeast European economies). For all other countries, we have to rely on less detailed information and construct their quarterly growth rates based on IMF projections of the average quarterly rate for emerging and developing economies (excl. China). Such numbers are reported in the June-2020 World Economic Outlook (WEO) which we combine with the country-specific annual GDP growth rate, reported in the July-2021 WEO update. [7] Finally, the information on policy support amounts per measure and sector is obtained from the French Government website on open data, *Etalab* - Enterprise Support Dashboard. [8]

Data cleaning. We start with a population of 4,356,766 legal units present in 2019 and keep only firms operating in the non-financial and non-agricultural sectors in our sample. We further remove the non-business sectors (health, education and governmental administrative services) as well as oil, extractive and refining industries. Next, we keep legal units which are submitted to business tax and have at least one employee (i.e. positive wages). The cleaning further consists of dropping firms with missing values for key variables used in the study, such as sales, debt, cash flow, etc. We also remove 23,188 firms with a negative value of sales minus variable costs, as they were not eligible to receive state support. We also remove firms having export sales in the FARE dataset but who do not report any destinations for

6. Note that it implies that we likely overestimate the growth shock that exporters faced by double counting the international exposure of the firm. Indeed, it is included in the domestic component for all firms in a sector on the one hand and in our evaluation of the foreign shock built using the firm's export-destination structure on the other hand.

7. Since the 57 countries for which we observe quarterly growth rates directly account for most of the World's GDP (and French trade volumes), we are confident that our imputation method does not significantly affect our results.

8. https://github.com/etalab/dashboard-aides-entreprises/tree/master/published-data.

their exports in the Customs data.

After all these steps, we are left with a sample of 1,565,614 firms. 86% of them are considered very small enterprises (VSE), 12.9% are SMEs, 0.6% are intermediary size enterprises (ISE), and 0.02% are large enterprises (BE).[9]

3.2 Variables

Our study is concerned with the impact of COVID-19 on the financial performance of French firms. Below we first present how we compute a firm-level demand shock in our database, then the financial indicators as well as how they are impacted by the shock. Finally we explain how we measure firm size and productivity in our sample, which we will use to identify sources of heterogeneity in our results.

Firm-specific COVID-19 shock. The firm-level shock β_i combines demand and supply-sided elements and has two components. The first (domestic) component is measured as a sector-level shock, identified as the change in value added reported by INSEE in 13 sectors (A21 disaggregation) in the year 2020. The second (foreign) component pertains to exporters and is firm specific. It is measured as the weighted average of GDP growth rates in firms' export destinations, based on their average sales in 2017-2019. The COVID-19 shock facing a firm is computed as the weighted average of the domestic and foreign shocks. Figure A3(a) in the appendix shows the importance of accounting for destination-specific components in the foreign shock, as countries have been affected differently by the pandemic. Figure A3(b) instead shows the heterogeneity across firms, whose shock ranges between -60% to +40%. The mean is negative (-10%), and as expected, firms in the hospitality sector (i.e. hotels and restaurants) were most negatively affected (-40%).

Firms' liquidity. Our main outcome variable is firms' liquidity. We compute firm i's initial liquidity in 2019 by combining different balance-sheet variables from the FARE dataset and define it as a function of its cash flow (CF) and liquid assets (LA) minus dividend payments

9. These size categories follow definitions harmonized at the European level based on sales and employment. Very small enterprises have less than 10 employees or sales below 2 million euros. SMEs' have between 10 and 249 employees, with sales above 2 million and below 50 million euros. Intermediary-size enterprises (ISE) have more than 249 employees but less than 5,000; while their sales are above 50 million but below 1.5 billion euros. Big enterprises (BE) have more than 5,000 employees or sales above 1.5 billion euros.

(DIV), investment (INV) and business tax expenses (BT):[10]

$$Liquidity_{i,2019} = CF_{i,2019} + LA_{i,2019} - DIV_{i,2019} - INV_{i,2019} - BT_{i,2019} \tag{1}$$

$$\begin{aligned} CF_{i,2019} = {} & [Sales_{i,2019} - Mat_{i,2019}] - Wages_{i,2019} + FinRev_{i,2019} \\ & -FinExp_{i,2019} - OtherCost_{i,2019} - Amort_{i,2019} \\ & -Taxes_{i,2019} - [Receivables_{i,2019} - TrCredits_{i,2019}] \end{aligned} \tag{2}$$

$$\begin{aligned} LA_{i,2019} = {} & Cash_{i,2019} + FinAss_{i,2019} + Stocks_{i,2019} + Receivables_{i,2019} \\ & -TrCredits_{i,2019} + OthersLA_{i,2019} \end{aligned} \tag{3}$$

The equations indicate how firms can differ in their vulnerability to a shock, given their pre-pandemic financial (liquidity) situation. Figure A4 in the appendix illustrates the heterogeneity in firms' liquidity in 2019. It reveals a long tail but also that 12% of the firms in our sample were already illiquid, according to our calculations.

Firm size and productivity. As we are interested in the patterns of policy efficiency across firms, we distinguish them along conventional dimensions, based on their size and productivity. We measure the size of a firm considering its total number of employees in full time-full year equivalent as well as their level of sales, leading to classify firms into the four official categories of size: Very Small Enterprises (VSE), Small and Medium Enterprises (SME), Intermediary Size Enterprises (ISE) and Big Enterprises (BE) (cf. footnote 9). Productivity is measured in relative terms, however, and we account for size and sector-specific differences to capture different production technologies. Hence, we measure each firm's labor productivity (i.e., value added divided by number of workers) relative to the maximum value of labor productivity within a specific size and 2-digit sector category. Productivity is eventually expressed in percentage terms and ranges between 0 and 100. A higher value implies that the firm's productivity is closer to the maximum within its sector and size class. Both our size and productivity measures rely on firm-level information for 2019, reported in the FARE database.

Table 1 reports the sectoral distribution in our sample which includes firms from both service and manufacturing sectors. Most firms belong to services, and the retail and hospitality sectors are the largest (together accounting for 40% of all firms). Though only 8.6%

10. A list with the definitions of the different balance sheet variables is presented in Table A2 in the appendix.

Table 1: Descriptive statistics across sectors

Sector name	Share of total (in %) Firms	Sales	Illiquid firms	Average of Size category	Productivity decile
Manufacturing	8.6	23.1	9.0	1.27	5.37
Elect.& Water. Prod. Dist.	0.5	3.8	13.5	1.29	8.23
Construction	18.5	7.0	8.9	1.10	4.97
Wholesale & Retail	25.4	38.1	7.2	1.17	2.86
Transport	5.4	7.5	15.2	1.17	3.75
Hotels & Restaurants	14.6	2.9	17.6	1.08	4.22
Info. & Commun.	4.1	5.1	20.6	1.15	4.50
Real estate	3.6	1.6	15.1	1.07	3.14
Scien. and techn. serv.	11.7	5.6	12.4	1.10	3.85
Administr. serv.	5.7	4.3	15.4	1.19	3.53
Culture and leisure	1.8	0.7	24.6	1.09	4.44

Source: FARE 2019, authors' calculations.

of firms belong to manufacturing, they account for 23 % of sales. The column in the middle of Table 1 shows the concentration of illiquid firms before the COVID-19 shock. Some of the sectors with a high proportion of illiquid firms were also among the most exposed to the pandemic and in need of government support. The last two columns in Table 1 display average values of the size category in which firms reside, ranging from small to large firms taking values between 1 and 4, and the average value of the productivity as a percentage of the maximum in the sector, as explained above. Larger firms are typically found in the manufacturing and utilities sectors, while the productivity of an average firm is closer to the most productive firm in manufacturing, utilities and information & communication.

4 Microsimulation exercise framework

In this section, we investigate how the three different support packages affected firms' liquidity and prevented major shortfalls. Doing so, we first simulate how the COVID-19 shock affects firm liquidity in 2020 compared to 2019. We refer to this change as the estimated gross loss faced by a firm due to the pandemic. In the second step we calculate how the support allocation scheme for each policy has reduced this loss.

4.1 Pandemic-induced liquidity loss

4.1.1 Baseline without government support

We calculate firms' gross liquidity losses as their estimated change in liquidity between 2019 and 2020:

$$\hat{Loss}_i = Liquidity_{i,2019} - \hat{Liquidity}_{i,2020}, \tag{4}$$

where $Liquidity_{i,2019}$ is observed in our data while $\hat{Liquidity}_{i,2020}$ is inferred as follows:

$$\hat{Liquidity}_{i,2020} = \hat{CF}_{i,2020} + \hat{LA}_{i,2020} - \hat{DIV}_{i,2020} - \hat{INV}_{i,2020} - \hat{BT}_{i,2020}. \tag{5}$$

Absent any information on actual dividend payments, investment and business taxes for 2020, we assume that investment projects were on hold due to uncertainty ($\hat{INV}_{i,2020} = 0$). Business Taxes were postponed for some firms but they were not cancelled entirely, so we keep them at their 2019 levels ($\hat{BT}_{i,2020} = BT_{i,2019}$). In order to receive public support, firms could not allocate dividends ($\hat{DIV}_{i,2020}$=0).

We calculate firms' cashflow and liquid assets in 2020 as follows:

$$\begin{aligned} \hat{CF}_{i,2020} &= (1+\beta_{i,2020}) \times [Sales_{i,2019} - Mat_{i,2019} - Receivables_{i,2019} + TrCredits_{i,2019}] \\ &\quad + FinRev_{i,2019} - FinExp_{i,2019} - OthCost_{i,2019} - Tax_{i,2019} - Amort_{i,2019} \end{aligned} \tag{6}$$

$$\begin{aligned} \hat{LA}_{i,2020} &= Cash_{i,2019} + FinAss_{i,2019} + Stocks_{i,2019} + OthersLA_{i,2019} \\ &\quad + (1+\beta_{i,2020}) \times [Receivables_{i,2019} - TrCredits_{i,2019}] \end{aligned} \tag{7}$$

Recall that we observe only firms where the expression of equation (6) in brackets is positive. Firms with a negative demand shock $\beta_{i,2020} < 0$ will have a proportionately lower operating cashflow, due to both lower sales, expenditure and trade credits. Firms facing a positive demand shock increase their cashflow. Moreover, liquid assets change in proportion to the shocks' impact on trade credits and short-term debt. This component of the balance sheet, hence, cancels out so that a firm's gross loss is ultimately determined by (i) the sign and magnitude of the shock ($\beta_{i,2020}$), (ii) the amount of its recurring fixed revenues and expenses, as well as (iii) its short-term financial buffer that consists of cash reserves, financial assets, stocks, and other liquid assets, as shown in Equation (7).

4.1.2 Accounting for policy support

Reductions of or even negative liquidity depress investment and other economic activity, so that governments can justifiably intervene to alleviate this shortfall. Ideally, government interventions k are implemented in such a way that the gross-liquidity loss is fully compensated and the net loss $NetLoss_{i,2020} = Loss_{i,2020} + \sum_k Aid_{ik,2020}$ is equal to zero. Hence, we calculate alternative statistics for firms' liquidity in 2020 as:

$$\begin{aligned} \hat{Liquidity}'_{i,2020} = & \hat{CF}'_{i,2020} + \hat{LA}_{i,2020} - \hat{DIV}_{i,2020} - \hat{INV}_{i,2020} - \hat{BT}_{i,2020} \\ & + \underbrace{P2_i \times PGE_{i,2020}}_{\text{State-guaranteed loan}}, \end{aligned} \tag{8}$$

where the cashflow becomes

$$\begin{aligned} \hat{CF}'_{i,2020} = & (1+\beta_{i,2020}) \times [Sales_{i,2019} - Mat_{i,2019} - Receivables_{i,2019} + TrCredits_{i,2019}] \\ & + FinRev_{i,2019} - FinExp_{i,2019} - OthCost_{i,2019} - Tax_{i,2019} - Amort_{i,2019} \\ & + \underbrace{P1_i \times AP_{i,2020}}_{\text{Wage subsidy}} - \underbrace{P2_i \times r^{PGE} \times PGE_{i,2020}}_{\text{Interest payments on loan}} + \underbrace{P3_i \times FSE_{i,2020}}_{\text{Solidarity fund}}. \end{aligned} \tag{9}$$

We simulate the effect of these support packages for firms by including them into our 2020 cashflow and liquidity equations conditional on a firm's eligibility to receive that support. Generally, we assume that an eligible firm requests and receives the support without incurring any additional costs for doing so. Whenever a firm is not eligible to receiving support, we set the respective indicator variables P1, P2, and P3 equal to zero. For each policy to which a firm is eligible, the indicator variable equals one.

The first policy (P1) is the wage-subsidy scheme (AP) and it enables firms to continue paying their employees' wages even though they work less, and affect firms via the cashflow. Second, the state-guaranteed loans (PGE, P2) directly add to liquidity and improve the firm's short-term financial position. They also have an impact on the cashflow of the firm to the extent it has to pay interests on this loan. Lastly, the solidarity fund (FSE, P3) is modeled as a direct cashflow transfer to eligible firms.

Before describing how we determine firms' eligibility to each policy and their received amount of support, we note that, in these simulations, the firm's own response to the crisis is assumed to be rather inert. In particular, we do not take into account that they may have raised money on capital markets. In fact, the ability of firms to fill their liquidity shortage depends on their financial situation such as their liquidity ratio or their ratio of interests over costs. It also depends on their expectation about future turnover, and therefore their anticipated repayment ability. Such expectations regarding their financial revenues might trigger them to sell assets or freeze some expenditures. Nevertheless, we hypothesize that firms do not adjust their plans in order to adjust their liquidity gap with respect do "normal times". This might be desirable if the government aims at safeguarding firm activity by going beyond the prevention of negative liquidity or even bankruptcy of firms. If we assume a conservative financial behavior, changes in their sales are partly included in the 2020 level of the sectoral demand shock. [11]

4.2 Allocation of support policies

As emphasized above, we evaluate the individual and combined effectiveness of three policies: the part-time employment subsidy (AP), the state-guarantee on loans (PGE) and the solidarity fund (FSE). In the absence of firm-level data informing on the amount of state aid that each firm has received, we construct proxies that rely on information across and within sectors. We further assume that all eligible firms (as identified by their observable characteristics in 2019) applied to receive the aid, while we ensure that the total simulated support matches the publicly reported amounts of disbursements through the individual support schemes at sector level. We allocate the observed amounts per sector across firms by considering firms' characteristics and matching the requirements of each type of policy. Since our simulation distributes the observed sectoral aid across all eligible firms, the true amount received by firms that actually applied is expected to be underestimated, while it is overestimated for those that did not apply.

Measuring the Wage Subsidy (AP). We gather public information on sectoral funds allocated to the wage subsidy in 2020 (AP_s) from the open data platform of the French Government (see above). Since we do not observe how these funds have been allocated across firms within each sector, we opt for a pragmatic solution and assume that firms receive these subsidies in proportion to the relative size of their total 2019 wage bill in the sector:

$$AP_{i,s} = \rho_{i,s} \times AP_s \qquad \text{where:} \quad \rho_{i,s} = \frac{Wages_{i,2019}}{\sum_{k \in s} Wages_{k,2019}}.$$

This is a simplifying assumption that, however, ensures that the sum of firm-specific support adds up to total sectoral expenditure via this policy. We note that the only (implicit)

11. We are also aware that within sector differences might be related to firms' differential ability to react to the shock in the form of e-commerce, digitalization, or new management practices which enhanced productivity, but we cannot observe them.

eligibility criterion is that a firm had employees in 2019 (and presumably also in 2020). Any other characteristic is not taken into consideration so that the firm-specific need for such support is unlikely to be met.[12]

Measuring the loan guarantee scheme (PGE). In the case of the loan guarantee scheme, we also account for the total sectoral funds pledged by firms (PGE_s). Indeed, accounting for the eligibility criterion only (firms could apply to a loan with a maximum value of three months of total sales, defining PGE_i^{max}) would greatly overestimate the amounts as indicated by the aggregate figures. We therefore proxy the amount firms requested to banks by their share in the total indebtedness of the sector, with the limitation that it cannot be larger than the maximum authorized amount they are eligible to:

$$PGE_i = minimum[PGE_i^{max} \;\; ; \;\; \sigma_{i,s} \times PGE_s]$$

where:

$$\sigma_{i,s} = \frac{Debt_{i,2019}}{\sum_{k \in s} Debt_{k,2019}} \quad \text{and} \quad PGE_i^{max} = Sales_{i,2019}/4$$

By using as weight the firm's share in sectoral debt, we account for firms' size as well as their propensity to use debt financing relative to what is usually done in their sector. The weight is also indicating the debt burden the firm was already affected with. The main caveat is that we could expect that highly indebted firms are also less inclined to borrow more, mostly because of a financial constraint. At the same time banks would be more likely to provide additional loans (this time guaranteed by the state) to indebted firms to insure they can reimburse old loans.

Measuring the solidarity fund (FSE). Finally, in the case of the solidarity fund, we also have to combine information on firms' eligibility as well as the sectoral distribution of funds. Given the complexity and changes of the rules over time, we stick to the most binding ones. Firms are considered eligible to the FSE if they belong to sectors having faced strict lockdown rules,[13] while being very small enterprises (i.e., VSE; below 11 employees and 1 million euros of sales).[14] This concerns 456,114 firms, which represent about one third of all VSEs in our sample. We compute losses using Equation (4) and allocate the observed

12. We are aware of the fact that the policy had several objectives, i.e. supporting demand and preventing layoffs and unemployment. Consequently, some degree of inefficiency in closing liquidity gaps might have been considered acceptable if it supported achievement of the other objectives.

13. Sectors concerned by the policy change at the time. We use the $S1$ sectors defined above as they were those eligible in 2020.

14. We did not use the restriction regarding the loss as a percentage of 2019 sales because this condition is associated with monthly sales and losses, which we do not observe.

total sectoral amounts of FSE disbursements (overall about €7.9 bn) to firms in proportion to their share in the total estimated loss of their sector.

$$FSE_{i,s} = \begin{cases} \chi_{i,s} \times FSE_s & \text{if } i \text{ is eligible to FSE} \\ 0 & \text{if } i \text{ is not eligible to FSE} \end{cases}$$

where:

$$\chi_{i,s} = \frac{loss_i}{\sum_{k \in s^e} loss_k}$$

The ratio $\chi_{i,s}$ depends on the share of the firm's sales loss in the group of firms eligible to FSE in its sector (s^e).

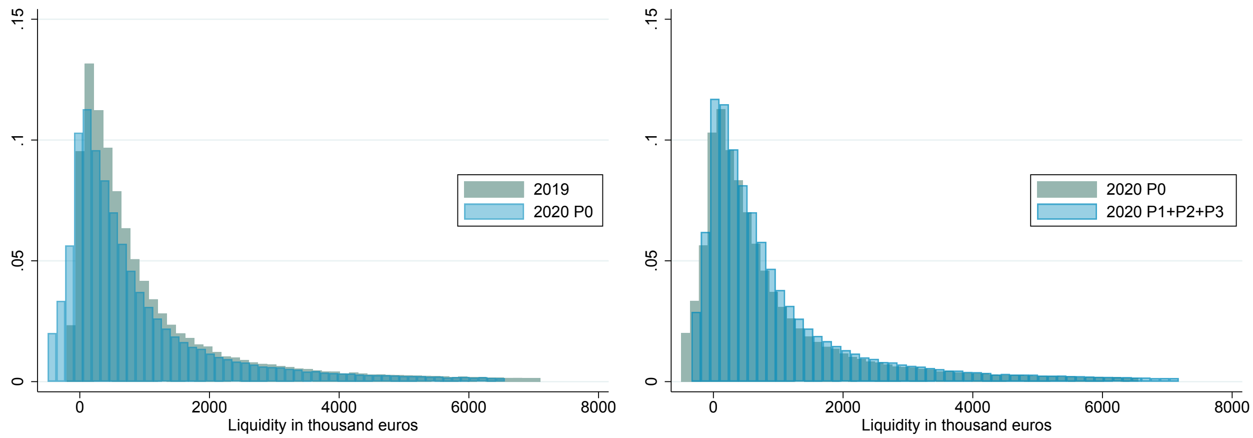
5 Simulation results

From Equation (4), we infer that whenever the gross loss is positive, a firm deteriorated its liquidity position between 2019 and 2020. The opposite is true if $Loss_i < 0$. We see in Figure 3(a) that the former case is the norm, as $\hat{Liquidity}_{i,2020}$ is clustered to the left of the initial distribution, and the fraction of illiquid firms is estimated to have doubled to represent 24% of our sample. Hence, the majority of firms experienced a negative shock and faced a reduction in their liquidity. Once we account for the three different support policies using the allocation rules described above, we see in Figure 3(b) that the share of illiquid firms falls to 18%. Although this is still more than the pre-pandemic figure from 2019, it suggests that the interventions have significantly decreased the share of illiquid firms and thereby the risk of bankruptcies in the French economy.[15]

15. We present a more detailed decomposition by policy scheme and sectors in Appendix Table A4.

Figure 3: Simulated liquidity shock, without and with policy support.

(a) No policy support (b) Full policy support



Note: Authors' calculations based on data and methodology described in Section 3. P0 = no policy suport; P1 = wage subsidy (AP); P2 = loan guarantee (PGE); P3 = solidarity fund (FSE).

5.1 Simulated losses and aids conditional on firm characteristics

In Table 2 we document how the policy support scheme impacted firms differently depending on the nature of their liquidity change, their sector affiliation, as well as their size and relative labor productivity. The last row of each panel in the table shows that in aggregate terms, the three policies only slightly overshooted the losses.

Panel A displays the distribution of firms across different types of liquidity change, given their respective losses and received support. We distinguish four groups: I) firms that experienced a reduction in liquidity between 2019 and 2020, but remained liquid (i.e. Pos-LessPos); II) firms with reduced liquidity, which turned from positive to negative (i.e. Pos-Neg); III) firms that were already illiquid and experienced a further reduction during the pandemic (i.e. Neg-MoreNeg); and finally IV) firms with positive initial liquidity which was improved further during the pandemic (Pos-MorePos).[16] We see that 70 percent of the firms belong to group I. They account for about 62 percent of the losses (€140.7 bn, excluding group IV) while capturing slightly larger fractions of the different government support packages (66 percent in total), except for the wage subsidy scheme (AP). Firms with reduced and negative simulated liquidity positions in 2020 (groups II and III) account for 38 percent of total losses but capture only 22 percent of the total aids. This imbalance is evident across all three government support initiatives, but is most pronounced for the

16. We do not observe any firms for the alternative combinations of liquidity change, i.e. no change, turning from negative into positive or from negative to less negative.

Table 2: Simulated losses and aids conditional on firm characteristics

	Percent	billion Euros				
Groups	%Firms	Loss	Total Aid	AP	FSE	PGE
Panel A: Liquidity change						
I. Pos-Less Pos	70	87.5	91	14.2	5.2	71.7
II. Pos-Neg	13	40.2	13.2	5.4	1.7	6.2
III. Neg-More Neg	10	13	16.9	2.9	0.8	13.2
IV. Pos-More Pos	7	-8.1	17.3	1.6	0.2	15.3
Total	**100**	**132.6**	**138.4**	**24.1**	**7.9**	**106.4**
Panel B: Firm size category						
Very Small (VSE)	86.5	28.7	26.8	5.4	7.9	13.4
Small and Medium (SME)	12.9	44.3	39.2	8.9	0	30.3
Intermediate sized (ISE)	0.6	33.2	46.6	6.1	0	40.5
Big enterprises (BE)	0.02	26.5	25.8	3.6	0	22.1
Total	100	132.6	138.4	24.1	7.9	106.4
Panel C: Industry sector						
Manufacturing	8.6	22.8	24.8	3.4	0.3	21.1
Elect.& Water. Prod. Dist.	0.5	1.6	0.9	0.1	0	0.7
Construction	18.5	19.9	13.2	2.1	0.1	11.1
Wholesale & Retail	25.4	11.7	36.2	4.3	1.9	30.0
Transport	5.4	30.0	11.7	2.1	1	8.6
Hotels & Restaurants	14.6	34.5	15.9	4.9	2.2	8.8
Info. & Commun.	4.1	-2.2	5.4	0.9	0.2	4.3
Real estate	3.6	0.3	2.0	0.3	0	1.6
Scien. and techn. serv.	11.7	6.4	16.3	2.2	1.0	13.1
Administr. serv.	5.7	5.8	7.4	1.8	0.5	5.1
Culture and leisure	1.8	1.8	4.6	1.9	0.5	2.0
Total	100	132.6	138.4	24.1	7.9	106.4
Panel D: Labor productivity						
LP decile 1	10	25.1	30.8	5.5	0.3	25.0
LP decile 2	10	16.6	13.1	3.2	0.47	9.5
LP decile 3	10	11.8	9.9	2.3	0.48	7.2
LP decile 4	10	7.3	7.5	1.4	0.61	5.5
LP decile 5	10	6.2	5.4	1.1	0.7	3.6
LP decile 6	10	5.3	4.4	1.0	0.74	2.7
LP decile 7	10	5.4	6.6	1.2	0.70	4.7
LP decile 8	10	6.3	8.3	1.1	0.70	6.5
LP decile 9	10	7.2	5.6	1.3	0.72	3.6
LP decile 10	10	35.8	32.4	5.0	0.87	26.5
Total	100	132.6	138.4	24.1	7.9	106.4

Source: FARE 2019, authors' calculations.

PGE. Looking at the last group of firms, for which liquidity improved during the pandemic, we see that they captured 12.5 percent of total aids and more than 14 percent of the PGE disbursement. These numbers suggest that the simulated reductions in firms' liquidity have not been fully compensated at the level of each firm. In fact, firms with a relatively favorable financial situation, having positive liquidity before and during the first year of the pandemic, were able to capture relatively larger fractions of the disbursed aids, primarily through better access to the PGE, i.e. guaranteed loans.

Panel B of Table 2 compares liquidity losses and aid allocation across different firm size categories. While small firms make up a high share of the firm population, their combined losses are fairly comparable to those of larger firms. Yet, the share of total aids they capture is slightly lower, which is driven primarily be the fact that very small enterprises received very little support via the PGE, while intermediate sized firms relied quite heavily on the guaranteed loans. The latter group turned out to be the greatest beneficiary of the COVID-19 policy support relative to its weight in the population of firms.

Turning to Panel C, we observe that next to the hospitality sector, the transportation and manufacturing sectors also reveal substantial reductions in their liquidity. Together those three sectors account for almost two thirds of the total simulated liquidity loss. They were indeed the most exposed to the prophylactic measures and faced a huge fall in their activity. Note also that, except for manufacturing, they also entered the crisis with a large share of illiquid firms in 2019 (see Table 1). Their combined fraction in total aids is considerably lower than their loss share, and amounts to 38 percent. Instead, disproportionately large fractions of aids have been allocated to scientific and technical services industries (11.8 percent) and to the wholesale and retail sector (26.2 percent). The latter figure is driven again by the PGE allocation and might indicate strategic investments into building infrastructure for online sales and delivery. Also the manufacturing sector reports a high amount of PGE, as well as wage subsidies (AP). Concerning AP, hotels and restaurants as well as wholesale and retail sectors received the largest shares.

In the final panel of Table 2, we distinguish firms across different productivity deciles, after controlling for sector and firm-size characteristics. Interestingly, the distribution of losses and total aids is U-shaped: firms residing in the most and in the least productive deciles account for 60 percent of total simulated losses and aids. A similar pattern can be observed for their use of wage subsidies (AP) and state-guaranteed loans (PGE), while the least productive firms benefited the most from the solidarity fund scheme (FSE) that was disbursed only to very small enterprises. The support to the least productive firms was therefore (too) generous.

Altogether, our simulations suggest that the government support program was relatively effective in terms of providing sufficient resources to compensate the losses experienced by firms. However, the fact that the guaranteed loans were not necessarily used by (or possibly accessible to) firms and industries most in need, implies that the aggregate numbers mask inefficiencies in the allocation mechanism. Indeed, the figures presented in Panel A indicate that the sum of aids disbursed to firms with a worsened liquidity position in 2020 (i.e. groups I-III) falls short of their combined losses by €19.6 bn (about 14 percent).

Though it is reassuring to see that some sector, size or loss groups were well targeted by the policy scheme as a whole, it does not mean that within each group, all firms were well compensated given their loss, their previous liquidity position and their access to the support. In the following section we evaluate the degree of heterogeneity within each group to deepen our understanding of the quality of the matching between losses and policy support at firm level. To do so, we present and discuss a more comprehensive measure of the generosity and efficiency of the French support policies.

5.2 Generosity and efficiency of government support

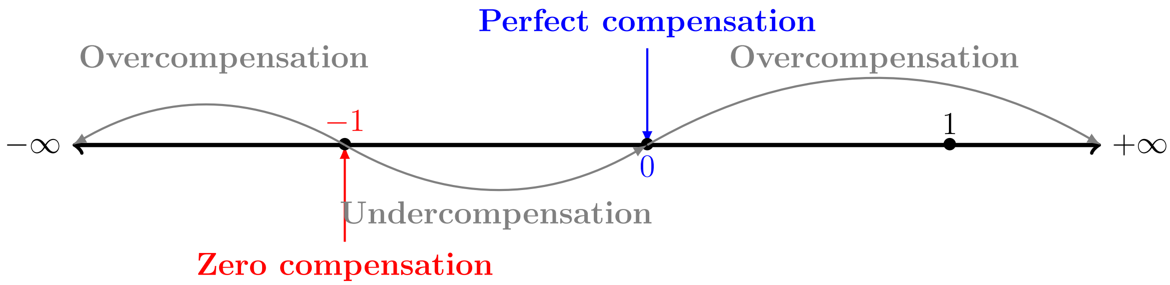
5.2.1 Extensive and intensive margins of overcompensation

In what follows we present an indicator that computes the efficiency of the support package in compensating the liquidity losses experienced at the firm level. To do so, we calculate firms' pandemic-induced liquidity shortfall before and after the policy. In particular, we are interested to evaluate the amount of aids received by each firm in relation with its losses, and especially whether firms were overcompensated or not, and if so, by how much.

Extensive margin of overcompensation We distinguish two dimensions of the extensive margin of generosity, or overcompensation. A firm is said to be over-compensated (i.e. $OVER_i = 1$) if the aid that it received is larger than its liquidity loss. Using this information, we first compute the share of overcompensated firms (overall, and per group). Second, we compute the monetary amount of the overcompensation as the sum of aid-loss differential over all overcompensated firms ($\sum_i (aid_i - loss_i) * OVER_i$). Whenever a firm has a negative loss (i.e. a liquidity improvement), we set the amount of overcompensation equal to the amount of aid the firm received.

Intensive margin of overcompensation Next to these aggregate indicators, we want to measure the importance of policy support for each firm that received it, relative to its liquidity loss. To express this in an single indicator, we calculate the post-policy shortfall (i.e. net-liquidity loss) relative to the gross loss. Multiplying this number with (-1) gives a

Figure 4: Values of γ and intensity of compensation



measure of government's compensation intensity:[17]

$$\gamma_i \equiv -\frac{Loss_i - Aid_i}{Loss_i}$$

For 93% of the firms experiencing a decrease in their liquidity position ($Loss > 0$) the measure γ increases with the generosity of public support. Figure 4 illustrates the meaning of the different values of γ:

— *No compensation*: $\gamma = -1$ when $Aid = 0$

— *Perfect compensation*: $\gamma = 0$ whenever $Loss > 0$ and $Loss = Aid$.

— *Undercompensation*: Values $-1 < \gamma < 0$ imply partial yet too little compensation (i.e. $Loss > 0$ and $Loss > Aid$)

— *Overcompensation*: values of $\gamma \notin [-1, 0]$ (equivalent to $OVER_i = 1$) imply two forms of overcompensation. First, a firm gets overcompensated if it has actual losses but receives more support than it needs. In such cases $Loss > 0$ and $Aid > Loss$, so that $\gamma > 0$. The second case occurs if a firm's liquidity in 2020 was higher than in 2019 ($Loss < 0$), but still receives government support, which results in $\gamma < -1$. 7 percent of the firms fall into this latter category according to our simulations.

5.2.2 Extensive and intensive margins of overcompensation conditional on firm characteristics

17. Note that γ is not defined for $Loss = 0$, which would occur if a firm's liquidity was exactly the same in 2019 as in 2020. We do not encounter any such case in our data.

Table 3: Extensive and intensive margins of overcompensation conditional on firm characteristics

	Extensive margin				Intensive margin
	% firms over-compensated		€bn over-compensation		
Groups	AP+FSE	AP+FSE+PGE	AP +FSE	PGE	Avg. γ
		Panel A: Liquidity change			
I. Pos-Less Pos	19.9	37.1	4.3	47.4	0.8
II. Pos-Neg	6.8	10.6	0.4	1.0	-0.4
III. Neg-More Neg	26.5	42.8	0.9	9.7	1.3
IV. Pos-More Pos	100	100	1.8	15.3	-2.5
		Panel B: Firm size category			
Very Small (VSE)	25.7	38.8	4.9	7.4	0.5
Small and Medium (SME)	16.3	37.4	1.2	19.9	0.3
Intermediate sized (ISE)	22.3	49.9	0.9	31.3	0.6
Big enterprises (BE)	26.1	46.3	0.5	14.8	-0.2
		Panel C: Industry sector			
Manufacturing	31.2	44	0.7	14.2	1.4
Elect.& Water. Prod. Dist.	7.5	24	0.02	0.5	-0.2
Construction	3.2	8.4	0.7	7.7	-0.6
Wholesale & Retail	21.7	58.7	2.2	23.3	1.7
Transport	52.8	53.3	0.5	2.8	0.1
Hotels & Restaurants	1.1	7.1	0.4	2.3	-0.5
Info. & Commun.	96.9	97.9	1.1	4.2	-1.7
Real estate	56.9	74.1	0.1	1.4	1.5
Scien. and techn. serv.	25.8	31.8	1.0	11.9	0.5
Administr. serv.	32.7	38.8	0.4	4.0	0.3
Culture and leisure	95.8	97.8	1.4	1.3	3.3
		Panel D: Labor productivity			
LP decile 1	28.7	41.5	0.9	19.1	0.6
LP decile 2	20.8	38.6	0.7	5.9	0.5
LP decile 3	23.2	44.5	0.6	4.3	0.8
LP decile 4	24.9	45.8	0.6	3.7	0.8
LP decile 5	24.1	41.8	0.6	1.9	0.7
LP decile 6	21.6	37.1	0.5	1.5	0.5
LP decile 7	19.8	33.9	0.6	3.2	0.4
LP decile 8	17.9	30.6	0.4	5.0	0.3
LP decile 9	17.2	29.0	0.4	1.9	0.2
LP decile 10	16.4	27.7	0.9	16.7	0.2
All	24.5	38.7	7.5	73.4	0.5

Source: FARE 2019, authors' calculations.
The last column displays the average γ per group, after excluding the top and bottom 1% of the group's distribution.

Table 3 displays our results for both the extensive (columns 2 to 5) and intensive (column 6) margins of over-compensation, also disentangling results by type of support package.

We observe in Panel A that the fraction of overcompensated firms is higher in group III (negative to more negative liquidity) than in group I (positive to less positive liquidity). Firms experiencing a decline from positive to negative liquidity (group II) were largely under-compensated, as only up to ten percent of them received aid that was equal or greater than their losses. An average γ of -0.4 further indicates that many of these firms received only a fraction of the support they needed. In absolute terms, the overcompensation concentrates in group I, where 70 percent of the firms in our sample belong. Firms in group I capture around 60 percent of the excess AP and FSE transactions (column 4) as well as PGE volumes (column 5). Considering $\gamma > 0$ as an indicator of generosity (and leaving aside group IV), we observe that on average the three support policies were most generous towards group III. [18]

Looking at Panel B and the different firm size categories, we see that small and medium-sized enterprises (SMEs) have the lowest fraction of overcompensated firms — especially when considering the loan subsidy (AP) and solidarity fund (FSE). Their proportion grows considerably once we take the PGE into account. This indicates that overcompensation among SMEs (and larger firms) was mainly driven by loans (which need to be repaid), while very small enterprises benefited mainly from actual government expenditures via the FSE and AP. The last column indicates further that the value of γ for SMEs and BEs is fairly close to zero, meaning that an average firm of these size categories was only slightly over- or under-compensated. The average degree of overcompensation was more pronounced among VSEs and ISEs, but these numbers could also mask heterogeneity within these groups, which we explore below.

In Panel C of Table 3, we look at different sectors. Not surprisingly, overcompensation is prevalent in the Information and Communications (ICT) industry, where most firms experienced and improvement in their liquidity with respect to 2019 (see Table A3). Large fractions of overcompensation by AP and FSE are also found in the Culture and leisure, Real estate and Transport industries where almost every firm faced lower liquidity and only about 65 percent of the firms maintained a positive liquidity balance in 2020. The hospitality sector, where 70 percent of firms experienced negative liquidity in 2020, was by far the most affected by the crisis but barely experienced any overcompensation according to our calculations. As in the previous section, it is interesting to focus on the Wholesale and retail sector, where most of the overcompensation results from guaranteed loans. More than 92 percent of firms in this sector had positive balances in 2020, and more than 5 percent

18. Note that the average intensity is negatively affected by the share of firms belonging to group IV for which γ is always negative. But the weight of these firms is always below or equal to 7%.

saw an improvement, which suggests that the PGE might have been a good opportunity for the sector to modernize its technologies. The last column reports that the French support packages have been most generous for wholesalers and retailers. Overall, the distribution of overcompensated firms is quite unequal across industries. Next to cases discussed before, also the manufacturing and real estate sectors report average values of γ above one, and a high share of overcompensation (column 3). On the contrary, construction and utilities saw more modest fractions of overcompensation and firms have on average been under-compensated (column 6).

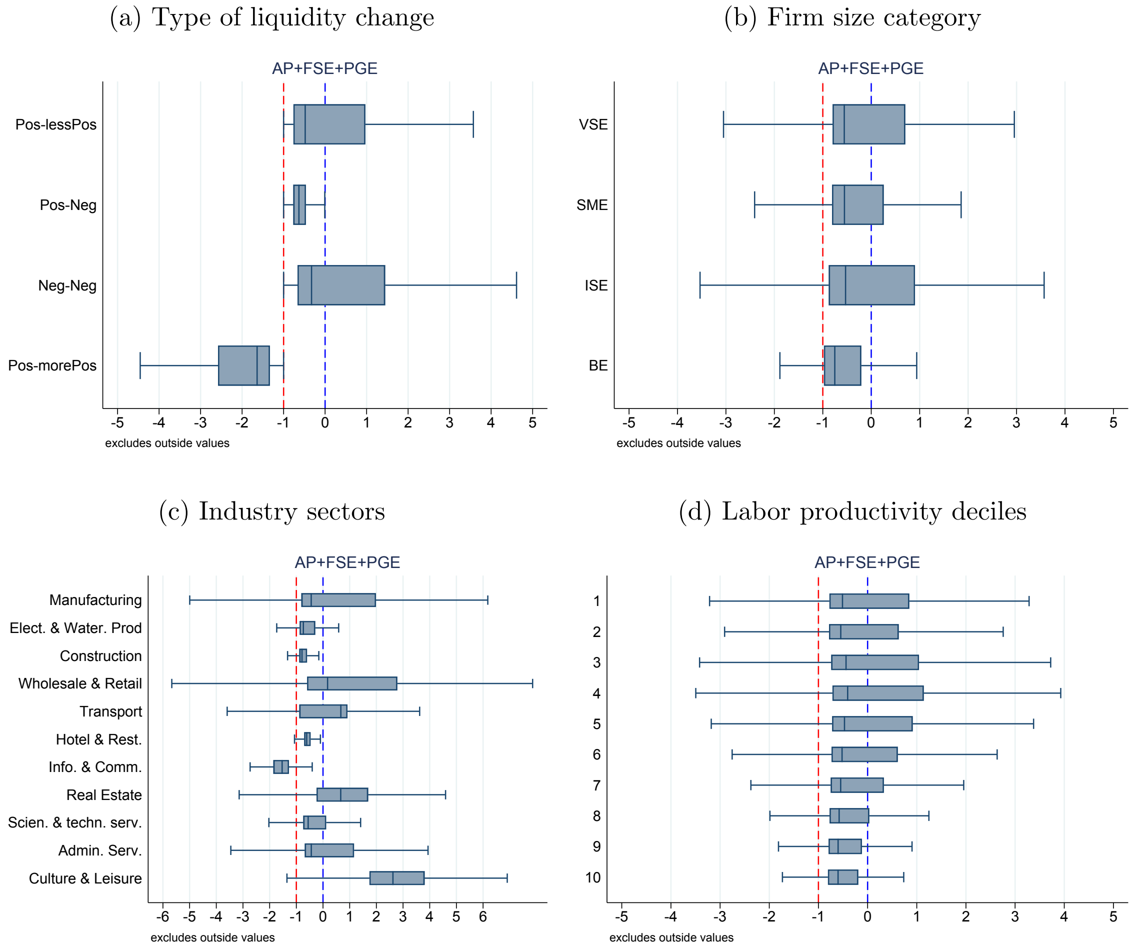
In the final panel of Table 3, we observe some further interesting patterns. Looking at the fraction of overcompensated firms based solely on FSE and AP (column 2), the numbers indicate a negative relationship with firm's labor productivity: the higher the productivity decile, the lower the share of overcompensated firms. This pattern is somewhat dissolved if we take into account also the PGE (column 3) or if we look at the intensive margin, considering firms' average γ values across productivity deciles (column 6). Indeed, firms in the lower-middle range of the productivity distribution seem to be most frequently and extensively overcompensated by the PGE, while firms of the top deciles reveal slightly lower rates. The more productive firms are also the least overcompensated both at the extensive and intensive margins.

5.2.3 Within-group distribution of the intensity of overcompensation

In Figure 5 we take a closer look at the generosity measure γ and how it is distributed across firms of the same group. The median lines in the box-plot diagrams of Panel (a) indicate that only a minority of firms benefited from substantial overcompensation (i.e. having values of $\gamma \geq 1$). At the same time, we see that about 50 percent of the firms in each group with a negative liquidity shock (i.e. the top 3) was insufficiently compensated and report values of γ below -0.5. This means that these firms received compensation that was worth less than 50 percent of their losses. Considering the most vulnerable group of firms with negative liquidity already in 2019 (i.e. Neg-Neg), the median was slightly closer to zero (i.e. full compensation) than for firms with initially positive liquidity. A similar pattern is found in Figure 5(b), where the median of γ is consistently between -1 and 0, but closer to 0 for smaller firms (groups VSE, SEM and ISE). The group of big enterprises (in terms of employees) reveal the lowest degree of government generosity, as most of their firms reside at values below zero.

Considering the lower two panels of the figure, we see broadly similar patterns than in Table 3. An additional dimension that is revealed here is the diverse degree of heterogeneity across sectors. While the predominantly under-compensated sectors of hotels and restau-

Figure 5: Heterogeneity of generosity



(a) Type of liquidity change

(b) Firm size category

(c) Industry sectors

(d) Labor productivity deciles

rants, construction, and utilities reveal fairly homogeneous values of γ concentrated in the undercompensation zone (i.e. between -1 and 0), the greatest beneficiaries based on our aggregated and summary statistics above are extremely diverse. Especially the wholesale and retail sector, but also manufacturing, real estate and the culture and leisure industries reveal a broad spectrum of values of γ across firms. Figure 5(d) further shows that the highest three deciles of productivity contain mostly firms which were under-compensated, and that, on the contrary, the deciles below the median are those where over-compensated firms are more largely present.

6 Conclusion

This paper relies on French firm level data to describe and simulate firm-level exposure to economic contractions during the COVID-19 pandemic, and how policy support packages compensated the related liquidity losses.

Overall, the results of our microsimulation exercise show large and effective support to firms during the first year of the pandemic. We estimate a liquidity loss for firms amounting to €132.6 bn in 2020, a number that matches well the cumulative amount of support allocated to firms via three major initiatives: the wage subsidy scheme, a state-guarantee on private bank loans, and the so-called solidarity fund, which entailed direct transfers to small firms suffering revenue losses during strict lockdown periods.

While aggregate numbers turn out to match the simulated needs of firms well, we uncover heterogeneities across firms that result in a potentially inefficient allocation of the resources provided by the government. Indeed, we estimate that about 24.5% of the firms in our sample have likely been over-compensated, which implies €7.5 bn of subsidies (i.e. AP and FSE) that could have been spared. Moreover, if we also consider the PGE scheme, the total of overcompensated firms rises to 39%, and almost €73.4 bn of the guaranteed loans were allocated in excess of liquidity needs. We locate them mostly in the Wholesale and retail, manufacturing and Culture and Leisure sectors.

Although we observe that the sectoral allocation of support packages matches our simulated losses, some less affected sectors still benefited from wage subsidies and eased access to finance. Consequently, we find that a significant fraction of firms was "under-compensated", which appear to be especially those that suffered the most: those that became illiquid and firms in the hospitality or in the construction sectors. Also were under-compensated, the very large or highly productive firms and this could indicate a potentially (unintended) adverse selection effect resulting from the design of selected support packages.

Our study contributes to a body of literature evaluating the effectiveness of policy measures implemented to counter the economic consequences of the COVID-19 pandemic. As data on the actual performance of enterprises during that episode becomes available, ex-post evaluations will be needed both to infer the actual effect of policies and to inform the validity of modelling choices made in studies such as this one.

In the French context, future research should therefore make use of actual firm-level data on FSE, PGE and AP disbursements, as well as corresponding balance sheet data to observe firms' performance and risk-of-failure during the crisis. In fact, liquidity reductions and shortfalls do not necessarily imply bankruptcy and job losses, so the actual toll of the pandemic is still to be determined. Another promising avenue of research regards the assessment of potential strategies that firms can pursue to mitigate their exposure and vulnerability to shocks. International economic integration — both on the demand and the supply side — can be such a strategy, but evidence on the importance of this channel is still scarce.

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Appendix

A Additional materials

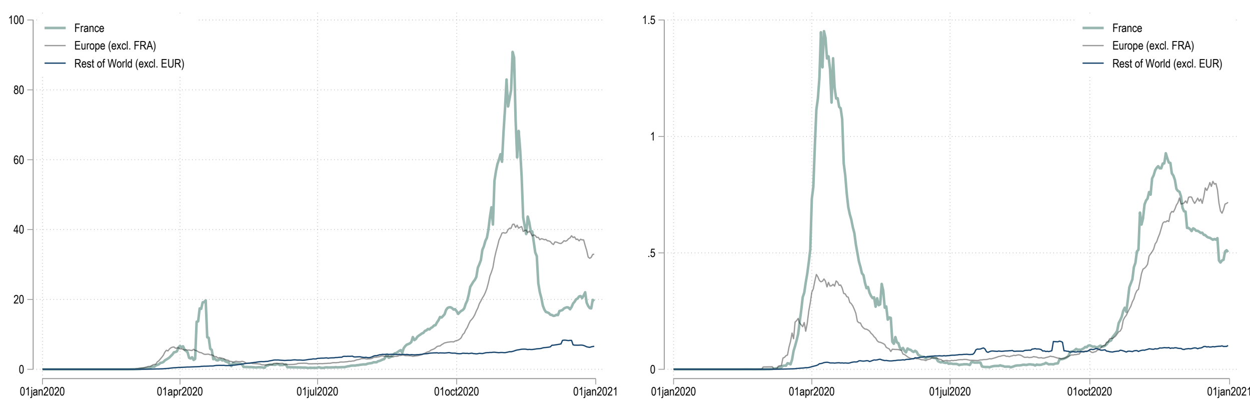
Table A1: Distribution of firms and sales across sectors

Sector code	Sector name	Share firms (%)	Share Sales (%)
C	Manufacturing	8.6	23.1
D	Elect. Prod. Dist.	0.2	2.9
E	Water. Prod. Dist.	0.3	0.9
F	Construction	18.5	7.0
G	Retail	25.4	38.1
H	Transport	5.4	7.5
I	Hotels & Restaurants	14.6	2.9
J	Info. & Commun.	4.1	5.1
L	Real estate	3.6	1.6
M	Scien. and techn. serv.	11.7	5.6
N	Administr. serv.	5.7	4.3
R	Culture and leisure	1.8	0.7

Source: FARE 2019, authors' calculations.

Figure A1: COVID-19 impacts in France vs. other countries

(a) Incidence rates (b) Death rates

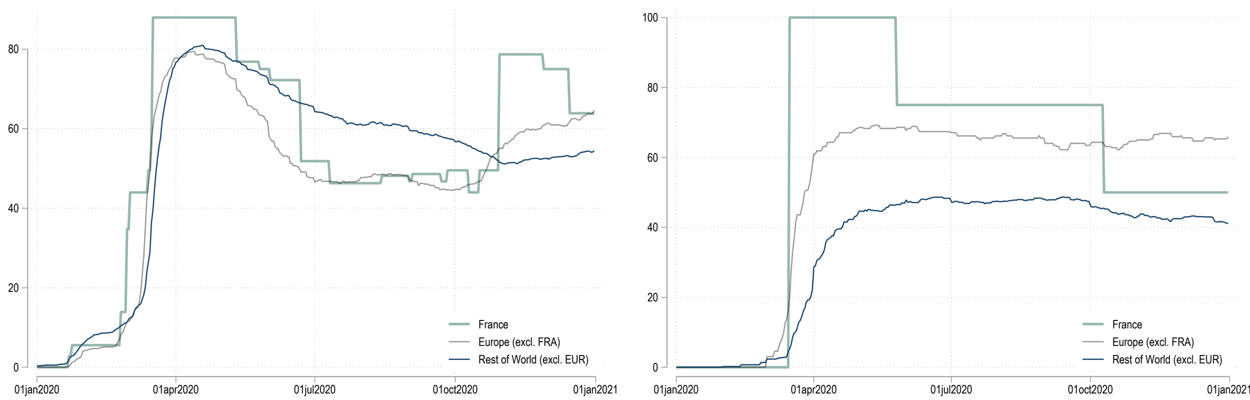


Note: Authors' calculations; data from OxCGRT (Hale et al., 2020, accessed: 06-09-2021). Incidence and death rates relative to population size at WDI online database.

Figure A2: Policy responses in France vs. other countries

(a) Lockdown stringency index

(b) Economic support index

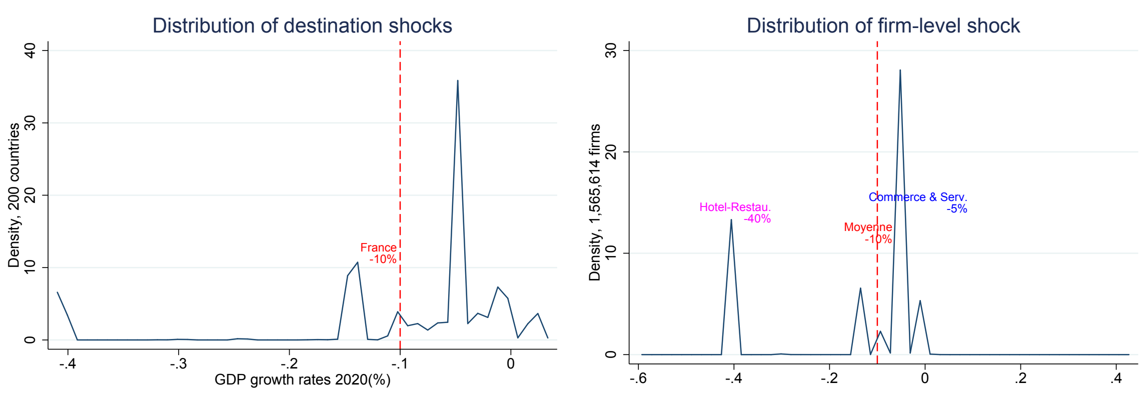


Note: Authors' calculations; data from OxCGRT (Hale et al., 2020, accessed: 06-09-2021). Incidence and death rates relative to population size at WDI online database.

Figure A3: Heterogeneity of the demand shock.

(a) Across destination countries

(b) Across firms



Note: Authors' calculations. Spikes reflect firms from the hospitality and the retailing sectors.

Figure A4: Heterogeneity of financial vulnerability before COVID-19

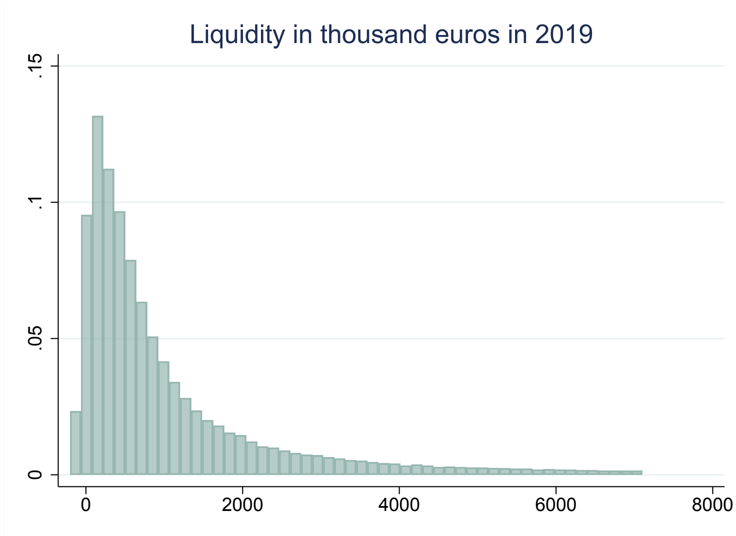


Table A2: Definition of variables from the FARE dataset.

Name	Definition	2020's Value
CF	Cash flow	estimated
DIV	Dividends	0
INV	Investment	0
BT	Business tax on profits	2019's value
Sales	Sales	estimated
Mat	Materials	estimated
Wages	Total wage costs	2019's value
FinRev	Financial revenues	2019's value
FinExp	Financial expenses	2019's value
OtherCost	Other expenses (n.e.s.)	2019's value
Amort	Amortization	2019's value
Taxes	Tax expenses (excl. BT)	2019's value
TrCredits	Trade credits	estimated
Receivables	Trade receivables	estimated
Cash	Cash reserves	2019's value
FinAss	Financial assets	2019's value
Stocks	Production inventories	2019's value
OthersLA	Other liquid assets	2019's value

Table A3: Sectoral shares of estimated liquidity losses and shares of firms per group of liquidity shock

Sector	Share of Loss in %	Share of firms in % Pos-lessPos	Pos-Neg	Neg-moreNeg	Improved
Manufacturing	18	85	3.4	8.2	2.3
Elect. Prod. Dist.	.8	83	0.2	10	6.6
Water. Prod. Dist.	.3	81	1.3	13.3	4.3
Construction	14	77	12	8.4	2.3
Retailing	9	87	1.3	6.3	5.2
Transport	21	63	21.1	14.7	1.1
Hotel & Restaurant	26	29	53.2	17.3	.5
Info. & Commun.	.2	3.2	0.07	2.3	94.4
Scien. and techn. serv.	5	80	3.3	10.9	5.3
Administr. serv.	4	76	6.4	14.3	3.4
Culture & leisure	1	64	10	23.6	1.9

Source: INSEE FARE 2019, Ministry of economy and finance

Table A4: Share of illiquid firms under each policy simulation, in percent

Sector	$P0$	$P1$	$P2$	$P3$	P^{1+3}	P^{1+2+3}	Δ	Pol. Effect.
Manufacturing	12.4	11.6	10.4	12.1	11.3	9.5	2.9	-1.4
Elect. Prod. Dist.	11.8	11.6	11.6	11.8	11.8	11.6	0.2	0.7
Water. Prod. Dist.	15.9	15.5	14.6	15.9	15.6	14.4	1.5	-0.3
Construction	20.9	18.8	18.3	20.8	19.1	16.7	4.2	.59
Retailing	8.5	7.9	6.8	8.1	7.6	6.1	2.4	-1.8
Transport	36.2	33.9	33.8	26.0	24.9	23.7	12.5	-0.1
Hotels & Restaurants	70.7	64.4	62.1	64.8	58.7	48.6	22.1	0.5
Info. & Commun.	19.6	19.2	19	19.6	19.2	18.6	1	-3.3
Scien. and techn. serv.	15.7	14.5	15.3	14.5	13.3	13.0	2.7	-0.5
Administr. serv.	21.7	19.0	20.5	20.7	18.2	17.2	4.5	-0.11
Culture and leisure	34.6	24.5	25.1	22.5	21.4	15.8	20.9	-3.1
All	24	22.4	22.0	22.5	20.6	18	6	

Source: INSEE FARE 2019, Ministry of economy and finance. P0: no policy; P1: wage subsidy; P2: loan guarantee; P3: solidarity fund. Δ is the illiquidity share percentage points difference with and without the three policies.

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