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What Types of Firms Become Illiquid as a Result of COVID-19? A Firm-Level Perspective Using French Data

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The analysis uses information available until the end of May 2020 when the manuscript was initially completed. During the review process the contextual information have been updated to reflect the situation until October 2020 before the measures adopted in France in the wake of the second wave of COVID-19.

The choice to illustrate the analysis using French firms is based on data availability. Consequently, the comparison to the situation in other EU countries is outside the scope of this analysis.

Authorised for publication by Massimo Suardi, Director for the Economies of the Member States III.

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A Firm-Level Perspective Using French Data

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Abstract

This analysis uses the most recent cross-section of financial statements of French companies from the ORBIS database only as an illustration in order to evaluate their capacity to cushion the COVID-19 shock on sales through previously accumulated cash reserves, operational flexibility and policy intervention. This paper has two main objectives. The first one being to investigate the extent to which the ability to cushion the economic shock is linked to specific company characteristics. The second objective is to evaluate how variation in the parameterisation of the economic shock, i.e. policy intervention and duration of the economic shock, affects the likelihood that specific types of companies become illiquid.

We find evidence that both more productive companies and firms with a higher solvency ratio (profits/liabilities) are less likely to become illiquid. This result is robust to the parameterisation of the economic shock. Policy intervention, modelled as additional operational flexibility, alleviates the risk of facing a liquidity shortfall across the board, but does not eliminate it. Finally, using sectoral data from Eurostat, this analysis connects the risk of liquidity shortfalls to specific characteristics of the labour force, finding that the relatively vulnerable sectors are those that rely the most on labour, and whose workforce is relatively young and low-skilled.

JEL Classification: C25, C54, D22, D24, G30.

Keywords: Firms, COVID-19, France, illiquidity, probit, productivity, solvency.

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1. INTRODUCTION

The strict containment measures adopted by countries around the world to limit the spread of COVID-19 are having a significant impact on our daily lives. As a result, studying how such a systemic shock affects members of the same group in a different way is important in many disciplines. According to the World Health Organization (WHO), older people and those with pre-existing medical conditions seem to develop severe symptoms with a higher probability than other individuals infected with the virus.[1] While scientists are investigating which characteristics make individuals and regions more affected by the virus, economists need to focus on what types of firms are particularly vulnerable to the COVID-19 crisis. In this respect, Bloom et al. (2018) argue that the health risks of outbreaks and epidemics relate to various non-trivial economic risks that are not distributed equally throughout the economy. This is in line with the observation that the pandemic and the lockdown measures have translated into a sharp drop in turnover, especially for some firms, which may still have to honour financial commitments, such as orders to suppliers, rents, taxes or labour costs. These short-term negative shocks have generated negative cash flows for a large number of firms, exhausting in some cases their liquidity stocks. As some may not be able to meet their short-term obligations, a significant increase of firm insolvencies may occur, resulting in long-term effects on employment, investment, growth and prosperity.

Banks in principle should supply the necessary credit to firms that were profitable before the crisis. However, the previous financial crisis shows that policymakers should act to avoid that a temporary economic shock results in a liquidity crisis with economic damage in the medium and long term. This is particularly important given that access to credit lines is uneven across firms (BIS, 2020). For this purpose, governments have enacted measures that aim to support the liquidity of firms with the objective to facilitate the economic recovery once the pandemic is under control. Around the world, these policies, while different in detail (types of firms targeted, generosity, size, etc.), largely rely on short-term working arrangements, loan guarantees, moratoriums on debt and taxes, and subsidies.[2] In this paper, we focus on the case of France given that sectors such as tourism or aeronautics, which are particularly affected by the pandemic, represent an important share of the French GDP.[3] In response to the crisis, the French authorities took a comprehensive set of measures to support the economy, targeting both households and firms. Among others, policies which support firms include a short-time work scheme (*chômage partiel*), deferral of taxes and social security contributions, a state-guarantee scheme and other financial instruments. Despite the package of support measures, the government still expects bankruptcies in the coming months, as the support measures are gradually withdrawn.[4] According to COFACE, the number of defaults is expected to increase by 21% in France by the end of 2021 compared to 2019.[5]

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[1] See https://www.who.int/emergencies/diseases/novel-coronavirus-2019/question-and-answers-hub/q-a-detail/q-a-on-on-covid-19-for-older-people for more details.

[2] See https://www.oecd.org/coronavirus/country-policy-tracker/ for more details.

[3] As the COVID-19 crisis is ongoing, we will use information available until the end of May 2020, when the manuscript was initially completed, to simulate the economic shock. Nevertheless, we forecast several scenarios for the remaining months of 2020, thereby covering the possible implications of the second wave in the second semester of 2020.

[4] See https://www.lefigaro.fr/conjoncture/oui-il-y-aura-des-faillites-et-des-licenciements-previent-le-maire-20200522 for more details.

[5] See https://www.coface.com/fr/Actualites-Publications/Actualites/Defaillances-d-entreprises-en-Europe-les-amendements-des-procedures-juridiques-repoussent-temporairement-l-echeance for more details.

A good understanding of the type of firms that are particularly vulnerable to the COVID-19 crisis is then important for policymakers in order to avoid the negative consequences of policy inaction. For instance, while providing untargeted credit to firms may avoid insolvencies in the short-term, facilitating credit for firms already experiencing financial difficulties could artificially keep them operating, without reducing their vulnerability in the future and hence, increasing risks for the credit provider. Indeed, Caballero and Hammour (1994) argue that economic crises have a "cleansing effect", as the exit of inefficient firms makes more resources and capital available to the efficient ones. At the same time, a drop in demand combined with increased credit constraints can affect efficient firms negatively. They may exit the market while being viable in the medium and long term, but even if they were to survive, they may decrease their investment capacity. This could lead to a vicious circle, with reductions on production capacities affecting employment, income and consumption, which in turn affects investment (Bénassy-Quéré, 2020).[6] Consequently, efficient support policies should be designed in order to make sure that companies kept afloat are able to recover relatively quickly, alleviating the severity and duration of the economic crisis, as well as ensuring the stability of the financial sector.

This paper has two main objectives, the first one is to investigate the extent to which the ability to cushion the economic shock is linked to specific firm characteristics. The second objective is to evaluate how variations in the parameterisation of the economic shock, i.e. policy intervention and duration of the shock, affect the likelihood that specific types of firms become illiquid. For this purpose, we use the most recent cross-section financial statements of companies based in France, using the ORBIS database. Similarly to the deterministic approach used by Schivardi and Romano (2020), we evaluate the ability of firms to cushion the COVID-19 shock on sales through previously accumulated cash reserves, operational flexibility, and policy intervention. Throughout this paper, we define vulnerable or financial distressed non-financial corporations as those firms whose cash stock turns negative. In other words, we categorise those firms as illiquid since we assume that they cannot honour their short-term financial commitments in a specific period, which is different from insolvency. While Schivardi and Romano (2020) mainly focus on potential financial needs and unconditional probabilities, we explore firms' vulnerabilities to the COVID-19 crisis using conditional probabilities. We complement this approach to allow for different scenarios of policy intervention. We also analyse the extent to which the effect of firm characteristics is sensitive to the parameterisation of the economic shock, in terms of duration and magnitude. Specifically, we use data on sectoral shocks as published by the French authorities on April 2020 and we forecast several scenarios for the remaining months of 2020, thereby potentially covering the implications of the ongoing second wave.[7]

In terms of policy intervention, we evaluate the effect of some measures adopted by the French authorities to reduce firm costs, focusing on the schemes that apply to all firms. In this regard, and in line with the approach adopted by OECD (2020), we illustrate the short-term work scheme (*chômage partiel*) by increasing the elasticity of labour costs to a decrease in sales. We also examine additional measures to protect the liquidity of firms, notably the introduction of deferrals of taxes and interest payments on loans. This last policy results from a non-legally binding agreement with the banking

[6] The need to support investment is recognised in the EUR 100 billion recovery plan put forward by the French government in early September. It gives new opportunities to small and medium-sized companies to refloat their equity and quasi-equity capital, through a new "*recovery*" (*Relance*) label with access to public equity guarantee and quasi-equity loans by banks.

[7] As economic data becomes available, sectoral data capturing the monthly evolution of turnover can be used instead to parametrise the actual shock on the various economic sectors.

sector.[8] In terms of the duration of the crisis, we evaluate the extent to which the type of firm that is affected varies with a longer duration of the economic shock. Finally, using sectoral data from Eurostat, this analysis connects the risk of liquidity shortfalls to specific characteristics of the labour force, finding that the relatively vulnerable sectors are those that rely the most on labour, and whose workforce is relatively young and low-skilled.

Summary of the main findings:

- Firms identified as facing financial distress are operating in the sectors most affected by the lockdown measures, are relatively young and big, relatively unproductive and characterised by relatively lower solvency ratios. This is evidence that relatively less productive and solvent firms are likely to experience financial difficulties first.

- Policies targeting all firms, i.e. short-time work scheme and deferrals of taxes and interest paid, reduce the probability of illiquidity by an average of 5.4 percentage points across different firm characteristics. This decrease is uniform across different firm characteristics, from solvent firms (20.3% to 15.5%) to large-sized businesses (55.6% to 48.9%). However, the risk is still significant and justifies other policies aiming at supporting the liquidity of firms, e.g. the EUR 300 billion French loan guarantee fund.

- As for the timing of the potential illiquidity problems, we find that on average, firms in the most affected sectors become at risk of illiquidity at an earlier stage. This underlines the necessity of a targeted action from the government. In an illustration of the second wave of COVID-19, liquidity risks extend to more productive and solvent firms, potentially representing an important obstacle for the economic recovery.

- The most affected sectors are those that rely the most on labour. Moreover, their workforce is relatively young and low-skilled. This suggests that the most economically disadvantaged groups of the French population could suffer disproportionally more from the economic shock originated from the COVID-19 outbreak.[9]

- Given the vulnerabilities identified in this paper, the targeted and general actions taken by the French government seem to match well the characteristics of the firms most likely to require liquidity support.

[8] While the French government did not impose any moratorium on corporate loan repayments, financial institutions have collectively agreed to follow the government's call to support companies with slumped sales.

[9] Instead of presenting the various results using sectors, results could be presented using industrial ecosystems. The notion of ecosystems captures the complex set of interlinkages and interdependencies among sectors and firms.

2. METHODOLOGY AND DATA

This analysis uses a reduced-form framework to evaluate the capacity of firms to alleviate the COVID-19 shock on sales through operational flexibility, previously accumulated cash reserves and policy intervention. For this purpose, we build on the analysis laid out by Schivardi and Romano (2020),[10] who analysed financial statements of Italian firms in order to estimate the number of firms whose liquidity stock turned negative since the start of the COVID-19 crisis. Drawing on their exercise, it enables us to identify the type of firms most affected by the COVID-19 crisis in France and to illustrate how different policy measures affect the firms' likelihood of becoming illiquid.

To that end, we have analysed the financial statements of 551,544 unconsolidated companies in France using the ORBIS database,[11] covering around 24.1% of the 2,290,990 firms in France (agriculture, financial services and self-employment excluded) as of 2017 (INSEE, 2020c).[12] Given that the time of data reporting is not homogeneous across firms, we use firm information from the most recent available year, which ranges from 2015 to 2019.[13] The variables used in this analysis to identify the firms facing liquidity risk are: (1) liquidity stock,[14] (2) turnover,[15] and firms' costs, including (3) taxation, (4) other operating expenses,[16] (5) material costs, (6) the cost of employees, and (7) interest paid. Using these variables, a firm is classified as vulnerable or financial distressed when the liquidity stock becomes negative, i.e. when it becomes illiquid. However, such a firm is not necessarily insolvent, as short-term financing may still be possible. Throughout this paper, we will use interchangeably the words "illiquid", "vulnerable" or "financial distressed". Indeed, a firm in France is considered insolvent only when the available assets have decreased to less than the liabilities due,[17] which is interpreted as having negative equity (Guerini et al., 2020). Given that the European Commission (2020) finds smaller needs using the firms' equity, our paper can be considered on the higher side of the range of estimates.

The classification of firms relies on several steps, starting from the baseline equation:

$$Cashflow_{it} = revenue_{it} - costs_{it} = \Delta liquidity_{it} - \Delta debt_{it}$$

[10] The approach used in this paper is also close to the analysis proposed by De Vito and Gomez (2020).

[11] The ORBIS database by Bureau van Dijk (BvD) is a comprehensive firm-level database that contains comparable financial and business information covering more than 100 countries, including EU Member States. More information can be found on their website, https://www.bvdinfo.com.

[12] As other countries are available in the ORBIS database, the exercise can be replicated to check whether the results are consistent across countries.

[13] Implicitly, we assume that on aggregate, companies would have similar liquidity needs in their latest available year as they would have in 2019. In this analysis, we assume that the liquidity needs in both years are comparable: the proportion of illiquid firms is similar when we only consider each year of data in isolation.

[14] We also assume that the liquidity of a company at the beginning of the lockdown is that of their latest available financial statement. Liquidity stocks are obtained as "Cash or cash equivalent".

[15] Turnover includes sales and other income.

[16] Other operating expenses are approximated as Turnover – EBIT – material costs – staff costs.

[17] French Code de commerce, art. L. 631-1. There are proceedings available when firms are solvent but face difficulties (ad hoc mediation, conciliation, safeguard). However, in 2018, receiverships and liquidations, opened to insolvent debtors, represented 90.8% of the applications for pre-insolvency and insolvency proceedings.

where i is the firm and t the month, Δ indicates the variation between t and $t-1$, and $costs_{it}$ include other operating expenses, material costs, personnel expenses, taxation and interest paid. In this exercise, government policies influence the operational flexibility of costs incurred by the firms such as labour costs, taxes and interest paid. We also assume that firms can postpone the payment of the principal of the loan. Therefore, the baseline equation that gives the evolution of the liquidity stock is as follows:

$$liquidity_{it} = liquidity_{it-1} + revenue_{it} - costs_{it}$$

The monthly revenue for a firm i is given by $S_{it} = (1 - d_{st})S_i/12$, where d_{st} is the percentage fall in revenue expected in its core sector s, as obtained by INSEE (2020a and 2020b), and S_i captures the total yearly revenue. As for costs, we assume that material costs (M) have an elasticity of $\varepsilon_M = 0.9$ with respect to revenue,[18] meaning that if sales fall by 10%, expenditure in intermediates falls by 9%. This is justified by the idea that suppliers have also suffered from the lockdown, making the use of intermediate inputs move closer with the fall in sales. Other operating expenses (O) are arguably not as adjustable in terms of changes in sales, given that they include fixed costs such as rents. For this reason, we assume an elasticity of $\varepsilon_O = 0.1$ with respect to sales, which reflects that some types of costs (e.g. utilities) within the other operating expenses category can be adjusted during the lockdown.

Finally, the elasticity of personnel costs (W) with respect to sales used in this analysis varies depending on whether we consider government policies or not. Using firm-level data for the EU, Konings and Murphy (2006) find that sectoral employment elasticities range between 0.33 and 0.72. In line with the approach adopted by OECD (2020), we use the lower limit elasticity to calibrate a hypothetical scenario of a lack of government intervention and the upper limit to illustrate the measures introduced as a result of the COVID-19 crisis. We argue that using a relatively high adjustment of labour costs to sales for firms in France during the COVID-19 crisis illustrates the short-term unemployment scheme put into place (*chômage partiel*). This scheme encourages firms to keep their employees during the crisis instead of dismissing them. Under the French scheme, firms pay 70% of the gross monthly salary (equivalent to around 84% of the net salary), which is completely reimbursed[19] within 10 days by the State, up to a ceiling of EUR 6,927 (gross) per month. This is an important measure given that, as of 25 May 2020, 12.9 million employees - more than half of the workforce in the private sector - in 1,040,000 firms have benefited from the scheme since the beginning of the COVID-19 crisis.

We include interest paid (I) and taxation (T) depending on whether we assume government policies.[20] Consequently, the equation then becomes:

$$liquidity_{it} = liquidity_{it-1} + \frac{(1 - d_{st})S_i}{12} - \left(\sum_X \frac{(1 - \varepsilon_X d_{st})X_i}{12}\right) - g\left(\frac{I}{12} + \frac{T}{12}\right)$$

[18] Schivardi (2020) finds elasticities of $\varepsilon_M = 0.9$ in pre-crisis times by regressing the percentage change in intermediate expenditure on the percentage change in turnover.

[19] The French government has begun phasing out the scheme: since 1 June 2020, it only reimburses 60% of the gross monthly salary except in the most affected industries, with the remaining paid by the employer.

[20] While we acknowledge that some of these costs may be incurred by the firm as quarterly payments, this exercise assumes that they are incurred on a monthly basis.

$$where\ X = M, W, O\ and\ g \in \{0,1\}$$

From this last equation, we can calculate the monthly evolution of each firm's liquidity stock, allowing for some extra operational flexibility on the firms' costs when government intervention is considered. In this regard, we assume that the firm needs some sort of extra liquidity support once the liquidity stock becomes negative.

All our scenarios assume that the lockdown ends after eight weeks, independently of the different policy actions considered. Contrary to De Vito and Gomez (2020), who use distress scenarios corresponding to a drop in sales of 50% and 75%, but similarly to Schivardi and Romano (2020) in the case of Italy, we use specific French estimates of the sectoral economic impact during the lockdown period from INSEE (2020a).[21] Since the economy gradually reopened after the first wave, we assume a first scenario, "*Scenario 1*",[22] where the effect of the sectoral economic shock decreased following the post-lockdown estimates by INSEE (2020b) until the end of June. The exception is the hospitality industry,[23] for which we assume 75% of the shock, post-lockdown. Then, we assume that sales return to pre-crisis levels in all sectors, except for the hospitality sector, which suffers from 50% of the lockdown shock in July and 25% in August. This is justified by the observation that restaurants and bars only reopened on 2 June following the first wave, and only partially in some areas,[24] with strict social distancing and hygiene requirements. This is also consistent with the observation that large gatherings (more than 5,000 people) such as festivals or sport events remained forbidden then.[25] However, as the evolution of the economic recovery is still highly uncertain, we also use a second scenario "*Scenario 2*". This evaluates the evolution of each firm's liquidity assuming that the post-lockdown drop in economic activity estimated by INSEE (2020b) will continue until the end of 2020. In the case of the hospitality industry, we assume that 75% of the shock lasts until the end of 2020.[26]

Figure 1 shows the cumulative potential number (in 1000s) of French firms facing liquidity problems until December 2020 under *Scenario 1* (in yellow) and *Scenario 2* (in blue) without any government policies. On the other hand, Figure 2 contains the same information but taking into account policy measures aiming at reducing the costs of French firms. Figure 1 and Figure 2 show a concave curve where most firms become illiquid very quickly, some have enough cash reserves to survive a few months, whereas others have at least until the end of 2020. As previously mentioned, it must however be noted that this is not a potential timeline of insolvencies, as their materialisation depends on many factors, such as the presence of negative equity. Moreover, in response to the crisis, the French government lifted the obligation to open insolvency proceedings within 45 days of it happening until 24 August 2020, in line with several other European countries (Coface, 2020). As a result, the number of

[21] Estimates are obtained from the Point de conjoncture (INSEE) published on 9 April 2020.

[22] As of 31 October, "Scenario 1" can be seen as an optimistic scenario that did not materialise given the ongoing second wave of COVID-19.

[23] The hospitality sector is defined here as the "accommodation and food service activities" sector here, as we do not have or cannot differentiate data on sectors such as entertainment and tourism.

[24] For instance, as of the end of August, restaurants in French Guiana cannot reopen without outdoor seating.

[25] Such gatherings are forbidden since 30 October due to the second wave of COVID-19.

[26] While "Scenario 2" is slightly more pessimistic than "Scenario 1", it does not take into consideration the materialisation of the second wave of COVID-19. Despite using a slightly more optimistic economic scenario, we do not expect the main conclusion of the paper to differ.

insolvencies paradoxically decreased in March and April 2020 compared to the previous year (Banque de France, 2020).

Figure 1: **Number of illiquid French firms, 2020 (no policies, ORBIS sample)**

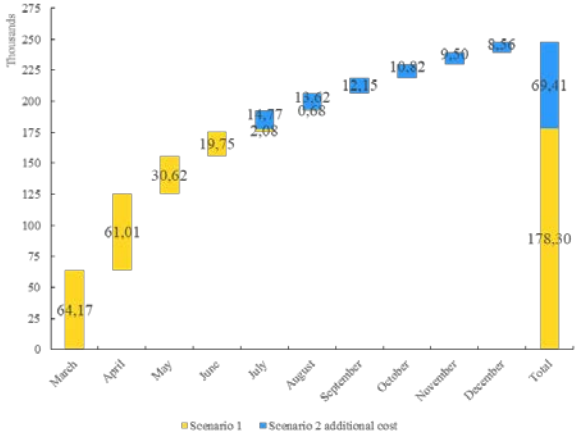
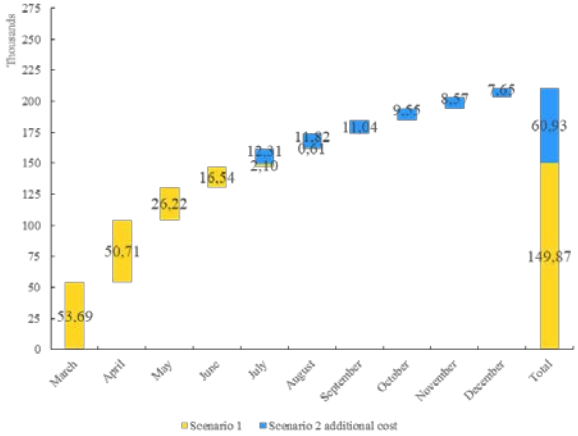


Figure 2: **Number of illiquid French firms, 2020 (All policies, ORBIS sample)**



Note: For the months of July and August in Scenario 1, only the hospitality sector is considered.

In order to quantify the impact of specific firm characteristics on the firms' probability to become illiquid, we use different firm variables from the firms' financial statements. Table 1 shows descriptive statistics for the firm variables used in this analysis. It is important to highlight that firm characteristics used in this analysis intend to control for the characteristics of firms prior to the COVID-19 crisis.

In this regard, we control for the pre-shock solvency ratio, defined as the net income after tax plus depreciation over total liabilities. Firms with negative liquidity stocks that require external financing to meet their short-term obligations will increase their total liabilities as a result, negatively affecting their solvency ratio. Consequently, if firms that require external finance are more likely to be those already experiencing low solvency ratios before the COVID-19 crisis, the risk of insolvencies in the medium and long-term increases significantly, potentially slowing down the economic recovery and affecting the medium and long term investment capacity. We test other firm characteristics such as the firm size, the age of the firm, the GDP of the region where firms are located, labour productivity and a measure of potential financial distress prior to the COVID-19 crisis.[27] Table 4 in Annex I provides descriptive statistics at a sectoral level. The firm characteristics affected by the pandemic are broadly consistent across sectors, except for sectors affected relatively less, i.e.. real-estate services, and sectors with a very small sample of firms, i.e. manufacture of coke and refined petroleum products.

[27] A firm is classified as financially distressed if it records negative profits (EBIT) in the latest available year and it is at least 10 years old. As we only have one financial statement by firm, we acknowledge that the latest available year may not be representative for a given firm, but we assume that on aggregate, it gives a good indication of the financial distress of firms.

Table 1: **Summary statistics (Firm characteristics prior to the COVID-19 crisis)**

Variable	Mean	Median	Standard Deviation	Observations
Sectors				
Accommodation and food service activities	.	.	.	56,035
Business services	.	.	.	104,520
Manufacture of capital goods	.	.	.	5,373
Construction	.	.	.	87,502
Energy, water, waste	.	.	.	8,657
Food industry	.	.	.	13,821
Information and communication	.	.	.	26,770
Manufacture of coke and refined petroleum products	.	.	.	28
Manufacture of transport equipment	.	.	.	1,496
Other manufacturing	.	.	.	36,254
Real estate services	.	.	.	36,878
Trade	.	.	.	152,471
Transportation	.	.	.	21,739
Solvency ratio[28]				
Between 0 and 0.1	0.052	0.052	0.028	129,742
Between 0.1 and 0.2	0.147	0.145	0.029	106,463
More than 0.2	1.639	0.406	177.376	223,128
Negative	-0.807	-0.135	23.447	92,211
Estimated business size				
0 to 49	5.197	2	8.299	528,943
50 to 249	104.649	87	50.778	18,098
More than 250	1,131.14	459	4,898.211	4,503
Age				
Less than 5 years old	2.745	3	1.535	153,630
Between 5 and 10 years old	7.904	8	1.409	114,073
Between 10 and 20 years old	14.843	14	2.859	136,982
More than 20 years old	33.385	29	12.05	146,858
Regional GDP				
Below national average	.	.	.	112,998
Above national average	.	.	.	438,546
Labour productivity (turnover per employee)[29]				
Low (bottom 20%)	100,025.9	106,962	30,419.66	114,679
Middle (between 20th and 60th percentiles)	257,890.1	252,936	60,881.97	212,837
High (top 40%)	800,425.2	594,566	4,804,675	224,017
Negative	-210,348	-92,652	432,648.2	11
Financial distress				
No	.	.	.	472,559
Yes	.	.	.	78,985

[28] Firms with insufficient information to compute the solvency ratio are ignored in the analysis.

[29] For the firms that do not share their number of employees, labour productivity is estimated using the average number of employees in its sector.

3. EMPIRICAL STRATEGY

As previously mentioned, this paper has two main objectives, the first one is to investigate the extent to which the ability to cushion the economic shock is linked to specific firm characteristics. The second objective being to evaluate how a variation in the parameterisation of the economic shock, i.e. policy intervention and duration, affects the likelihood that specific types of firms become illiquid. For the first objective and the analysis of policy intervention, we will use a probit model, given that the liquidity status of firms is treated as a limited dependent variable:

$$P(y_i = 1|\boldsymbol{X_i}) = \Phi(\beta \boldsymbol{X_i})$$

where Φ represents the standard normal cumulative distribution function and $\boldsymbol{X}$ denotes the vector of firm variables we condition on, as described above. Using the *Scenario 1* described in the previous section, probit models are estimated using different types of government intervention. In this respect, the sign and statistical significance effect of each coefficient in each probit allows to identify which type of firms are more likely to be affected by the COVID-19 crisis. As part of our second objective, in order to evaluate how different policy measures affect the probability that a type of firm becomes illiquid, we are going to use the observed changes in the predicted probabilities.

In order to evaluate the variation in the duration of the economic shock, as part of our second objective, we are going to use information from *Scenario 2*. This scenario evaluates the evolution of each firm's liquidity, assuming that the economic effect from the lockdown, as reported by INSEE (2020b), will continue until the end of the 2020. This hypothetical scenario can be used as an illustration to study whether relatively stronger firms, in terms of productivity and solvency ratios, are affected as the duration of the crisis continues. Our main hypothesis is that the COVID-19 crisis affects relatively weaker firms in terms of productivity and solvency ratios at an earlier stage. For this purpose, we use an ordered probit model, which considers the discrete (i.e. the specific period in which the firm becomes illiquid) and the ordinal nature as to when the firms' liquidity turns negative.[30] We see the evolution of the liquidity stock of firms as a continuous 3-period process, where the different periods are: (1) Lockdown (until the end of May)[31] (2) Post-Lockdown (May until December) and (3) firms remaining liquid at the end of 2020. This is translated into an ordered dependent variable y_i, which, in our analysis, is indexed as 0 if the firm becomes illiquid in the first period, 1 if the firm becomes illiquid in the second period and 2 if the firm remains liquid at the end of the year.

From the assumption that in an ordered probit model the error term follows a standard normal cumulative distribution function, we obtain the probability of observing a firm becoming illiquid in each of the considered periods:

$$P(y_i = 0) = \Phi\big(\tau_0 - (\beta \boldsymbol{X_i})\big)$$

[30] While the use of an ordered probit is justified by the idea that the time when firms face liquidity problems has a natural ordering, multinomial models have been used as a robustness check and the results are still consistent.

[31] We extend the "lockdown" period to the end of May, as the hospitality sector was closed until 2 June, and some parts of France were then defined as "red" zones without a significant lifting of restrictions. This also corresponds to the second phase of the reopening of the country following the first wave.

$$P(y_i = 1) = \Phi\big(\tau_1 - (\beta \boldsymbol{X_i})\big) - \Phi\big(\tau_0 - (\beta \boldsymbol{X_i})\big)$$
$$(y_i = 2) = 1 - \Phi\big((\beta \boldsymbol{X_i})\big)$$

where Φ represents the standard normal cumulative distribution function, $\boldsymbol{X}$ denotes the vector of firm variables we condition on. β and τ capture the boundary values between the different groups and are estimated using the maximum likelihood estimation subject to the constraint that $\tau_0 < \tau_1$.

4. RESULTS

4.1 DIFFERENCE BETWEEN LIQUID AND ILLIQUID FIRMS

In our sample of around 560,000 firms, we observe around 178,300 and 149,900 firms facing potential liquidity risks under *Scenario 1* with and without policy intervention respectively. What are the differences between those firms that have the capacity to cushion the COVID-19 shock compared to those that do not? To answer this question, we investigate the extent to which the ability to overcome the economic shock is linked to specific pre-pandemic firm characteristics, and whether this is consistent across different policy scenarios. Table 2 presents the conditional coefficients for the probit model. Each column represents a different policy environment, with Column (1) estimating the probit model assuming a hypothetical scenario without government measures alleviating the economic costs during the pandemic. Column (2) assumes the introduction of government measures, allowing a higher adjustment of labour cost for firms facing a decrease in sales, as well as complete deferrals on taxes and interest payments. Columns (3) and (4) repeat the same exercise but this time distinguishing between the two government measures. *Scenario 1* is used in order to obtain our dependent variable, i.e. a binary measure equal to 1 if the firm becomes illiquid by the end of August and 0 otherwise. Consequently, a positive (negative) coefficient in an explanatory variable shows that the change in the probability that a firm becomes illiquid moves in the same (opposite) direction as the variable. As a result, in our probit model, increasing one of the regressors, while keeping the other explanatory variables constant at their means, is equivalent to shifting upwards the probability of firms becoming illiquid. Comparing each of the coefficients allows us to rank the different firm characteristics from least to most likely to become illiquid.

In each of the four columns of Table 2, we observe that the sign and statistical significance level of each coefficient do not change across the different policy scenarios. Starting from the coefficients of the sector variable in the table, we observe that these are negative. This means that the average firm in the hospitality sector is more likely to become illiquid than in any other sector. The largest negative coefficient relative to the hospitality sector is observed in the real estate industry, indicating that firms in this sector have the lowest liquidity risk in our analysis. This result is largely driven by lockdown and post-lockdown estimates of the sectoral impact in the COVID-19 crisis from INSEE (2020a and 2020b), which indeed find that real estate services and the hospitality sector are the least and most affected sectors respectively.

Table 2: **Differences between liquid and illiquid firms under different policy scenarios (probit method)**

VARIABLES	(1) No policies	(2) All policies	(3) Only higher labour costs adjustment	(4) Only tax and interest deferrals
Sectors (ref: Accommodation and food service activities)				
Business services	-1.520***	-1.497***	-1.515***	-1.501***
	(0.00853)	(0.00875)	(0.00869)	(0.00856)
Manufacture of capital goods	-0.668***	-0.630***	-0.660***	-0.634***
	(0.0194)	(0.0197)	(0.0196)	(0.0195)
Construction	-0.550***	-0.519***	-0.550***	-0.518***
	(0.00813)	(0.00811)	(0.00810)	(0.00813)
Energy, water, waste	-1.604***	-1.521***	-1.510***	-1.611***
	(0.0201)	(0.0213)	(0.0206)	(0.0207)
Food industry	-1.856***	-1.718***	-1.720***	-1.851***
	(0.0169)	(0.0176)	(0.0172)	(0.0172)
Information and communication	-1.559***	-1.462***	-1.503***	-1.514***
	(0.0124)	(0.0129)	(0.0128)	(0.0125)
Manufacture of coke and refined petroleum products	-0.623**	-0.702***	-0.674***	-0.756***
	(0.244)	(0.246)	(0.246)	(0.245)
Manufacture of transport equipment	-0.290***	-0.228***	-0.273***	-0.242***
	(0.0350)	(0.0348)	(0.0347)	(0.0350)
Other manufacturing	-0.820***	-0.760***	-0.783***	-0.796***
	(0.0100)	(0.0101)	(0.0101)	(0.0100)
Real estate services	-2.429***	-2.452***	-2.281***	-2.600***
	(0.0156)	(0.0181)	(0.0157)	(0.0180)
Trade	-0.721***	-0.681***	-0.690***	-0.710***
	(0.00824)	(0.00825)	(0.00822)	(0.00824)
Transportation	-0.892***	-0.784***	-0.819***	-0.857***
	(0.0114)	(0.0115)	(0.0115)	(0.0114)
Solvency ratio (ref: Between 0 and 0.1)				
Between 0.1 and 0.2	-0.258***	-0.288***	-0.280***	-0.270***
	(0.00575)	(0.00587)	(0.00582)	(0.00578)
More than 0.2	-0.745***	-0.785***	-0.756***	-0.771***
	(0.00518)	(0.00537)	(0.00529)	(0.00524)
Negative	0.164***	0.183***	0.186***	0.158***
	(0.00638)	(0.00644)	(0.00639)	(0.00642)
Business size (ref: Between 0 and 49)				
Between 50 and 249	0.504***	0.484***	0.501***	0.490***
	(0.0104)	(0.0104)	(0.0104)	(0.0104)
More than 250	0.785***	0.759***	0.784***	0.768***
	(0.0203)	(0.0202)	(0.0201)	(0.0203)
Age class of the firm (ref: Less than 5 years)				
Between 5 and 10 years	-0.00126	-0.0176***	-0.0137**	-0.00358
	(0.00570)	(0.00588)	(0.00581)	(0.00575)
Between 10 and 20 years	-0.0662***	-0.0852***	-0.0801***	-0.0686***
	(0.00576)	(0.00597)	(0.00590)	(0.00582)
More than 20 years	-0.103***	-0.108***	-0.106***	-0.105***
	(0.00579)	(0.00600)	(0.00592)	(0.00585)
Regional GDP (ref: Below national average)				
Above national average	-0.0426***	-0.0333***	-0.0328***	-0.0424***
	(0.00475)	(0.00490)	(0.00485)	(0.00480)
Labour productivity (ref: Low – Bottom 20%)				
Middle (Between 20th and 60th percentiles)	-0.119***	-0.0881***	-0.0750***	-0.132***
	(0.00592)	(0.00610)	(0.00606)	(0.00595)
High (Top 40%)	-0.423***	-0.376***	-0.344***	-0.454***
	(0.00639)	(0.00660)	(0.00653)	(0.00644)
Negative	-0.200	-0.0163	-0.0142	-0.204
	(0.386)	(0.386)	(0.386)	(0.386)
Potential financial distress (ref: No)				
Yes	0.148***	0.178***	0.158***	0.164***
	(0.00662)	(0.00673)	(0.00667)	(0.00667)
Constant	0.962***	0.721***	0.746***	0.939***
	(0.00840)	(0.00836)	(0.00832)	(0.00842)
Observations	551,544	551,544	551,544	551,544

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Apart from the sectoral activity of the firm, we include other firm characteristics as categorical variables to facilitate the exposition of results. In this respect, firms with a good solvency ratio, defined as greater than 0.2, face lower risk of illiquidity and we observe that bigger firms are more at risk of illiquidity, despite most of the firms at risk being small-sized. Given that there are 528,943 firms with less than 50 employees in our sample and that, depending on the policy scenario, 139,436 to 166,352 of them would face liquidity risk by the end of August, most of the firms that remain liquid are also small-sized. In other words, once a large enterprise becomes illiquid, given the low number of such firms, the proportion of large-sized firms is comparatively higher. Moreover, large firms may have disproportionally smaller liquidity buffers, as they can rely more easily on external finance. In addition, as one could expect, poorer regions may be more affected, as their firms are more likely to become illiquid, which may aggravate existing regional disparities.[32] Furthermore, a relatively higher labour productivity decreases the likelihood that a firm becomes illiquid. Using this finding, as a result of the pandemic, we may see a productivity increase in the aggregate economy, as less productive firms might be more likely to exit. Finally, we observe that firms that are not profitable, and therefore are classified as facing financial distress, are more likely to become illiquid during the COVID-19 crisis.

While the sign of the coefficients are informative, we complement this information by taking the predicted probability for a firm to become illiquid for each variable and category. To control for other explanatory firm variables, we use the Average Adjusted Predictions (AAPs). This approach allows comparing different hypothetical samples of firms when considering the role of a specific firm characteristic. For example, we could compare two hypothetical samples of firms, i.e. one with all firms with low productivity and one with all firms with high productivity, which have the exact same values on the other independent variables in the model. Since the only difference between these two samples is their productivity, we argue that this is the cause of the differences in their likelihood of facing liquidity problems. This approach uses all the data and not just the means, which consequently leads to superior estimates than alternative approaches.[33]

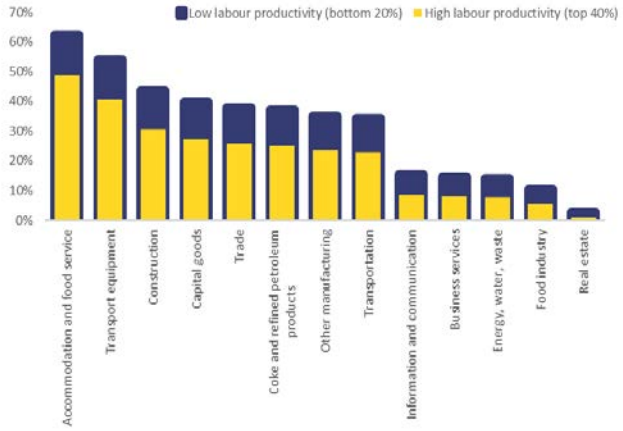
To illustrate the range of obtained predicted probabilities, we use the probit model, including all government policies, and we present the predicted probabilities of different firm characteristics across different sectors (see Column (2) of Table 2). Figure 3 shows that in all sectors, firms with lower labour productivity are more likely to become illiquid than higher productive firms. However, high productive firms still face a substantial risk of illiquidity or financial distress. As previously mentioned, if the COVID-19 crisis induces only the more productive firms to survive, we might observe intra-industry effects, resulting in an aggregate industry productivity growth. Figure 4 shows the probability of becoming illiquid for firms with different solvency ratios. We observe that firms already experiencing low solvency ratios (between 0 and 0.2) are particularly vulnerable as a result of the COVID-19 crisis. This finding raises the dilemma of whether to facilitate credit to these firms to alleviate their observed short-term financial needs at the expense of potentially increasing their vulnerability to future shocks. Figure 5 shows the predicted probabilities of facing illiquidity for small and large firms. We observe that when looking at comparable firms, large firms are more likely to become illiquid. However, it is important to highlight that large firms have at their disposal more options in terms of raising external

[32] However, it must be noted that ORBIS may have a better coverage of richer regions.

[33] An alternative method of estimating the predicted probabilities is the Adjusted Predictions at the Means (APMs), that uses the mean value for the independent variables other than the variable in question. However, this approach only uses the means values which are one of many possible sets of values that could be used. For this reason, we use the Average Adjusted Predictions (AAPs).

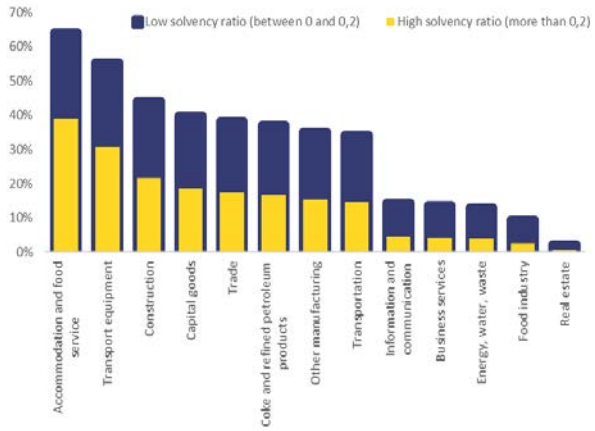
finance in the form of credit lines, bank loans, leasing or hire-purchase, trade credit or equity, as suggested by the one of the latest SAFE survey reports.[34] Finally, Figure 6 suggests that when evaluating across comparable firms, young firms, defined as less than 5 years old, are slightly more likely to become illiquid. This may be explained by the increasing cash reserves held by incumbent, i.e. older firms, a trend that is observed in France and across other major industrialised countries over the past two decades (Dao and Maggi, 2018).

Figure 3: **Probability of becoming illiquid for firms with low and high labour productivity by sector, with policies**



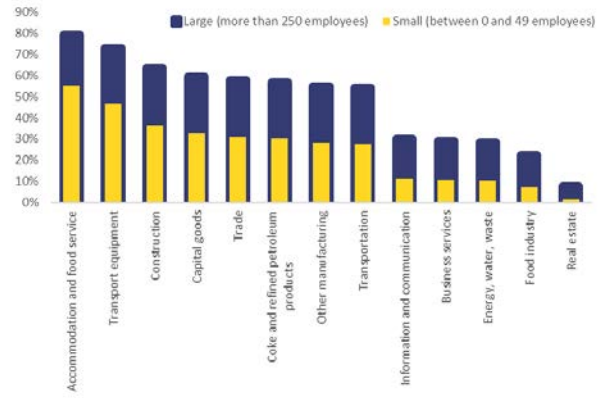
Source: ORBIS and own calculations.

Figure 4: **Probability of becoming illiquid for firms with low and high solvency ratios, with policies**



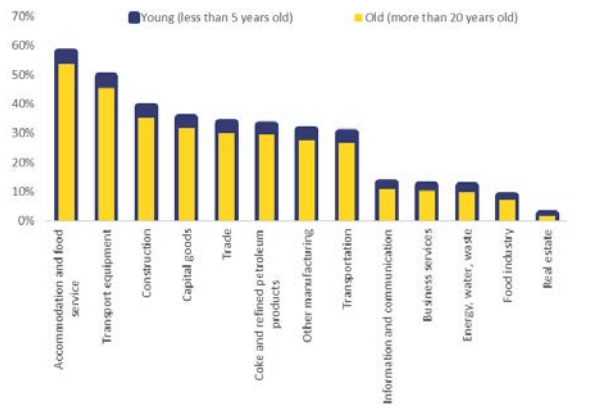
Source: ORBIS and own calculations.

Figure 5: **Probability of becoming illiquid for small and large firms, with policies**



Source: ORBIS and own calculations.

Figure 6: **Probability of becoming illiquid for young and old firms, with policies**



Source: ORBIS and own calculations.

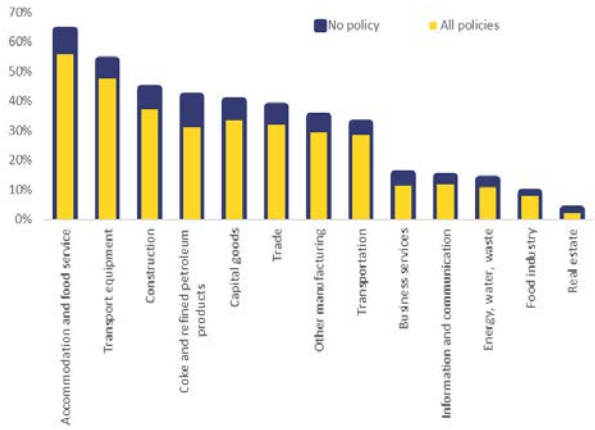
[34] Survey on the Access to Finance of Enterprises in the euro area. See https://www.ecb.europa.eu/pub/economic-bulletin/focus/2020/html/ecb.ebbox202004_03~45b9442bb3.en.html or https://www.ecb.europa.eu/stats/accesstofinancesofenterprises/pdf/ecb.safe201911~57720ae65f.en.pdf for more details.

4.2 EVALUATING SHORT-TERM POLICY MEASURES

Next, we evaluate different type of policy intervention as part of the second objective. Using Table 2, we obtain the conditional probabilities of firms becoming illiquid using different government policies, which aim at increasing the adjustment capacity of firms as regards their variable costs.

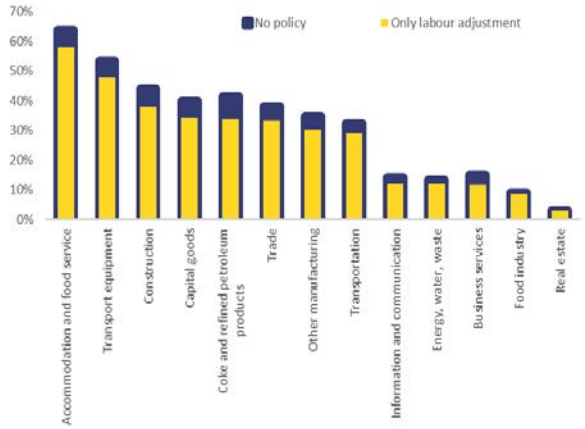
While the sign and the statistically significance of the coefficients do not change across the different scenarios displayed in Table 2, the predicted probabilities of firm characteristics might differ across each policy scenario. Figure 7 and Figure 8 show the firms' probability of becoming illiquid in each sector with different policy measures. For example, Figure 7 shows that firms in accommodation and food services have a probability of becoming illiquid around 64% if policies are not considered, which is reduced to around 56% if government measures are taken into account. Figure 8 repeats the same exercise, taking into account only a higher flexibility of the labour cost for firms with a decrease in sales (Column (3)). The difference between both graphs shows the role of taxes and interest referrals in alleviating the probability of firms becoming illiquid. Given the similarities between Figure 7 and Figure 8, we observe that the most effective measure for reducing the risk of illiquidity is the increase in the elasticity of labour costs with respect to sales. Using the example of firms in the "Accommodation and food services" sector, we observe that the probability of illiquidity is reduced from 63.8% to 55.7%, an 8.1 pp. decrease, of which around 75% can be associated with a higher adjustment of labour costs.

Figure 7: **Impact of all policy action on the probability to become illiquid (across sectors)**



Source: ORBIS and own calculations.

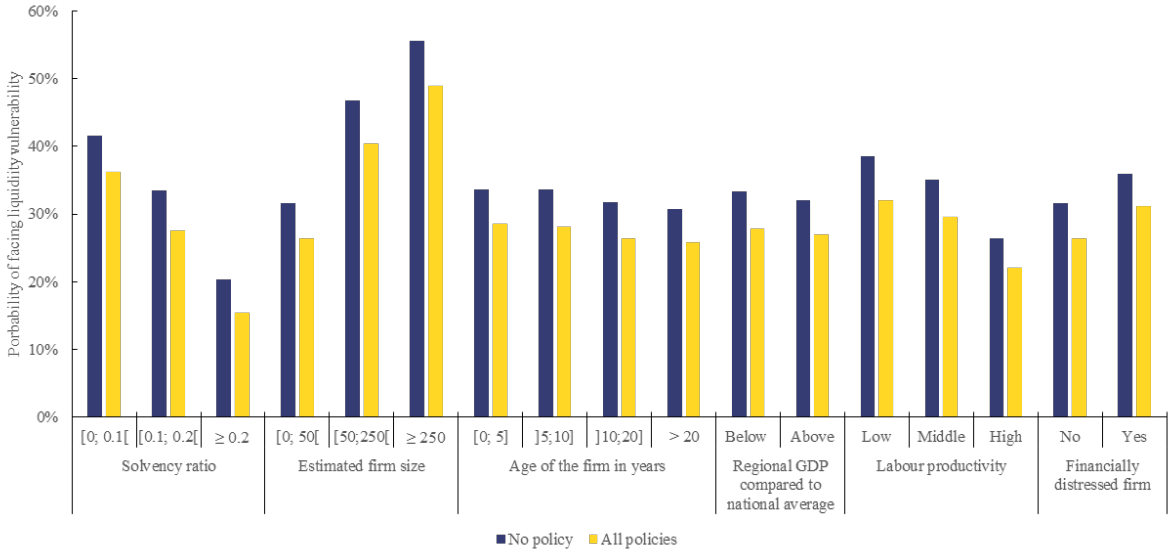
Figure 8: **Impact of policy on the labour market on the probability to become illiquid (across sectors)**



Source: ORBIS and own calculations.

While some sectors might be more affected than others, within each sector, different characteristics of firms might be affected differently. Figure 9 presents the predicted probabilities of the other firm characteristics with and without policies, which correspond to coefficients in Columns (1) and (2) of Table 2. For each firm characteristic considered, the presence of policies (partial activity, deferral of taxes and interest) reduces the probability that firms become illiquid, with the probability of illiquidity falling on average by 5.4 pp. This decrease is uniform across all firm categories, from solvent firms (20.3% to 15.5%) to large businesses (55.6% to 48.9%). Consequently, despite the policies considered here, the risk of illiquidity remains high, underlining the importance of additional measures taken by the French government, such as the EUR 300 billion loan guarantee fund and the solidarity fund for very small firms, amounting to EUR 7 billion.

Figure 9: **Probability of becoming illiquid for the average firm, by firm characteristic**



Source: ORBIS and own calculations.

4.3 EVALUATING THE TIMEFRAME OF LIQUIDITY VULNERABILITIES

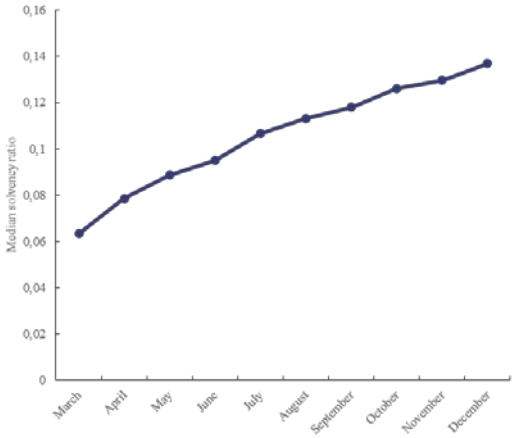
The question arises as to whether the types of firms at risk of illiquidity are different as the economic crisis continues. Figure 1 and Figure 2 show that most firms become vulnerable in the first months of the crisis. To answer the question above, this section evaluates whether different characteristics of firms become illiquid at different stages as a result of the COVID-19 shock. For this purpose, we evaluate the liquidity stocks of all firms using *Scenario 2*, which assumes a slow recovery where immediate post-lockdown shocks remain until the end of 2020.[35] Figure 10 and Figure 11 depict the median solvency ratio and labour productivity of the firms according to the month when they become illiquid, suggesting that firms with a higher solvency ratio and a higher labour productivity become illiquid at a later stage.[36]

To confirm this finding, we need to control for other important firm characteristics. For this purpose, we use the ordered probit method as described above, which considers the discrete, ordinal nature of the time when firms face negative stocks originated from *Scenario 2*. We define three categories: (1) the lockdown period defined by the firms becoming illiquid until the end of May, (2) the post-lockdown period defined by those becoming illiquid between June and December, and (3) those that remain liquid at the end of the year.

[35] While "Scenario 2" does not take into consideration the materialisation of the second wave of COVID-19, we do not find any evidence that the main findings may change significantly.

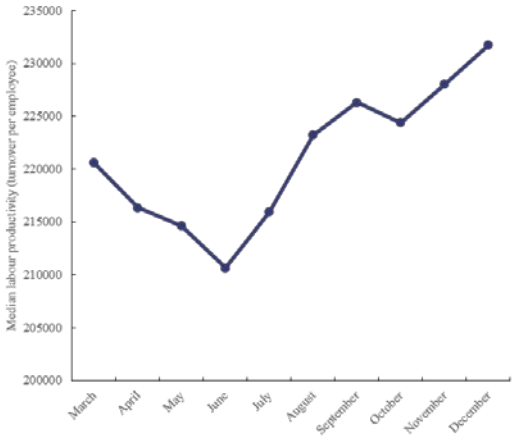
[36] Figure 11 shows a drop in the median labour productivity until June. This is mainly due to the fact that the firms that become illiquid at the earliest stage of the crisis have a higher labour productivity than average, as evidenced by the fact that the average labour productivity is relatively higher in the hospitality sector (see Annex I).

Figure 10: **Median solvency ratio of illiquid firms according to the month when they become illiquid (with policies)**



Source: ORBIS and own calculations.

Figure 11: **Median labour productivity of illiquid firms according to the month when they become illiquid (with policies)**



Source: ORBIS and own calculations.

Table 3 presents the conditional coefficients for the ordered probit for two scenarios: (1) without policies, (2) with policies. A positive (negative) coefficient in the explanatory variable indicates that the change in probability of firms becoming illiquid move in the opposite (same) direction as the coefficient. In other words, the greater a coefficient, the longer it takes for the firm to become illiquid. Therefore, in our ordered probit model, increasing the explanatory variables, while keeping the two cut-offs and the other explanatory variables at their mean values, is equivalent to moving the probability distribution to a stronger firm resilience in terms of the liquidity stock. Given that the two cuts-offs are statistically significant, it confirms a statistical difference between each period considered.

For example, using the sector variables, where the hospitality industry is used as a reference, we observe that all coefficients are positive. This indicates that, on average, firms in other sectors have negative liquidity stocks at a later stage. The industries that fare the best are the food industry and the real estate industry, as they experience the smallest losses of activity from the lockdown (INSEE, 2020a). In terms of other firm characteristics, firms with a greater solvency ratio will have a greater resistance to the crisis. Larger firms will become illiquid faster due to characteristics linked to their size, as previously discussed. Older firms and firms that are relatively more productive have an advantage and are more likely to resist for longer with positive liquidity stocks. While adding policies to the ordered probit yields a decrease in the probability of becoming illiquid, it does not change the timeline of characteristics of firms that are going to face the consequences of the COVID-19 crisis.

Table 3: **Duration until illiquidity under different policy scenarios (ordered probit method)**

VARIABLES	(1) Without policies	(2) With policies
Sectors (reference: Accommodation and food service activities)		
Business services	1.481***	1.502***
	(0.00758)	(0.00776)
Manufacture of capital goods	0.515***	0.508***
	(0.0174)	(0.0176)
Construction	0.396***	0.417***
	(0.00730)	(0.00729)
Energy, water, waste	1.626***	1.578***
	(0.0178)	(0.0187)
Food industry	1.863***	1.766***
	(0.0147)	(0.0153)
Information and communication	1.508***	1.454***
	(0.0108)	(0.0112)
Manufacture of coke and refined petroleum products	0.610***	0.630***
	(0.220)	(0.222)
Manufacture of transport equipment	0.118***	0.103***
	(0.0318)	(0.0317)
Other manufacturing	0.697***	0.693***
	(0.00895)	(0.00905)
Real estate services	2.501***	2.567***
	(0.0134)	(0.0154)
Trade	0.575***	0.592***
	(0.00738)	(0.00742)
Transportation	0.815***	0.749***
	(0.0102)	(0.0104)
Solvency ratio (ref: Between 0 and 0.1)		
Between 0.1 and 0.2	0.242***	0.279***
	(0.00516)	(0.00525)
More than 0.2	0.735***	0.798***
	(0.00460)	(0.00476)
Negative	-0.158***	-0.162***
	(0.00578)	(0.00583)
Business size (ref: Between 0 and 49)		
Between 50 and 249	-0.507***	-0.494***
	(0.00944)	(0.00951)
More than 250	-0.781***	-0.757***
	(0.0188)	(0.0187)
Age class of the firm (ref: Less than 5 years old)		
Between 5 and 10 years old	-0.0116**	0.00286
	(0.00506)	(0.00522)
Between 10 and 20 years old	0.0473***	0.0721***
	(0.00510)	(0.00528)
More than 20 years old	0.0847***	0.0981***
	(0.00513)	(0.00531)
Regional GDP (ref: Below national average)		
Above national average	0.0462***	0.0380***
	(0.00422)	(0.00435)
Labour productivity (ref: Low – Bottom 20%)		
Middle (Between 20th and 60th percentiles)	0.117***	0.0910***
	(0.00531)	(0.00545)
High (Top 40%)	0.448***	0.400***
	(0.00573)	(0.00590)
Negative	-0.174	-0.0961
	(0.344)	(0.359)
Potential financial distress (ref: No)		
Yes	-0.151***	-0.197***
	(0.00594)	(0.00603)
/cut1	0.699***	0.525***
	(0.00746)	(0.00747)

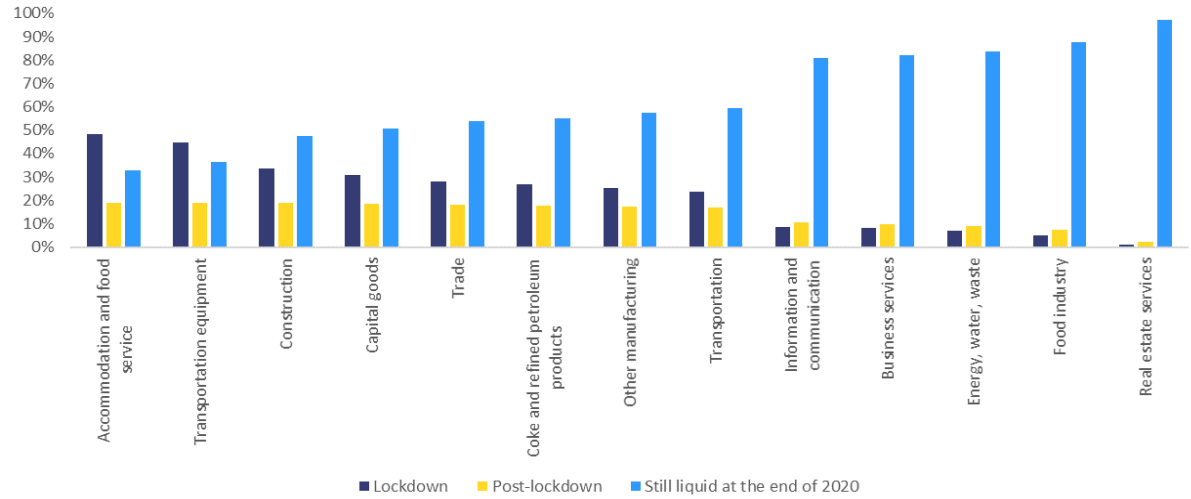
/cut2	1.275***	1.061***
	(0.00757)	(0.00755)
Observations	551,544	551,544

Standard errors in parentheses *** p<0.01, ** p<0.05, * p<0.1

Figure 12 and Figure 13 display the conditional probability that the average firm becomes illiquid due to the crisis in the presence of policy intervention, for each of the periods defined above. As expected, Figure 12 shows that the sectors where the average firm is most likely to become illiquid by the end of 2020 are those that suffer the highest losses of activity from the crisis (INSEE, 2020a and 2020b). It also shows that firms, on average, have become vulnerable at an early stage, i.e. before June. This justified the necessity of a swift policy action by the French government. However, there is no significant difference in the time for firms in the least affected sectors, i.e. real-estate or the food industry. Moreover, despite deferrals of taxes and interest, and the short-term work scheme, the risk of illiquidity is still substantial: in the hospitality sector, firms have a 48.3% probability to become illiquid by June 2020. Other policies are therefore required to support firms, which justifies, for instance, the loan guarantee scheme introduced by the French government amounting to EUR 300 billion.

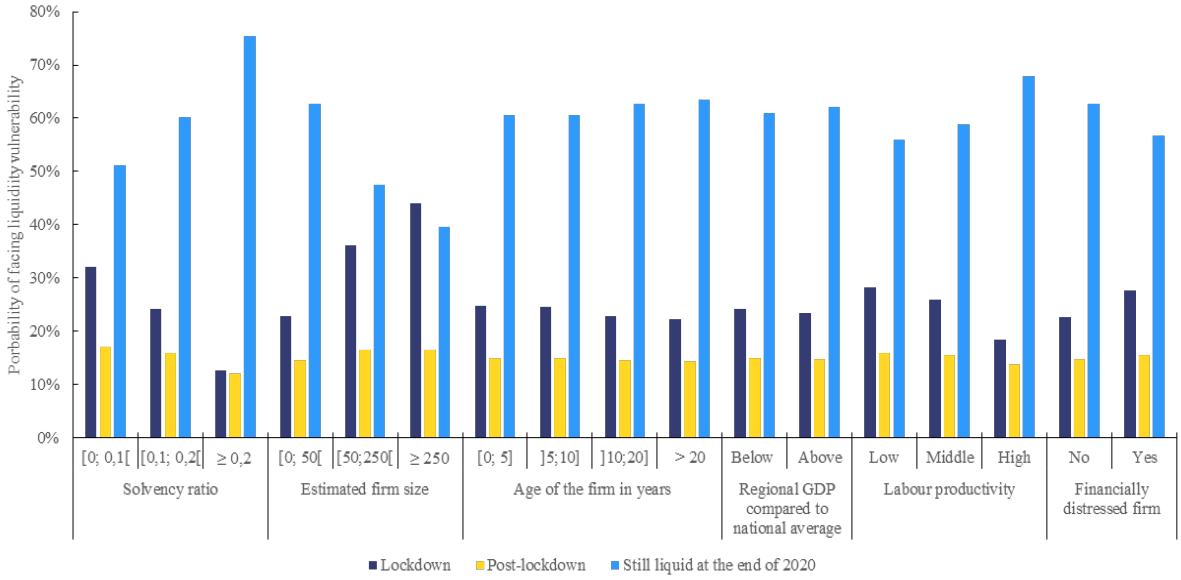
Figure 13 reinforces the idea that most vulnerable firms are at risk at an early stage. In addition, it shows that in general, the average firm should be able to resist a liquidity crisis until at least the end of the year, with a probability of more than 50%. While Figure 3 showed that the different categories of most firm characteristics, such as the age of the firm or the GDP of the region where the firm is located, do not significantly influence the firms' probability of becoming illiquid, Figure 13 shows that the timing of illiquidity is also similar for aforementioned characteristics. Even for those firm characteristics that do influence the firms' probability of becoming illiquid (solvency ratio, firm size, and labour productivity), the probability of illiquidity post-lockdown is similar across the board, at around 18%.

Figure 12: **Probability of becoming illiquid in each period for the average firm, by sector (with policies)**



Source: ORBIS and own calculations.

Figure 13: **Probability of becoming illiquid in each period for the average firm, by firm characteristic (with policies)**



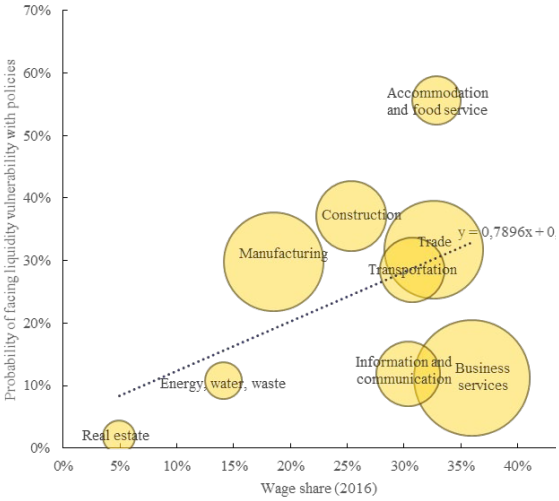
Source: ORBIS and own calculations.

4.4 WHAT DO AFFECTED SECTORS HAVE IN COMMON?

In the previous sections, we have described which firm characteristics increase the probability of illiquidity as a result of the COVID-19 crisis. Ideally, we would like to complement this information with characteristics of the labour force employed by those firms. Given that labour force characteristics are not available at a firm level in the ORBIS database, we use sectoral data on employment from Eurostat. This allows to check through correlations, whether specific groups of employees are more likely to be disproportionally affected by the COVID-19 crisis. We start from the wage share[37] of each sector, defined as the proportion of the sectoral output dedicated to the wage bill. We expect unemployment to be particularly affected if vulnerable sectors are characterised by relatively higher labour intensity. Figure 14 shows a positive correlation, with the outliers of information and communication and business services, between the wage share and the sectoral probability that a firm becomes illiquid. The size of the bubble indicates the total wage bill of the sector, where we observe Business Services, Trade and Manufacturing as the most important sectors for the overall employment.

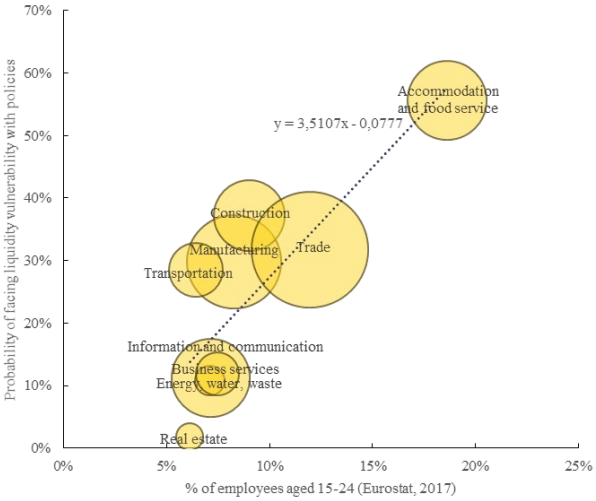
Figure 15 examines whether there exists a correlation between the proportion of young employees within a sector, where young is defined as those aged between 15 and 24, and the sectoral probability that a firm becomes illiquid. The bubble size indicates the absolute number of young employees, where we observe the hospitality and trade sectors being the biggest employers of young people. We find a clear correlation, indicating that firms in sectors that hire relatively younger people are more likely to become illiquid. However, as Eurostat include part-time work, student jobs may be included. In 2016, 32.1% of students in France declared working during the academic year (internship/apprenticeship excluded).[38] With this observation, we argue that a second-round effect of the crisis may arise, as those students who rely on part-time work to finance their studies may require financial support. Next, we look at a potential relationship between the level of education of the workforce and the liquidity vulnerability of sectors. Indeed, if sectors with low-skilled workers, usually associated with lower wages, are those that suffer the most from the pandemic, then the impact of the COVID-19 crisis might also increase income inequalities. Figure 16 correlates the level of education of employees by sector with the sectoral probability that a firm becomes illiquid. In this case, the size of the bubble indicates the absolute number of highly educated employees.[39] We observe that a higher proportion of highly educated employees is negatively correlated with the vulnerability of the sector to the COVID-19 crisis, which confirms that the most affected sectors are those with a higher fraction of lower-skilled workers. Finally, the data allows us to confront the illiquidity risks with gender. While young and lower skilled population seem to be particularly vulnerable to the COVID-19 crisis, Figure 17 shows that at this level of data aggregation, we do not observe that workers are particularly more affected based on their gender. In this final case, the size of the bubble represents the total number of female workers.

Figure 14: **Wage share and the probability of becoming illiquid with policies by sector**



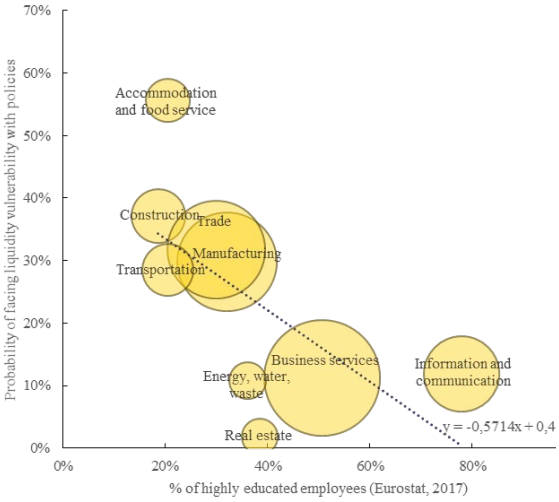
Source: Eurostat, ORBIS and own calculations.

Figure 15: **Percentage of employees aged 15-24 and the probability of becoming illiquid with policies by sector**



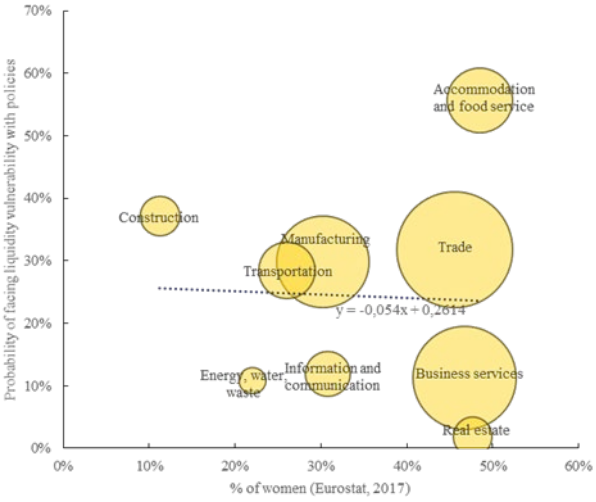
Source: Eurostat, ORBIS and own calculations.

Figure 16: **Percentage of highly educated employees and the probability of becoming illiquid with policies by sector**



Source: Eurostat, ORBIS and own calculations.

Figure 17: **Percentage of female employees and the probability of becoming illiquid with policies by sector**[40]



Source: Eurostat, ORBIS and own calculations.

[37] The observed correlation is also consistent if we use sectoral labour intensity instead of the wage share of each sector.

[38] See http://www.ove-national.education.fr/wpcontent/uploads/2018/11/Fiche_activite_remuneree_CdV_2016.pdf for more details.

[39] High-educated employees are defined as those who benefited from tertiary education using the International Standard Classification of Education. In France, this includes short-cycle education (BTS, DUT, DEUG), a bachelor's degree, a master's degree or a PhD.

[40] Sectoral data on a more disaggregated level is not available.

5. CONCLUSION

In response to the economic crisis induced by the COVID-19 pandemic, governments around the world have taken unprecedented measures to support the liquidity and solvency of firms. In the case of France, the support policies notably include a short-time work scheme (*chômage partiel*), deferral of taxes and social security contributions, state-guaranteed treasury loans and other financial instruments.

In this analysis, we analysed measures common to all firms, namely the short-time work scheme, and the deferral of taxes and interest paid on corporate loans. While our results suggest that these policies reduce the probability that a firm becomes illiquid for the different characteristics we considered, the risk related to liquidity continues to be substantial. This underlines the need for additional policies, such as the EUR 300 billion loan guarantee fund put in place by the French authorities. We document that firms in sectors that have been hardest by the crisis are more at risk. This finding underscores the relevance of the sectoral recovery plans unveiled by the French government. This includes measures for industries, such as tourism, automotive, aeronautics or the technology sector. In addition, policies previously untargeted are becoming more restrictive, such as the short-time work scheme, which is being phased out with the exception of a few industries. Overall, the measures put forth by the French government, both targeted and general, seem to match well the characteristics of the firms most likely to require liquidity support.

Our analysis underpins that firms with a low solvency ratio are more likely to require liquidity support. It could be argued that such firms may require equity injections. Indeed, the French government has provided state aid for specific large firms, available on a case-by-case basis. It could thus be argued that firms with a low solvency ratio should be subject to additional screening. From this observation, we argue that the 70% to 90% limit guaranteed by the state as part of the EUR 300 billion loan guarantee scheme may be a proxy of such screening, preventing banks from lending to already financially distressed firms. As the second wave unfolds, further work on the extent to which support measures should be adjusted to prevent excess exit and/or facilitate firm restructuring is needed. In particular, to ensure the long-term sustainability of companies that would be otherwise viable.

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ANNEX I

Table 4: **Summary statistics by sector**

	Accommodation and food service activities				Business services				Manufacture of capital goods			
Variable	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**
Solvency ratio												
Between 0 and 0.1	0.054	0.056	0.028	11,538	0.05	0.05	0.028	20,808	0.055	0.055	0.028	1,179
Between 0.1 and 0.2	0.147	0.146	0.029	11,415	0.147	0.146	0.029	17,041	0.147	0.146	0.029	1,130
More than 0.2	0.759	0.388	12.7	22,788	4.143	0.48	377.501	48,599	0.578	0.383	0.972	2,164
Negative	-0.279	-0.104	1.691	10,294	-1.662	-0.2	36.139	18,072	-0.484	-0.13	4.598	900
Estimated business size												
0 to 49	6.339	3	7.983	55,128	4.115	1	7.49	100,645	11.229	6	12.228	4,314
50 to 249	90.38	71	46.282	762	107.62	90	52.687	3,006	111.037	93	53.64	799
More than 250	1,092.517	515	1,697.585	145	1,062.94	453	3,759.689	869	814.45	464	999.295	260
Age												
Less than 5 years old	2.628	3	1.529	21,766	2.771	3	1.53	32,617	2.804	3	1.547	581
Between 5 and 10 years old	7.826	8	1.416	11,882	7.889	8	1.412	24,885	8.093	8	1.419	610
Between 10 and 20 years old	15.774	14	2.846	12,334	14.689	14	2.825	27,083	15.555	16	2.865	1,323
More than 20 years old	32.214	28	11.883	10,053	30.157	27	9.504	19,935	36.134	32	13.314	2,859
Regional GDP												
Below national average	.	.	.	10,303	.	.	.	17,504	.	.	.	1,384
Above national average	.	.	.	45,732	.	.	.	87,016	.	.	.	3,989
Labour productivity (turnover per employee)												
Low (bottom 20%)	102,406.4	108,901.5	23,084.93	48,488	87,143.07	88,168	38,347.1	15,690	111,326.1	117,076	30,313.94	741
Middle (between 20th and 60th percentiles)	188,078.7	165,762	48,945.93	3,417	265,053.2	275,418	54,448.91	52,686	284,876.1	310,193	61,435.45	3,876
High (top 40%)	1,038,198	566,572.5	1,736,414	164	1,179,979	661,419	6,193,195	3,997	1,000,917	477,208	2,891,784	399
Negative	.	.	.	.	-99,961.67	-123,955	85,432.43	3	-133,130	-133,130	.	1
Financial distress												
No	.	.	.	48,722	.	.	.	91,165	.	.	.	4,327
Yes	.	.	.	7,313	.	.	.	13,355	.	.	.	1,046

	Construction				Energy, water, waste				Food industry			
Variable	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**
Solvency ratio												
Between 0 and 0.1	0.054	0.055	0.027	18,281	0.055	0.588	0.028	2,680	0.055	0.057	0.027	3,211
Between 0.1 and 0.2	0.148	0.146	0.029	17,399	0.145	0.142	0.029	2,481	0.148	0.146	0.029	3,263
More than 0.2	0.673	0.398	3.263	39,547	1.164	0.344	11.864	2,542	0.697	0.346	8.431	5,553
Negative	-0.499	-0.167	3.609	12,075	-0.302	-0.061	1.543	954	-0.3	-0.09	1.963	1,794
Estimated business size												
0 to 49	5.571	3	7.922	85,211	3.787	1	7.561	8,245	6.474	3	9.197	12,823
50 to 249	95.5579	81	45.004	1,914	111.291	93	55.927	302	111.55	93.5	52.685	750
More than 250	776.732	420	1,001.457	377	2,457.818	462.5	8,721.771	110	822.04	457.5	1,064.968	248
Age												
Less than 5 years old	2.708	3	1.554	25,535	3.354	4	1.503	1,909	2.772	3	1.506	3,922
Between 5 and 10 years old	7.936	8	1.405	18,806	7.718	8	1.297	3,871	7.846	8	1.399	2,580
Between 10 and 20 years old	14.744	14	2.86	21,905	14.213	13	2.729	1,542	14.962	15	2.778	3,029
More than 20 years old	32.785	29	11.159	21,256	35.466	31	13.302	1,335	38.177	31	17.239	4,290
Regional GDP												
Below national average	.	.	.	19,165	.	.	.	2,047	.	.	.	3,590
Above national average	.	.	.	68,337	.	.	.	6,610	.	.	.	10,231
Labour productivity (turnover per employee)												
Low (bottom 20%)	107,637.7	115,064	30,140.83	17,693	96,547.58	101,066.5	35,230.75	484	83,467.82	79,485.5	29,686.65	2,824
Middle (between 20th and 60th percentiles)	225,042.7	223,577.5	38,732.73	56,740	280,657.5	289,822	70,580.89	908	288,292	302,687.5	56,890.12	8,246
High (top 40%)	1,163,963	597,370	4,976,533	1,817	658,458.8	544,695.5	1,430,912	3,630	915,866.7	537,555	2,318,599	1,271
Negative	-378,891.3	-12,032	738,545.5	4	.	.	.	.	.	.	.	.
Financial distress												
No	.	.	.	76,513	.	.	.	7,933	.	.	.	11,874
Yes	.	.	.	10,989	.	.	.	724	.	.	.	1,947

	Information and communication				Manufacture of coke and refined petroleum products				Manufacture of transport equipment			
Variable	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**
Solvency ratio												
Between 0 and 0.1	0.05	0.051	0.028	4,549	0.051	0.06	0.031	9	0.053	0.053	0.028	388
Between 0.1 and 0.2	0.147	0.146	0.028	3,725	0.15	0.136	0.023	7	0.149	0.148	0.029	333
More than 0.2	1.178	0.529	4.417	12,653	0.335	0.293	0.126	7	0.506	0.35	0.539	507
Negative	-1.332	-0.235	22.725	5,843	-0.124	-0.1	0.089	5	-0.315	-0.148	0.799	268
Estimated business size												
0 to 49	4.229	1	8.209	25,442	17.6	18	15.551	15	9.468	4	12.4	1,095
50 to 249	104.673	89	50.493	1,049	103.8	109	31.948	5	114.066	100	53.978	258
More than 250	1,264.384	487	4,370.218	279	1,022.375	520	1,344.081	8	2,357.434	585	8,995.865	143
Age												
Less than 5 years old	2.717	3	1.527	8,609	.	.	.	.	2.789	3	1.545	209
Between 5 and 10 years old	7.93	8	1.409	5,946	8	8	.	1	7.975	8	1.43	200
Between 10 and 20 years old	14.842	15	2.825	7,255	17	20	5.196	3	15.229	15	2.869	327
More than 20 years old	31.186	28	10.892	4,960	50.917	48.5	21.677	24	36.3	32	13.502	760
Regional GDP												
Below national average	.	.	.	2,984	.	.	.	11	.	.	.	389
Above national average	.	.	.	23,786	.	.	.	17	.	.	.	1,107
Labour productivity (turnover per employee)												
Low (bottom 20%)	93,295.57	97,550	36,184.94	3,507	6,999	6,999	.	1	103,871.2	108,834	33,242.95	221
Middle (between 20th and 60th percentiles)	301,071.5	317,232	78,323.87	8,207	291,192.6	290,991	48,284.63	5	244,646.2	229,458	68,434.04	441
High (top 40%)	779,389	441,063	7,040,518	4,567	1,501,501	1,107,343	1,778,737	20	1,048,468	622,240	6,332,768	662
Negative	.	.	.	.	.	.	.	.	.	.	.	.
Financial distress												
No	.	.	.	22,629	.	.	.	19	.	.	.	1,201
Yes	.	.	.	4,141	.	.	.	9	.	.	.	295

	Other manufacturing				Real estate services				Trade			
Variable	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**	**Mean**	**Median**	**Standard Deviation**	**Obs.**
Solvency ratio												
Between 0 and 0.1	0.055	0.057	0.027	7,034	0.044	0.042	0.027	12,812	0.052	0.053	0.028	43,140
Between 0.1 and 0.2	0.148	0.147	0.029	7,551	0.143	0.14	0.029	4,854	0.145	0.143	0.029	32,992
More than 0.2	0.627	0.374	4.227	16,067	2.86	0.575	29.032	11,799	0.874	0.362	37.796	50,122
Negative	-0.384	-0.137	1.847	5,602	-1.133	-0.067	17?974	7,413	-0.557	-0.122	28.57	26,217
Estimated business size												
0 to 49	8.686	4	10.667	32,583	2.237	1	5.393	36,340	4.8	2	8.009	147,368
50 to 249	106.48	89.5	50.923	2,966	104.096	87	50.404	448	103.051	86	49.594	4,226
More than 250	781.221	449	1,289.736	705	623.956	426.5	547.483	90	1,156.464	466	3,345.504	877
Age												
Less than 5 years old	2.811	3	1.529	5,347	2.814	3	1.513	8,228	2.795	3	1.527	38,978
Between 5 and 10 years old	7.996	8	1.41	4,854	8.032	8	1.434	7,271	7.908	8	1.41	29,474
Between 10 and 20 years old	15.341	15	2.885	8,554	14.586	14	2.773	10,816	14.955	15	2.89	37,870
More than 20 years old	35.566	31	12.844	17,499	36.063	31	13.887	10,562	33.28	29	11.616	46,149
Regional GDP												
Below national average	.	.	.	10,068	.	.	.	5,931	.	.	.	34,620
Above national average	.	.	.	26,186	.	.	.	30,947	.	.	.	117,851
Labour productivity (turnover per employee)												
Low (bottom 20%)	105,995.5	110,007	30,274.73	6,469	87,934.44	88,526	32,670.45	2,991	102,278.6	108,130	34,033.66	10,305
Middle (between 20th and 60th percentiles)	259,258.4	267,084	47,926.47	24,748	308,612.6	328,476	65,838.92	12,739	275,980.5	280,548.5	73,907.32	28,578
High (top 40%)	1,096,903	572,394	3,575,716	1,523	725,900.5	452,311	2,924,074	3,403	766,926.5	602,384.5	4,783,267	79,544
Negative	.	.	.	.	-3,069	-3,069	.	1	-181,089.5	-181,089.5	125,069.5	2
Financial distress												
No	.	.	.	29,580	.	.	.	29,575	.	.	.	130,684
Yes	.	.	.	6,674	.	.	.	7,303	.	.	.	21,787

	Transportation			
Variable	**Mean**	**Median**	**Standard Deviation**	**Obs.**
Solvency ratio				
Between 0 and 0.1	0.055	0.056	0.028	4,113
Between 0.1 and 0.2	0.149	0.147	0.029	4,272
More than 0.2	0.893	0.379	25.35	10,580
Negative	-0.421	-0.125	2.992	2,774
Estimated business size				
0 to 49	8.02	4	10.758	19,734
50 to 249	108.447	92	52.062	1,613
More than 250	1,819.926	445	12,126.29	392
Age				
Less than 5 years old	2.52	2	1.546	5,929
Between 5 and 10 years old	7.869	8	1.419	3,693
Between 10 and 20 years old	15.063	15	2.89	4,941
More than 20 years old	33.995	30	1.796	7,176
Regional GDP				
Below national average	.	.	.	5,002
Above national average	.	.	.	16,737
Labour productivity (turnover per employee)				
Low (bottom 20%)	97,989.13	101,110	33,159.29	5,265
Middle (between 20th and 60th percentiles)	241,821.5	246,723	41,209.81	12,246
High (top 40%)	1,482,842	642,665	3,396,034	669
Negative	.	.	.	.
Financial distress				
No	.	.	.	18,337
Yes	.	.	.	3,402

ANNEX II

Table 5: **Sectoral shocks used (inspired by INSEE, Point de conjoncture, 7 and 27 May 2020)**

Sector	Part in the GDP	Monthly activity loss during lockdown	Monthly activity loss after lockdown
Food industry	2%	5%	2%
Manufacture of coke and refined petroleum products	0%	55%	35%
Manufacture of capital goods	1%	61%	42%
Manufacture of transport equipment	1%	69%	54%
Other manufacturing	6%	43%	25%
Energy, water, waste	2%	23%	14%
Construction	6%	75%	38%
Trade	10%	47%	27%
Transportation	5%	59%	40%
Accommodation and food service activities	3%	90%	90%
Information and communication	5%	31%	23%
Real estate services	13%	2%	1%
Business services	14%	44%	26%

ANNEX III

Methodological note

Definition of the sectors

We use the NACE code of the primary sector ("core" sector) of each unconsolidated firm. It is given at a 4-digit level in the ORBIS database. We restrict ourselves to a 2-digit NACE code in order to be as close as possible to the INSEE classification, with the following correspondence.

Sector name used in the paper (inspired by INSEE)	NACE sectors included
Accommodation and food service activities	Accommodation (I55) and Food and beverage service activities (I56)
Business services	Legal and accounting activities (M69), Activities of head offices; management consultancy activities (M70), Architectural and engineering activities; technical testing and analysis (M71), Scientific research and development (M72), Advertising and market research (M73), Other professional, scientific and technical activities (M74), Veterinary activities (M75), Rental and leasing activities" (N77), Employment activities (N78), Travel agency, tour operator and other reservation service and related activities (N79), Security and investigation activities (N80), Services to buildings and landscape activities (N81) and Office administrative, office support and other business support activities (N82)
Manufacture of capital goods	Manufacture of computer, electronic and optical products (C26), Manufacture of electrical equipment (C27) and Manufacture of machinery and equipment n.e.c. (C28)
Construction	Construction of buildings (F41), Civil engineering (F42), Specialised construction activities (F43)
Energy, water, waste	Electricity, gas, steam and air conditioning supply (D35), Water collection, treatment and supply (E36), Sewerage (E37), Waste collection, treatment and disposal activities; materials recovery (E38) and Remediation activities and other waste management services (E39)
Food industry	Manufacture of food products (C10), Manufacture of beverages (C11) and Manufacture of tobacco products (C12)
Information and communication	Publishing activities (J58)
Manufacture of coke and refined petroleum products	Manufacture of coke and refined petroleum products (C19)
Manufacture of transport equipment	Manufacture of motor vehicles, trailers and semi-trailers (C29) and Manufacture of other transport equipment(C30)
Other manufacturing	Manufacture of textiles (C13), Manufacture of wearing apparel (C14), Manufacture of leather and related products (C15), Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (C16), Manufacture of paper and paper products (C17), Printing

	and reproduction of recorded media (C18), Manufacture of chemicals and chemical products (C20), Manufacture of basic pharmaceutical products and pharmaceutical preparations (C21), Manufacture of rubber and plastic products (C22), Manufacture of other non-metallic mineral products (C23), Manufacture of basic metals (C24), Manufacture of fabricated metal products, except machinery and equipment (C25), Manufacture of furniture (C31), Other manufacturing (C32) and Repair and installation of machinery and equipment (C33)
Real estate services	Real estate activities (L68)
Trade	Wholesale and retail trade and repair of motor vehicles and motorcycles (G45), Wholesale trade, except of motor vehicles and motorcycles (G46) and Retail trade, except of motor vehicles and motorcycles (G47)
Transportation	Land transport and transport via pipelines (H49), Water transport (H50), Air transport (H51), Warehousing and support activities for transportation (H52) and Postal and courier activities (H53)

In section 4, "manufacturing" refers to "manufacture of capital goods", "energy, water, waste", "manufacture of coke and refined petroleum products", "manufacture of transport equipment" and "other manufacturing".

Definition of the remaining control variables:

- The solvency ratio is defined as follows:

$$\frac{\text{Profit after tax + depreciation}}{\text{Current liabilities + Non-current liabilities}}$$

  We divide the sample between those firms that have a negative ratio, a ratio between 0 and 0.1, between 0.1 and 0.2 and greater than 0.2. This is because 0.2 is commonly used as a threshold of firm solvency in accounting.

- The business size is divided in three categories: between 0 and 49 employees, between 50 and 249 employees and more than 250 employees. This follows the EU definition of respectively a small, medium and large enterprise, with the balance sheet criterion excluded.[41]

- The regional location of each firm is defined by the NUTS1 variable in the ORBIS database. Regions having a GDP below the national average are Hauts-de-France, Grand Est, Bourgogne-Franche-Comté, Centre-Val de Loire, Corse and French overseas territories (Guadeloupe, French Guiana, Martinique, Reunion Island, Mayotte).

- Labour productivity is defined as turnover in EUR divided by the number of employees.

- A firm is defined as financially distressed if it is more than 10 years old and has recorded negative profits (EBIT) in the latest available year.

[41] Commission Recommendation of 6 May 2003 concerning the definition of micro, small and medium-sized enterprises (Text with EEA relevance) (notified under document number C(2003) 1422)

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