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The Zombification of the Economy? Assessing the Effectiveness of French Government Support During COVID-19 Lockdown

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Abstract

This paper evaluates the risk of zombification of the French economy during the sanitary crisis, as a result of the unconditional financial support provided to firms by public authorities. We develop a simple theoretical framework based on a partial-equilibrium model to simulate the liquidity and solvency stress faced by a large panel of French firms and assess the impact of government support measures. Simulation results suggest that those policies helped healthy but illiquid firms to withstand the shock caused by the pandemic. Moreover, the analysis finds no evidence of a "zombification effect", as government support has not disproportionately benefited less productive companies.

JEL Codes: H12, H32, J38, G33, L20.

Keywords: Covid-19, zombie firms, job-retention schemes, microsimulation, policy evaluation.

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1 Introduction

At the onset of the COVID-19 pandemic, many governments across the world imposed strict lockdown rules in order to limit the virus diffusion. As a result, demand plummeted and economic activity experienced an unprecedented slowdown. To limit the negative effect on income and employment, and reduce the risks of viable but illiquid companies being forced out of the market, authorities introduced a wide range of policies to support workers and firms (OECD 2020, 2021*b*).

This paper aims to evaluate the risk of "zombification" of the economy. With this term we mean the possibility for inefficient firms to remain active thanks to the unconditional and extensive COVID-related government financial support, which might limit the efficiency of market selection. To assess such risk, the paper combines micro-simulation and regression analyses to investigate the impact of the job-retention scheme enacted by the French government on the liquidity and solvency of companies.

French authorities have been very responsive, setting up two important measures within days of the first lockdown. First, the French Government extended the job retention scheme called Partial Activity Scheme ("Dispositif d'Activité Partielle", AP), initially set up in 2008. Originally, public authorities would indemnify a fixed amount of almost 8 euros per hour not worked, while firms compensated temporally laid-off (TLO) workers up to 70% of the gross wages. With the COVID crisis, the French government has significantly changed the scale of the AP scheme, since public authorities would then compensate TLO workers 70% of the original gross wage, while the remaining wage loss was covered at the discretion of the employer. This allowed companies to lay-off substantial shares of the labour force at virtually no cost. The UNEDIC, the organization responsible for the implementation of AP, estimates the overall cost for public authorities to be €35bn in 2020 and 2021 (UNEDIC 2022). A second important scheme was the State-Guaranteed-Loans ("Prêt Garanti par l'Etat", PGE). In this case, the government pledged €300bn in order to cover the loss in case a company defaulted on a bank loan. In other words, the risk of default is borne by the state rather than the banks. This scheme aims at facilitating access to additional financial resources for illiquid firms, although the final decision remains within the hands of financial institutions.[1] Benitto et al. (2022) report that as of January 2022, €145bn had been lent out to more than 700,000 firms, and the anticipated loss for the Government is €1.4bn.

Official figures show that firm liquidations dropped by 50% in 2020, and remain stubbornly low during the first half of 2022.[2] This led several authors to warn against the possible side effects of public support schemes that, because in most of the cases are unconditional, not discriminating between efficient and inefficient firms, may hamper the cleansing effect of market selection, preventing unproductive firms from being forced out of the market (Banerjee & Hofmann 2020, Laeven et al. 2020, Helmersson et al. 2021, Araújo et al. 2022) and leading to a zombification of the economy. OECD (2021*a*,*b*) find that the number of "zombie" firms – defined as companies with an interest coverage ratio lower than one for three consecutive years – has spiked in 2020. Bankruptcies in 2020 were approximately 30% lower than the pre-pandemic average, suggesting that the safety net provided by governments might have prevented large scale failures.

Concerns about the ability of market selection to direct resources toward the most productive companies and the effects of misallocation of credit on productivity and growth is certainly not new (Caballero et al. 2008), and has grown louder in the last decade, when very loose monetary policy made it easier for (quasi-)zombie firms to access credit and roll-over debt (McGowan et al. 2018, Acharya et al. 2020, Sedláček 2020, Schivardi et al. 2020). In fact, productivity slowdown and weak business dynamism observed in several OECD countries are often considered two symptoms of economic malaise associated with a reduction in market selection efficiency (Storz et al. 2017). Similarly, zombification could constrain the post-pandemic recovery by limiting productivity growth and preventing an efficient allocation of resources Sedláček (2020).

There is little reason to believe that the sudden fall in firm exit we have seen since the pandemic is permanent. But its slowness to come back to normal levels limits our ability to evaluate the extent of the possible zombification of the economy based on empirical data.

[1]Repayment carries over the 6 forthcoming years, with a possible extension up to 10 years. The first two years may leave companies free from repayment duties.

[2]See e.g. https://www.banque-france.fr/en/statistics/business-failures-france-2022apr.

The widespread firms reliance on public support schemes conceals the true state of firm financial health. Moreover, because liquidations, bankruptcies and exit procedures are lengthy, and lockdown measures have *de facto* frozen the work of administrative tribunals, the actual effect of the pandemic on firm demography may take years to materialize. Our contention, then, is that if one wishes to evaluate the risk of zombification associated with Covid-related support measures, one needs to rely on micro-simulations.

The rest of the paper is organized as follows. Next Section describes the simulation model, presents the data and discusses the main results. Section 3 builds on the simulations to study the impact of the job-retention scheme across the productivity distribution and evaluate the risk of zombification. Section 4 concludes.

2 Simulations

We develop a partial equilibrium model with a finite number of companies, denoted by $i = 1, \ldots, N$, each belonging to a single sector $j = 1, \ldots, J$. The model is set in monthly discrete time $t = 1, \ldots, T$ and is calibrated with French firm-level data. The simulation covers the January 2020 – April 2021 period, covering one full year after the first French lockdown in late March 2020.

2.1 Simulation model with COVID-19

COVID-19 shock. The COVID-19 pandemics and the related series of lockdown, imposed to limit the spread of viral contagion, generated severe and unprecedented sector-specific demand shocks to many businesses (Baqaee & Farhi 2022). In fact, the interruption of economic activity during lockdown was conditional upon the importance that each industry had in the value chain for the production of necessary final products and services (see Ferraresi et al. 2021). We model sector-specific shocks as demand shifters:

$$Q^d_{i,j,t} = Q^d_{i,j,t_0}(1 + \xi_{j,t}) \tag{1}$$

where $Q^d_{i,j,t}$ is the demand faced at period t by firm i, belonging to sector j. The term Q^d_{i,j,t_0} is the demand of the same firm, in the period right before the emergence of COVID-19 (i.e. January 2020). The term $\xi_{j,t}$ – either positive or negative depending on the nature of the shock – represents the sector demand shifter with respect to the pre-COVID-19 demand level. The larger the severity of the lockdown in sector j, the lower the value of $\xi_{j,t}$.

Firms' behaviour. Firms are modeled as price takers, given the short time horizon of the simulation. Although fixed in our model, observed prices may depart from competitive prices in all markets since they may not reflect the equalization of marginal cost and revenue.[3] Given prices, at each period, firms face a level of demand Q^d_{it}, which is assumed to be known. Thus, firms solve the following one-period cost minimization problem:[4]

$$\begin{cases} \underset{L_{it},M_{it}}{\arg\min}\ C_{it} = p_L L_{it} + p_M M_{it} + p_K K_{it} \\ \text{subject to} \\ Q_{it} \leq \mathcal{F}(K_{it}, L_{it}, M_{it}) = \omega_{it} K_{it}^{\beta_K} L_{it}^{\beta_L} M_{it}^{\beta_M} \\ Q_{it} \geq Q^d_{it} \end{cases} \tag{2}$$

where the choice variables are the demand for labour (in hours worked, L_{it}) and intermediate materials (M_{it}). Given the time horizon of the model, we assume capital stocks to be invariant over the simulation period, such that firms invest in maintenance without investment in additional productive capacity: $K_{it} = K_i$. The objective function is a linear cost function (C_{it}) accounting for the presence of two variable inputs and one fixed input. Prices P_K, P_L and P_M refer to the user costs of capital, hourly wage and price of materials, respectively. The first constraint is a Cobb-Douglas production function $\mathcal{F}(K_{it}, L_{it}, M_{it})$ with three inputs, where ω_i measures the firm-specific total factor productivity (TFP, see Appendix B for its estimation). The second constraint is the demand level, determined by Equation 1.

[3] That is, we do not assume perfect product and factor markets.

[4] In a period of high uncertainty as it was the 2020, characterized by new ordinances at weekly cadence, it was impossible for firms to make forecasts ahead of time. This is the reason for which we have avoid to model firms' behavior as an inter-temporal optimization problem.

Variable factor demand. Because of our interest in the short-term firm-level effects generated by COVID-19, we make the reasonable assumption that all prices are fixed. This allows us to derive the firms' optimal demand of the variables factors:

$$L^\star_{it} = \left[K_{it}^{-\beta_K}\frac{Q_{it}}{\omega_{it}}\left(\frac{P_M}{P_L}\frac{\beta_L}{\beta_M}\right)\right]^{\frac{1}{\beta_L+\beta_M}} \tag{3}$$
$$M^\star_{it} = \left[K_{it}^{-\beta_K}\frac{Q_{it}}{\omega_{it}}\left(\frac{P_L}{P_M}\frac{\beta_M}{\beta_L}\right)\right]^{\frac{1}{\beta_L+\beta_M}}$$

However, we take into account that in most real world situation, companies' adjustments of the flexible inputs are not instantaneous. In fact, companies orders for intermediate inputs are lumpy and workers cannot be immediately dismissed due to the rigidity of many contracts. Furthermore, during the pandemic COVID-19 period it is likely that market imperfections and information asymmetries have been amplified. Therefore, we adopt a partial adjustment model for both variable inputs that take the following form.[5] This implies that at every period t firms won't achieve their optimal choices $L^\star_{it}$ and $M^\star_{it}$. Rather they slowly adjust toward these values as follows:

$$\hat{L}_{it} = L_{it-1} + \gamma_L(L^\star_{it} - L_{it-1}) \tag{4}$$
$$\hat{M}_{it} = M_{it-1} + \gamma_M(M^\star_{it} - M_{it-1})$$

where the parameters $\gamma_L, \gamma_M \in [0,1]$ describe the speed of adjustment for the flexible factors and the hat (e.g. $\hat{L}_{it}$) indicates that the variable has been only imperfectly adjusted. At one extreme, a value $\gamma_j = 1, j \in \{L, M\}$ implies firms can immediately adjust their inputs at their optimal levels. At the other extreme, if $\gamma_j = 0$, companies cannot adjust and the two inputs are kept fixed (see Appendix A).

Liquidity dynamics. Liquidity holdings (Λ) of firms evolve according to the following

[5]This setup is similar to one proposed by Schivardi & Romano (2020), with the main difference that our adjustment is micro-founded and approaching the optimal values $L^\star_{it}$ and $M^\star_{it}$ rather than proportional to the demand shock.

law of motion:

$$\Lambda_{it} = \Lambda_{it-1} + \ell_{it} \tag{5}$$

where cash flow ℓ_{it} is defined as:

$$\ell_{it} = PQ_{it} - P_L L_{it} - P_M M_{it} - FC_i - T_i \tag{6}$$

Equation (6) says that cash flow is the difference between revenues from sales and production costs, which include the wage bill ($P_L L$), the cost of intermediate products ($P_M M$), the fixed costs FC – defined as rents, interest and principal repayment – and the corporate tax bill T. Both the fixed costs FC and the tax bill T are kept constant over the simulation horizon. Writing Gross Operating Income as $\Pi_{it} = PQ_{it} - P_L L_{it} - P_M M_{it}$, Eq. (6) can be rewritten as $\ell_{it} = \Pi_{it} - FC_i - T_i$, implying that liquidity equals gross operating income minus fixed costs and corporate taxes.[6] Finally, it is worth noticing that we abstract from modeling dividends distribution.

Financial stress. A company is said to face liquidity stress whenever $\Lambda_{it} < 0$. This implies that the sum of liquidity holdings at the end of the previous accounting period Λ_{it-1} and the current gross operating profits Π_{it} are smaller than the sum of the firm's fixed costs plus the tax bill:

$$\begin{aligned} \Lambda_{it} &< 0 \\ \Lambda_{it-1} + \Pi_{it} &< FC_i + T_i. \end{aligned} \tag{7}$$

The same definition has been recently adopted by Demmou et al. (2020), Gourinchas et al. (2021).

Illiquid firms may continue operating by raising new debt, either *via* bonds or new loans. However, this cannot continue indefinitely. A company is said to be insolvent when liquidity holding Λ_{it} becomes negative, and in absolute value larger than its equity E_{it}.

[6] This is a reasonable assumption in the short-term.

This insolvency condition reads:

$$\Lambda_{it} + E_{it} < 0 \tag{8}$$

$$\Lambda_{it-1} + \Pi_{it} + E_{it} < FC_i + T_i$$

where the second form of Equation 8 suggests that a firm shuts down whenever all liquid and illiquid resources – i.e. the left hand side – are insufficient to cover financial and tax charges – i.e. the right hand side. In this situation, also short-term borrowing would be unfeasible because neither investors in corporate bonds nor a bank would rationally provide funds to such a firm.[7]

At the end of each accounting period t, both financial conditions are updated, thereby determining the share of illiquid and/or insolvent firms. Note that both liquidity and solvency are the results of a host of factors including productivity, output elasticities, operating profit, and the pre-COVID financial health of the firms in terms of debts and fixed costs.

Job Retention Scheme. We model the AP scheme put forward by the ordinance 2020-346 of March 27, 2020.[8] This policy device allowed companies to obtain a subsidy for the wage costs of the employees not directly involved in production during the COVID-19 series of lockdown. With respect to our model, this implies that such policy instrument allows firms to always reach their optimal level of hours worked $L^{\star}_{it}$ without sluggishness. Formally, we implement this policy setting $\gamma_L = 1$.

Time-line of events. At each time period, the following sequence of events takes place:

1. Firms observe the new level of demand $Q^d_{i,j,t}$ as determined by Equation 1;
2. firms determine the optimal flexible inputs $(L^{\star}_{it}, M^{\star}_{it})$ (see Equation 3);
3. firms take into account the partial adjustment and use the inputs $(\hat{L}_{it}, \hat{M}_{it})$ (see Equation 4);

[7] A condition for which a firm would be able to operate even when this condition is met, is that fresh capital is provided by shareholders, by a controlling firm, or by an acquiring firm. These, however, are situations that go beyond the scope of this paper.

[8] https://www.legifrance.gouv.fr/dossierlegislatif/JORFDOLE000041913361/.

4. firms produce the amount Q_{it} using the Cobb-Douglas technology of Equation 2;

5. firms cash flows are updated according to Equation 5.

2.2 Simulation model without COVID-19

To properly evaluate the effectiveness of the policy measure, it is necessary to build a counterfactual (i.e. No-COVID) scenario. Two main differences with respect to the model described in Section 2.1 must be emphasised. The first difference is empirical in nature and concerns the estimation of the demand shocks, had COVID-19 not struck. The second difference instead is theoretical, and concerns firm behaviour in a "business as usual" economic environment.

Demand shocks in the No-COVID scenario. In order to build the No-COVID scenario, we rely on standard time-series techniques. In particular, for each sector j, we employ the monthly time-series of value added in production covering the period from January 2012 to December 2019 ($T = 96$) with the aim of estimating sector-specific AR(1) processes with monthly dummies:[9]

$$g_{j,t} = \rho_s g_{j,t-1} + \delta_{j,m} + \varepsilon_{j,t} \ . \tag{9}$$

where $g_{j,t}$ measures the growth rate of industrial production in sector j at time t; ρ_j represents the first-order autoregressive parameter for a specific sector; $\delta_{j,m}$ captures the sector-specific monthly components of demand. Equation 9 can be consistently estimated by OLS.

We then employ the estimates of $\hat{\rho}_j$ and the twelve $\hat{\delta}_{j,m}$ dummies to carry out iterated one-step ahead predictions of the the growth rate for all subsequent months up to April 2021:

$$\hat{g}_{j,t+1} = \hat{\rho}_j g_{j,t} + \hat{\delta}_{j,m} \ . \tag{10}$$

Finally, to infer the demand shocks in the No-COVID scenario, we index the industrial

[9]See Hamilton (2020). Note that before estimating the process we transformed all the industrial production series in growth rates to ensure stationarity. All p-values of the sector-specific Augmented Dickey-Fuller (ADF) tests, computed on the residuals of Equation 9 are smaller than 10% (99% of them are below the 5% threshold) indicating that the autocorrelation present in the time series of industrial production growth has been taken into account either by the AR(1) component or by the monthly dummies.

production at January 2020 – i.e. null demand shifter $\xi_{j,0} = 0$ in January 2020 – and we iteratively forecast the index value of industrial production for all subsequent months using:

$$(1 + \xi_{j,t}) = (1 + \xi_{j,0}) \prod_{k=0}^{t} (1 + \hat{g}_{j,k})$$
$$(1 + \xi_{j,t}) = \prod_{k=0}^{t} (1 + \hat{g}_{j,k}) \tag{11}$$

Firm behaviour in the No-COVID scenario. The second difference concerns the choice of (L_{it}, M_{it}), as described by the minimization problem described by Equation 2. Absent any COVID shock, we can relax the assumption about the fact that firms gradually adjust by following the observed demand shocks. This assumption is reasonable when uncertainty is high and firms cannot resort to optimal behaviour. Therefore, in the No-COVID scenario, we assume that firms optimally choose L and M according to Equation 3. This is also consistent with Gourinchas et al. (2021).[10]

Overall, we end up with three different scenarios: (i) a No-COVID scenario, in which the demand shocks are generated coherently with the variability in the monthly growth rates of industrial production experienced over the 2012–2019 period; (ii) a COVID scenario, which takes into account the actual fall in value added experienced in 2020, as the demand shocks are drawn from the 2020 empirical observation; (iii) a COVID+Gov scenario where the demand shocks are equivalent to the COVID scenario, but in which we also model the intervention of the government by means of the AP scheme. These scenario form the bulk of our simulation exercise.

2.3 Firm-level data

The simulation exercise uses balance sheet data for 2019, as reported in the FARE database maintained by the French Statistical Office (INSEE), which represents a snapshot of the situation of French companies before the beginning of the pandemic and is based on tax

[10] Gourinchas et al. (2021) use this optimal behaviour also in the presence of the pandemic shock. This choice in turn requires them to assume also supply-side (productivity) shocks in order to generate higher firm exit in the COVID-19 scenario.

filings by companies. FARE 2019 includes more than 4 million companies (4,356,764). We exclude from the analysis companies with incomplete information; firms in Agriculture (AZ), Finance and Insurance (KZ) and Public Administration, Education, Human Health and Social Action (OQ) sectors; legal persons and organizations subject to administrative law, as well as self-employees and craftsmen. The reason for leaving these companies aside is that, their decisions on the amount of factors of production employed do not necessarily comply with the logic of our simulation model, which is based on cost minimization and on a production function framework.

The set of firms that are part of our exercise includes 752,603 companies (or 17.2% of FARE's legal units); more than 10.5 million jobs (76.2% of FARE jobs), and €914bn of added value (i.e. 74.1% of FARE). The simulation takes as a reference legal units. Thus we do not model possible resource flows among companies belonging to the same business group (or between parent and subsidiaries), which could affect their financial stress.

Output elasticities ($\beta_K, \beta_L, \beta_M$) are estimated using a Cobb-Douglas production function based on balance sheet data (taken from FARE) for the years 2012–2019 (see Appendix B).

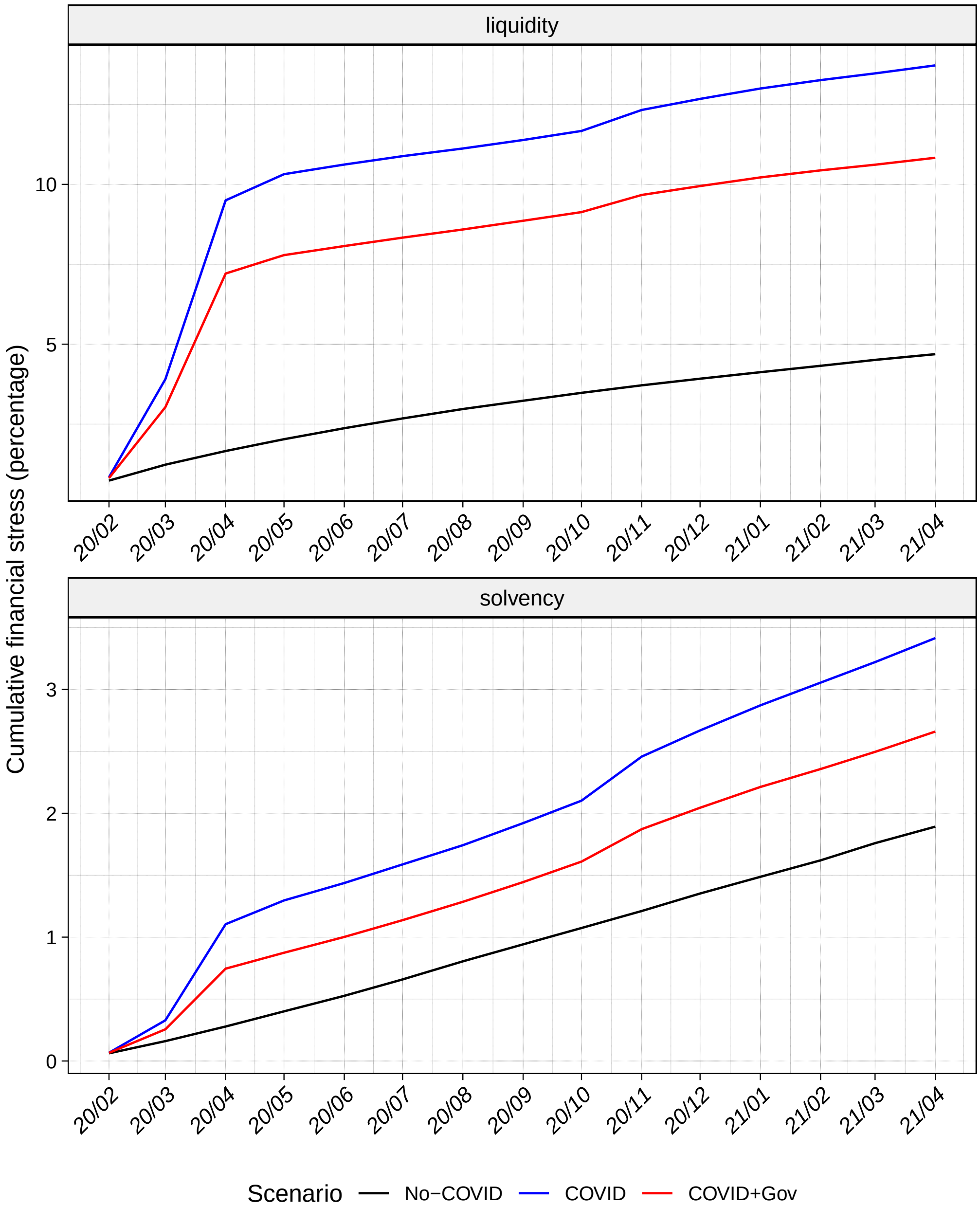
The size of the demand shock ($\xi_{j,t}$) at the 4-digit industry level (referenced as level $A732$ in the French nomenclature) is taken from INSEE.[11] In particular, we use industry-specific value-added indexes recorded over the COVID period to capture the size of fluctuations to demand during the pandemic. Exploiting the same information for 2012–2019 period we also build the counterfactual No-COVID scenario presented in Subsection 2.2.

2.4 Simulation results

Figure 1 presents the broad trends emerging from the simulations for the three scenarios. While the upward trend is at odds with the fall in the number of liquidations, we should bear in mind that we are not simulating a failure rate, but rather the unobserved financial health of firms, and that data from firms financial statements are affected by public support measures.

[11] See https://www.insee.fr/fr/recherche?q=Indice+production+industrielle&debut=0.

Figure 1: Dynamics of cumulative financial stress, as estimated from our simulations and according to the three different scenarios. Top panel: share of firms with liquidity issues. Bottom panel: share of firms with solvency issues.



Unsurprisingly, the pandemic has a sudden, brutal and sizable impact on the liquidity of French companies. The drastic drop in revenues determined by the lockdown, the presence of frictions in the markets for factors of production and of fixed costs that do not adjust to the level of production (or adjust very slowly) drain the liquidity of non-financial firms. The fraction of companies experiencing solvency (liquidity) issues climbs up to 3.4% (16%) by the end of the simulation. This contrasts with an insolvency (illiquidity) rate of around 1.9% (5%) in April 2021 under the baseline No-COVID scenario.

Figure 1 provides two additional insights. The first one concerns the impact of the partial activity scheme on solvency, which is large and positive. The measure reduces the number of insolvent companies, trimming it by 0.8 percentage points (from 3.4 to 2.6%) in April 2021.[12] The second one is that a number of firms face solvency issues irrespective of the pandemic (1.9%), implying that they are unprofitable even when the economy is growing. These companies are generally smaller, less productive, more indebted and have a lower level of liquidity than the others. This evolution is qualitatively similar to the results presented in OECD (2021*a*), despite the fact that the analysis is based on a sample of firms with different characteristics.

3 Public support and firm solvency: a policy evaluation exercise

3.1 Firm sorting

The first set of questions concerns the financial stress of firms across the different scenarios. Did public financial support relieve firms from financial stress during the sanitary crisis? We proceed in two steps. First, we look at the solvency stress of firms under the two scenarios. Table 1 discriminates among firms suffering from solvency stress in No-COVID and in the COVID scenarios without state support. Consistently with Figure 1, it shows that the number of insolvent firms raises from 1.9% to 3.4%. It also shows that the vast majority (726,438 firms, representing 96.5% of our sample) of firms have sufficient resources to escape from insolvency stress in either scenario. Among the 25,697 financially-stressed

[12] This would amount to roughly 30,000 companies being relieved from insolvency stress, relative to the 4 millions companies composing the French economy.

Table 1: Solvency stress under the No-COVID and COVID scenarios.

	COVID		
No-COVID	No	Yes	Total
No	$N = 726,438$ $PQ_0 = 374.03$ $AP^{€} = 19.75$ $AP/PQ_0 = 0.11$ $\omega_0 = 5.74$ $Lev_0 = 13.83$ $FC_0 = 23.99$	$N = 11,925$ $PQ_0 = 243.48$ $AP^{€} = 0.27$ $AP/PQ_0 = 0.13$ $\omega_0 = 2.85$ $Lev_0 = 44.64$ $FC_0 = 7.76$	$N = 738,363$
Yes	$N = 468$ $PQ_0 = 142.47$ $AP^{€} = 0.02$ $AP/PQ_0 = 3.40$ $\omega_0 = 1.92$ $Lev_0 = 10.83$ $FC_0 = 17.18$	$N = 13,772$ $PQ_0 = 120.00$ $AP^{€} = 0.22$ $AP/PQ_0 = 1.41$ $\omega_0 = 3.21$ $Lev_0 = 160.77$ $FC_0 = 228.39$	$N = 14,240$
Total	$N = 726,906$	$N = 25,697$	$N = 752,603$

No-COVID: Business As Usual. COVID: Partial adjustment model under COVID-19 without government support. Yes/No answers refer to whether the firm is experiencing solvency stress. No: $\Lambda_{it} + E_{it} < 0$; Yes: $\Lambda_{it} + E_{it} < 0$. N: Number of firms; PQ_0: monthly level of sales in January 2020; $AP^{€}$: Simulated cumulated amount of AP resources received by firms between March 2020 and April 2021, in billions of euros; AP/PQ_0: Simulated cumulated amount of AP resources received by firms between March 2020 and April 2021, relative to monthly level of sales in January 2020; ω_0: estimated level of Total factor Productivity in January 2020; FC_0: Fixed cost defined as monthly corporate taxes plus payment of principal and interest in January 2020; Lev_0 Leverage, initial level of debts to suppliers and other third party, relative to equity.

companies of the COVID scenario, more than half (13,772) show similar problems also in normal times, whereas our simulations reveal that almost 12,000 firms would become insolvent because of the crisis, absent any government support. A small number of firms (468) enjoy an improvement of their financial condition following the pandemic: this stems from the positive demand shock induced by the lockdown on few sectors (including utilities, and a range of telecommunication and transport services).

Relative to firms being financially stressed in both scenarios (bottom right quadrant), firms not exposed to the global lockdown (upper left quadrant) are generally larger (PQ_0), more productive (ω_0), less indebted (Lev_0), and face relatively low fixed costs (6.5% of their revenues). Firms suffering from the lockdown (upper right quadrant) appear globally healthy financially, both in terms of fixed costs and leverage. At the same time, they show a relatively low level of productivity ($\omega_0 = 2.85$).[13]

Our simulations allow retrieving the estimated cumulative AP resources perceived by firms, which altogether amounts to €21.5bn. Most resources (€19,75bn, 97.5% of AP spending) are perceived by firms that would not be threatened by either scenarios, even with the absence of the job retention scheme. In the same vein, firms undergoing solvency stress in both scenarios represent 1.1% of overall AP resources (€220ml). Firms entering into solvency stress due to the COVID crisis gather 1.3% of overall AP resources (€270ml). Overall, these preliminary figures cast doubts on the necessity of the job retention scheme. In the end, the bulk of AP spending applied to these 760,000 companies which did not need it in the first place. Our stand on this issue is far more moderate. First and foremost, AP is also a demand policy. Had AP not been implemented, the effect of the sanitary crisis on final demand would presumably have been much fiercer than observed. Second, although most firms can financially cope with the global lockdown, AP maintained their financial health such that they do not cope with solvency stress as defined here. It may still be that their financial health deteriorated.

The second step raises the question of the effect of government support on solvency stress. If anything, a well-functioning government support should favor financially-healthy firms in normal time (i.e. under the No-COVID scenario) while being unsupportive with insolvent one. Table 2 displays the effect of government aid on solvency for the 25,697 firms made potentially insolvent by the crisis, corresponding to the right column of Table 1. This allows us to address two issues.

One issue relates to a type-II error in government support: did the government support firms that would have experienced solvency stress in any case? Table 2 shows that 307 among the $13,772$ solvency-stressed firms (only 2%) have actually benefited from government support, becoming solvent during the crisis. Hence, government support has, by and

[13]This raises the issue of the selection effect of the global lockdown. Table 1 reveals that amongst the 25 thousand companies being solvency stressed under the sanitary crisis, those that also undergo a solvency stress in normal times are more productive than those remaining financially healthy. Our interpretation is that high productivity does not perfectly equate with financial health. Although related, the two do not map perfectly, so that market selection occurs on forces other than productivity.

Table 2: Solvency stress under the No-COVID and COVID+Gov scenarios, concerning firms facing solvency stress under the COVID scenario.

	COVID + Gov		
	No	Yes	Total
No-COVID			
No	$N = 5,371$ $\hat{N} = 2,635$ $PQ_0 = 332.47$ $AP^{€} = 0.17$ $AP/PQ_0 = 0.14$ $\omega = 3.01$ $Lev_0 = 32.12$ $FC_0 = 6.36$	$N = 6,554$ $\hat{N} = 9,290$ $PQ_0 = 170.50$ $AP^{€} = 0.10$ $AP/PQ_0 = 0.12$ $\omega = 2.73$ $Lev_0 = 54.90$ $FC_0 = 8.90$	$N = 11,925$
Yes	$N = 307$ $\hat{N} = 3,043$ $PQ_0 = 68.01$ $AP^{€} = 0.03$ $AP/PQ_0 = 0.35$ $\omega = 2.77$ $Lev_0 = 69.45$ $FC_0 = 31.72$	$N = 13,465$ $\hat{N} = 10,729$ $PQ_0 = 121.19$ $AP^{€} = 0.21$ $AP/PQ_0 = 1.43$ $\omega = 3.22$ $Lev_0 = 162.85$ $FC_0 = 232.64$	$N = 13,772$
Total	$N = 5,678$	$N = 20,019$	$N = 25,697$

$\chi^2 = 6,804.6$ ($p = 0.000$). No-COVID: Business As Usual. COVID+Gov: Partial adjustment model under COVID-19 with government support. Yes/No answers refer to whether the firm is experiencing solvency stress. No: $\Lambda_{it} + E_{it} < 0$; Yes: $\Lambda_{it} + E_{it} < 0$. N: Simulated number of firms. $\hat{N}$: Expected number of firms being financially stressed if the effect of government support on firm solvency were random. PQ_0: monthly level of sales in January 2020; $AP^{€}$: Simulated cumulated amount of AP resources received by firms between March 2020 and April 2021, in billions of euros; AP/PQ_0: Simulated cumulated amount of AP resources received by firms between March 2020 and April 2021, relative to monthly level of sales in January 2020; ω_0: estimated level of Total factor Productivity in January 2020; FC_0: Fixed cost defined as monthly corporate taxes plus payment of principal and interest in January 2020; Lev_0 Leverage, initial level of debts to suppliers and other third party, relative to equity.

large, not supported unhealthy firms. The other question relates to a type-I error: did the government fail to support firms that would not have experienced solvency stress under a No-COVID scenario? This applies to 11,925 firms. We observe that for almost half of them (5,371 companies, amounting 45% of financially health firms under the No-COVID scenario), government support has been key to support them throughout the sanitary crisis.

Table 2 also displays the expected frequency of each type of firms if the effect of government support on firms solvency were random. The gap between the observed (N) and the expected ($\hat{N}$) number of firms is an indication of the capacity of the support to sort correctly amongst firms. This suggests that government support, despite not being targeted, did not support financially unhealthy firms and did make a difference for firms that *deserved* to be supported.[14]

3.2 Zombification

We now move to the core of our empirical exercise, namely the evaluation of the policy measures enacted by the French government to mitigate the impact of the pandemic on firms.

We focus on the 11,925 companies which display no solvency issue under the notional No-COVID scenario, while facing a solvency problem in the baseline partial-adjustment model with no furlough scheme. Among these companies, we further discriminate among those that are made solvent by Activité Partielle (5,371) and the others (6,556). Note that by doing so, we avoid the obvious correlation between the amount of public help received by a firm and its financial fragility that stems from the fact that less productive firms have higher costs and thus are more likely to face liquidity and solvency issues when hit by a negative shock, as reported in Table 1.[15] When we properly account for this selection bias, we immediately see that firms with no solvency issue enjoyed a larger amount of government support as a fraction of their output, beside being on average larger, more

[14]Importantly, the χ^2-value imply that this effect is statistically significant.

[15]In Appendix C we report the estimates from a regression on the whole sample, showing that it does not account for sample selection bias.

productive, and having a stronger financial structure (with all means being significantly different across groups).

To address more directly the question of the effect of AP on French firms, we run a series of probit regression models in which the dependent variable is an indicator that takes value 1 if the company has faced solvency issues at any time in our simulation and the main explanatory variable is the amount of government support via AP scaled by sales.

Columns (1–3) of Table 3 show that the job retention scheme reduces the likelihood of facing solvency issues, and this remains valid when we add additional controls such as productivity, fixed costs and leverage, all of which have the expected sign. Size and productivity reduce the probability of becoming insolvent, while higher leverage and larger fixed costs increase it.

The issue of zombification can be addressed by means of an interaction term between the amount of public support received by the company and productivity. A positive coefficient would signal that AP has benefited mostly low-productivity firms, thus rising the risk of a zombification of the economy. Column (4) of Table 3 provides little support for this hypothesis, because the interaction term displays a positive but not significant coefficient.

The overall results could, however, conceal important heterogeneity across different sectors of the economy. Indeed, a quick look at the sample of firms included in the analysis reveals that 45% belongs to wholesale and retail trade, and another 41% to hotels and restaurants, two of the sectors that have been more severely affected by the pandemic. To investigate the presence of industry-specific effects, we run the regression model on specific subgroups of firms and obtain interesting insights – see Columns (5–7) of Table 3.

In wholesale and retail trade productivity has no significant effect on the probability to face solvency stress and even if the interaction term is positive and significant, the vast majority of firms in the sample (up to the 95^{th} percentile of the productivity distribution) lies in the region where AP has no meaningful effect on the dependent variable (see the bottom-left panel of Figure 2). The situation is different in the accommodation and food

Table 3: The determinants of the probability to experience solvency stress during the COVID global shutdown

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
VARIABLES	All sectors				Trade	Hotels	Others
AP/PQ_0	-0.166***	-0.172***	-0.218***	-0.230***	-0.502**	-0.685**	-0.330**
	(0.0426)	(0.0427)	(0.0437)	(0.0870)	(0.214)	(0.328)	(0.135)
ω_0		-0.287***	-0.495***	-0.480***	0.762	-0.345	-0.252*
		(0.0575)	(0.0594)	(0.114)	(0.565)	(0.559)	(0.145)
$AP/PQ_0 \times \omega_0$				0.009	0.664***	0.291	0.034
				(0.0611)	(0.249)	(0.346)	(0.0821)
FC_0			0.209***	0.210***	0.099***	0.420***	0.345***
			(0.0172)	(0.0176)	(0.0232)	(0.0370)	(0.0435)
Lev_0			0.196***	0.196***	0.217***	0.267***	0.037
			(0.0106)	(0.0106)	(0.0151)	(0.0193)	(0.0264)
PQ_0	-0.0835***	-0.0649***	-0.162***	-0.162***	-0.0599***	-0.310***	-0.210***
	(0.0126)	(0.0132)	(0.0159)	(0.0162)	(0.0220)	(0.0404)	(0.0411)
Constant	-0.323***	0.042	-0.011	-0.029	-0.460	-0.141	-0.029
	(0.0512)	(0.0891)	(0.0934)	(0.150)	(0.458)	(0.489)	(0.215)
$\frac{\partial \Pr}{\partial AP}$	-0.0638***	-0.0658***	-0.0811***	-0.0820***	0.0436	-0.163***	-0.100***
	(-0.0163)	(-0.0163)	(-0.0162)	(0.0171)	(0.0348)	(0.0466)	(0.0234)
Observations	11,925	11,925	11,925	11,925	5,377	4,895	1,653
LL	-7968	-7955	-7740	-7740	-3378	-3247	-1039
LR	478.9	503.8	933.6	933.6	273.4	289.1	90.43
Pseudo R-squared	0.029	0.031	0.057	0.057	0.039	0.043	0.042

Probit model estimated by maximum likelihood methods. *** $p<0.01$, ** $p<0.05$, * $p<0.1$. AP/PQ_0: estimated perceived amount of Activité Partielle, relative to sales in January 2020; ω_0: estimated level of Total factor Productivity in January 2020; FC_0: Fixed cost defined as monthly corporate taxes plus payment of principal and interest in January 2020; Lev_0 Leverage, initial level of debts to suppliers and other third party, relative to equity; PQ_0: monthly level of sales in January 2020. All explanatory variables are entered in natural logs.

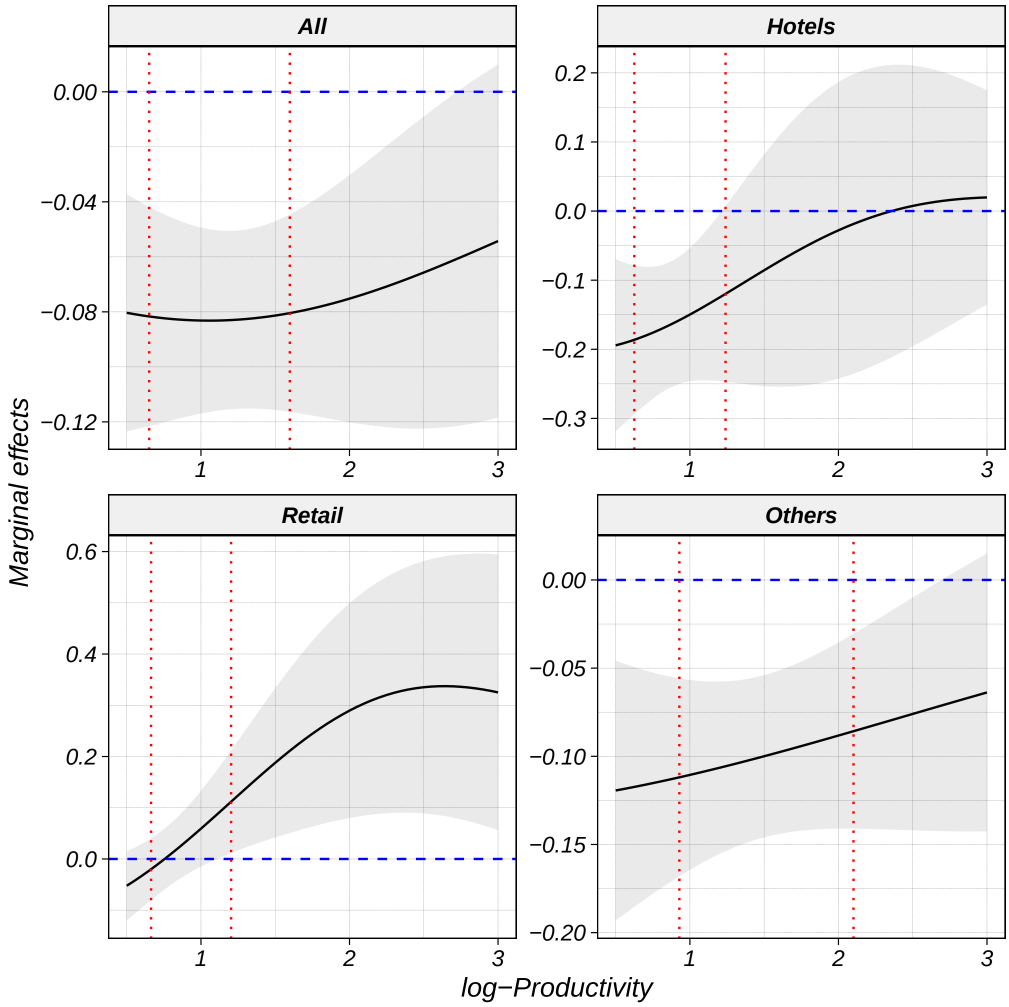
service sector, where AP reduces the probability to undergo solvency stress and 90% of the firms in the sample seem to benefit from it. Moreover, the interaction term is not significant, suggesting there is little evidence to support a process of zombification among hotels and restaurants. A similar, albeit stronger, effect is found for companies operating in all other sectors, for which the impact of the job retention scheme is positive while the differential effect across the productivity distribution is small and not significant (see the bottom-right panel of Figure 2).

4 Conclusion

This paper has addressed the issue of the possible negative effects of job retention schemes and other support measures enacted by governments in many advanced countries at the onset of the COVID-19 pandemic, when strict lockdown rules and the sharp contraction of aggregate demand threatened an avalanche of business failures. Because most of the policy measures were meant to offer companies a lifeline and did not discriminate among them, the risk of supporting non-viable firms is high. Beside being a waste of public money, such an outcome could undermine the recovery phase since zombie firms would absorb productive resources (such as capital, labour and credit), reduce entry by creating congestion, and act as a drag on productive investment and market reallocation.

We have developed a microfunded simulation framework that replicates the dynamics of liquidity for a sample of 750,000 French firms across different scenarios and sheds light on the effect of support measures implemented by the government. We find that the policies have been successful in significantly reducing the number of firms facing financial distress throughout the first part of the pandemic. Government support has mainly benefited financially healthy firms, whereas companies already under stress did not manage to overcome their problems thanks to additional public funds. Furthermore, we find no evidence of a zombification effect, since the impact of government support on relieving firms from insolvency is constant over the productivity distribution.

Figure 2: Estimated marginal effect of AP on the probability of experiencing solvency stress (black line) with its 95% confidence interval (grey shaded area). The dashed blue horizontal line represents the zero, above (below) which the estimated effect would (would not) imply a zombification of the economy. The dotted red vertical lines represent respectively the 5th and 95th percentile of the productivity distribution in the specific sector. Note: y-axis scale varies across quadrants.



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Appendix A. Supplementary material about the simulation

This appendix provides supplementary material about the simulations. Table A1 displays the values of the parameters used in the various scenarios. Figure A1 provides the share of firms in liquidity and solvency stress per sector.

Model Parameters

Table A1: Summary of model parameters, with their economic interpretation and values.

Symbol	Economic Interpretation	Value
γ_M	Speed of adjustment in the intermediate inputs market	0.250
γ_L	Speed of adjustment in the labour market	1.000
γ_L	Speed of adjustment in the labour market (COVID scenario only)	0.100
ξ	Demand shifter	-0.097[a]
ξ	Demand shifter (No-COVID scenario only)	0.033[a]
β_K	Output elasticity of capital	0.022[b]
β_L	Output elasticity of labour	0.210[b]
β_M	Output elasticity of materials	0.728[b]
ω	Efficiency parameter (total factor productivity)	5.648[c]

[a] Numbers denote 4-digit ($A732$) sector average.

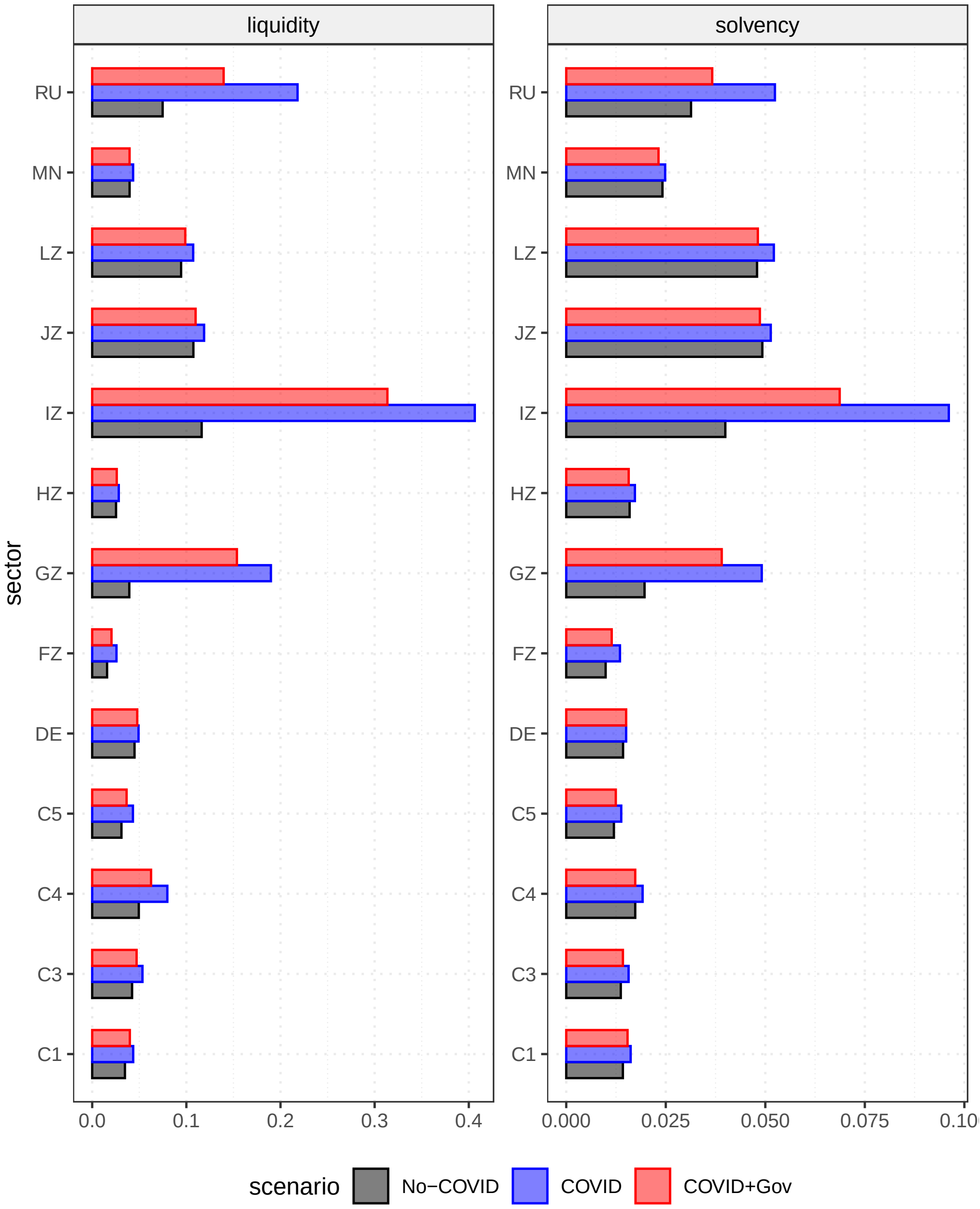
[b] Numbers denote 2-digit ($A88$) sector average.

[c] Firm average ($N = 752,653$).

Cumulative Financial Stress by Sector

Figure A1 presents the share of firms in financial stress, and exhibits substantial cross-sector heterogeneity across the three possible scenarios. The red bars display the estimated rate of firms under the COVID scenario with government support. The dark grey and blue bars display the estimated rate under a No-COVID and a COVID scenario without government support, respectively. The rankings of shares is consistent with our expectation, where the COVID+Gov bars systematically appear median with respect to the other two

Figure A1: Cumulative share of firms being stressed in their liquidity (left panel) and in their solvency (right panel), by aggregate sector



C1: Manufacture of food products, beverages and tobacco products; C3:Manufacture of electrical, computer, electronic equipment & machinery; C4: Manufacture of transport & equipment; C5: Other manufacturing; DE: Electricity, Gas, Steam; FZ: Construction; GZ: Wholesale and retail trade; repair of motor vehicles and motorcycles; HZ: Transportation and storage; IZ: Accommodation and food service activities; JZ: Information and communication; JZ: Financial and insurance activities; MN: Professional, scientific, technical, support service activities; RU: Other services activities.

scenarios. Focusing on the red bars, companies experiencing liquidity problems as of April 2021 under the COVID scenario vary between a minimum of 2% (*Construction*) to a maximum of 31% (hotels and restaurants, i.e. *Accommodation and food service activities*). The two sectors most affected are hotels and restaurants on the one hand and household services (*Other service activities*) on the other hand, the latter featuring almost 14% of illiquid firms. Other sectors (including manufacturing) display rates below 10%. Shifting to solvency problems delivers a very similar classification. *Accommodation, food and household services* are still very affected, with around 7% firms being insolvent firms.

Appendix B. Production function estimations

The methodology used to compute unbiased estimates of the output elasticities with respect to our inputs follows Petrin & Levinsohn (2012) and is related to the use of inputs to control for unobservables in production function estimations, as set out by Olley & Pakes (1996), Levinsohn & Petrin (2003), Ackerberg et al. (2015) and Wooldridge (2009). The basic idea behind this approach is that the estimation of a production function may suffer from endogeneity bias because of a correlation between unobserved productivity shocks and inputs. This issue is solved by including lagged values of specific inputs as proxies for productivity. The methodology employed in this paper starts with a first step reading:

$$q_{it} = g\left(k_{it}, l_{it}, m_{it}\right) + \epsilon_{it}, \tag{B1}$$

where q_{it} is the natural logarithm of output of firm i at yearly time t, and k_{it}, l_{it}, and m_{it} are respectively the natural logarithms of capital, labour in terms of hours worked, and materials used by the firm. In equation (B1), we use a third-order polynomial on all inputs and their interaction terms to obtain estimates of expected output, $\hat{q}_{it}$, and an estimate for ϵ_{it}. This first step is included to net out pure error term, i.e. measurement errors, in the measure of output and productivity (Ackerberg et al. 2015, De Loecker & Warzynski 2012).

Then, we use a general production function of the following type:

$$\hat{q}_{it} = f_s\left(k_{it}, l_{it}, m_{it}, \mathbf{B}\right) + \omega_{it} + \varepsilon_{it} \tag{B2}$$

where our inputs are transformed into the output according to the production function f_s, $\mathbf{B}$ is the parameter vector to be estimated in order to calculate the output elasticities, ω_{it} is the firm-level productivity term that is observable by the firm but not by the econometrician and ε_{it} is an error term that is unobservable to both the firm and the econometrician. Leaving subscripts i and t aside for simplicity, function f_s is assumed to be of a Cobb-Douglas log-form and reads:

$$f_s = \beta_K k + \beta_L l + \beta_M m \tag{B3}$$

Observe that function f_s is allowed to change across two-digit sectors, as implied by the subscript s. Thus, the parameter vector is composed of three parameters for each sector. The sector decomposition is the two digit level (referenced as level $A88$ in the French nomenclature).

Different estimators may be used to estimate the production function in equation (B2). The preferred estimator in this paper is the Wooldridge-Levinsohn-Petrin (WLP) estimator, as derived from Wooldridge (2009) and implemented in Petrin & Levinsohn (2012). The main reason is that it corrects for the simultaneous determination of inputs and unobserved productivity by proxying the latter with firm-level material inputs. Moreover, it does not assume constant returns to scale, it is robust to the Ackerberg et al. (2015) criticism of the Levinsohn & Petrin (2003) estimator and it is programmed as a simple instrumental variable estimator.

We assume that both labour and materials are a variable input with no rigidity in a business as usual (No-COVID) scenario. We instrument current labour and materials with the first and second lags of labour as well as the second lags of capital and materials. In addition, the WLP estimator requires the variables affecting the productivity process to be specified. We assume that productivity is a function of lagged capital and materials. Year fixed effects are also included to take into account time-variant shocks common to all firms. All these additional regressors are not included in the function f_s. Given $\hat{f}_s$, estimated total factor productivity $\hat{\omega}_{it}$ eventually reads:

$$\hat{\omega}_{it} = \hat{q}_{it} - \hat{\beta}_K k_{it} + \hat{\beta}_L l_{it} + \hat{\beta}_M m_{it} \tag{B4}$$

Alternatively, one could use the factor shares in revenues, α_K, α_L and α_M, as proxies for their output elasticities (see e.g. Gourinchas et al. 2021, for such an assumption). The cost would be that of assuming perfect product and factor markets. We choose instead to assume perfect markets away and let the series of output elasticities depart from their respective revenue shares.

Table B1 presents the average revenue shares for labour L and materials M. The estimation sample contains 752,653 firms. The factor shares conform to the usual characteristics that materials represent most of the costs (59% of total sales), whereas labour costs represent on average one-third of total sales (35%). The estimated factor elasticities $\hat{\beta}_M$ and $\hat{\beta}_L$ amount to 0.73 and 0.21, respectively. Overall, firms operate below constant returns to scale, as the sum of factor elasticities $\hat{\lambda} = 0.96$ lies below unity.

Table B1 also reports the estimated output elasticities from a Cobb-Douglas production function by two-digit industry, using the Wooldridge (2009) methodology. There is substantial heterogeneity across industries in the parameter estimates. The average capital elasticity $\hat{\beta}_K$ ranges between 0.001 in *Professional, scientific, technical, support service activities* to 0.07 in *Financial and insurance activities*. The values for $\hat{\beta}_M$ range between 0.60 (*Professional, scientific, technical, support service activities*) and 0.86 (*Wholesale and retail trade; repair of motor vehicles and motorcycles*), $\hat{\beta}_L$ takes values ranging between a minimum of 0.103 (*Wholesale and retail trade; repair of motor vehicles and motorcycles*) and a maximum of 0.39 (*Professional, scientific, technical, support service activities*). Estimated returns to scale $\hat{\lambda}$ are close to unity for most of the sectors, with values ranging between 0.94 (*Other manufacturing*) and 1.03 (*Financial and insurance activities*).

Table B1 also reports mean values of revenue shares. We observe a significant wedge between the output elasticities and the revenue shares. This suggest the presence of market imperfections in the product and factor markets. In turn, these relate to various factors affecting perfect composition such as the presence of entry barriers on the various markets, industry structures, the skill composition of labour, etc. Caselli et al. (2021) provide evidence of imperfect product and labour market imperfections in France based, where they show that product and labour market imperfections can be inferred from the combination of the series of β and α.

Table B1: Estimated output elasticities and revenue shares

Code	Sector name	N	α_K	α_L	α_M	$\hat{\beta}_K$	$\hat{\beta}_L$	$\hat{\beta}_M$	$\hat{\lambda}$
C1	Manufacture of food products, beverages and tobacco products	24,999	0.080	0.355	0.565	0.025	0.189	0.775	0.989
C3	Manufacture of electrical, computer, electronic equipment & machinery	5,562	0.056	0.296	0.648	0.018	0.206	0.773	0.997
C4	Manufacture of transport equipment	1,605	0.047	0.259	0.694	0.018	0.167	0.805	0.990
C5	Other manufacturing	46,022	0.068	0.332	0.600	0.035	0.243	0.706	0.984
DE	Electricity, Gas, Steam	5,118	0.148	0.221	0.631	0.054	0.178	0.755	0.987
FZ	Construction	128,605	0.061	0.346	0.594	0.032	0.208	0.732	0.972
GZ	Wholesale and retail trade; repair of motor vehicles and motorcycles	207,893	0.054	0.187	0.760	0.018	0.116	0.847	0.981
HZ	Transportation and storage	28,992	0.071	0.359	0.570	0.043	0.244	0.681	0.968
IZ	Accommodation and food service activities	94,079	0.078	0.347	0.575	0.030	0.165	0.830	1.025
JZ	Information and communication	24,609	0.017	0.479	0.503	0.027	0.345	0.655	1.026
LZ	Financial and insurance activities	24,322	0.155	0.408	0.437	0.071	0.298	0.664	1.034
MN	Professional, scientific, technical, support service activities	118,218	0.115	0.494	0.391	0.001	0.372	0.608	0.982
RU	Other services activities	42,579	0.069	0.481	0.450	0.019	0.280	0.698	0.997
All	All economy	752,603	0.074	0.338	0.589	0.024	0.217	0.749	0.989

*** N is the number of firms. Source: FARE 2012–2019. Capital shares α_K have been computed assuming constant returns to scales such that $\alpha_K = 1 - \alpha_L - \alpha_M$.

Appendix C. Naive Regression with Sample Selection Issue

A naive ordered-probit regression on the whole sample of firms (Table C1) suggests that AP increases the likelihood of a firm facing financial distress, while lowering the chances of it encountering no difficulties. This could mistakenly been interpreted as indicating that the policy has performed very poorly or, actually, in reverse. What is more, an interaction between the measure of policy support and productivity displays a positive and significant coefficient, which implies that the negative effect of the policy is particularly harmful to productive firms, possibly because by interfering with market selection it is propping up inefficient companies and putting additional competitive pressure on the more productive ones. These results, instead, are the outcome of a large sample selection bias.

Table C1: The determinants of the probability to experience liquidity and solvency stress during the COVID global shutdown.

	(1)	(2)	(3)	(4)
AP/PQ_0	0.806***	0.294***	0.100***	-0.270***
	(0.005)	(0.006)	(0.006)	(0.007)
ω_0		-1.306***	-1.367***	-0.749***
		(0.007)	(0.008)	(0.010)
$AP/PQ_0 \times \omega_0$				0.458***
				(0.005)
FC_0			0.281***	0.340***
			(0.003)	(0.003)
Lev_0			0.163***	0.170***
			(0.002)	(0.002)
PQ_0	0.095***	0.076***	-0.117***	-0.130***
	(0.002)	(0.002)	(0.003)	(0.003)
First cutoff	0.000	-0.417***	0.666***	-0.029
	(0.018)	(0.019)	(0.018)	(0.020)
Second cutoff	0.818***	0.465***	0.666***	0.910***
	(0.018)	(0.019)	(0.019)	(0.020)
$\frac{\partial \Pr}{\partial AP}$ (No issues)	-0.124***	-0.042***	-0.014***	-0.033***
	(0.001)	(0.001)	(0.001)	(0.001)
$\frac{\partial \Pr}{\partial AP}$ (Liquidity issues)	0.083***	0.029***	0.095***	0.025***
	(0.001)	(0.001)	(0.001)	(0.001)
$\frac{\partial \Pr}{\partial AP}$ (Solvency issues)	0.041***	0.014***	0.004***	0.008***
	(0.000)	(0.000)	(0.000)	(0.000)
Observations	752,603	752,603	752,603	752,603
LL	-257,009	-240,253	-232,736	-228,259
LR	93,191	126,702	141,736	150,691
Pseudo R-squared	0.153	0.209	0.223	0.248

Ordered probit model estimated by maximum likelihood methods. Outcome variable $Y = 1$ if the firm has neither liquidity nor solvency issues. Outcome variable $Y = 2$ if the firm has liquidity issues. Outcome variable $Y = 3$ if the firm has solvency issues. *** p<0.01, ** p<0.05, * p<0.1. AP/PQ_0: estimated perceived amount of Activité Partielle, relative to sales in January 2020; ω_0: estimated level of Total factor Productivity in January 2020; FC_0: Fixed cost defined as monthly corporate taxes plus payment of principal and interest in January 2020; Lev_0 Leverage, initial level of debts to suppliers and other third party, relative to equity; PQ_0: monthly level of sales in January 2020. All explanatory variables are entered in natural logs. Outcome = 1 if firms has neither liquidity nor solvency issues.

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