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THE EFFECTS OF THE COVID-19 SHOCK ON CORPORATES' LIQUIDITY NEEDS, BALANCE SHEETS AND RISKINESS

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The recession triggered by the COVID-19 pandemic substantially raises the share of Italian incorporated firms that will likely have a liquidity and capital shortfall in 2020. The main support measures enacted by the Italian Government between March and August have been very effective: they substantially eliminated the liquidity shortfall and they reduced, albeit not completely, the weakening of firms' net worth. Nevertheless, access to new loans, including those with public guarantees, increases indebtedness, especially for ex-ante riskier firms. The resulting weakened balance sheets increase the probability of firms' default.

This note studies the impact of the shock triggered by the COVID-19 pandemic on the liquidity position, net worth and financial structure of about 730,000 Italian incorporated firms. For about 270,000 of these, representing over 70 per cent of the sales of the overall sample, the Bank of Italy In-House Credit Assessment System (ICAS)[2] allows the impact of the shock on the 12 months default probability (PD) to be measured. The analysis is based on a macroeconomic scenario in which the evolution of firms' sales is coherent with the GDP forecast released last July by the Bank of Italy, which, in the baseline scenario, falls by 9.5 per cent in 2020.[3]

The data necessary to realize the estimates are only available for incorporated firms, which are a highly representative sample of Italian firms (80 per cent of value added, and 87 per cent of sales). Non-incorporated firms, a common corporate structure in the sectors most hit by the pandemic (tourism, restaurants and hotels, and recreational activities), are therefore excluded.[4] These firms could

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[1] Bank of Italy. The opinions expressed in this note are those of the authors and do not necessarily reflect those of the Bank of Italy.

[2] The ICAS is the Bank of Italy's internal credit assessment system to evaluate loans used as collateral in monetary policy operations.

[3] See Bank of Italy, *Economic Bulletin*, 3, 2020.

[4] The note uses balance sheet data of incorporated firms from Cerved (as of 2018, the last year for which complete data are available) and of several other data sources available at different levels of disaggregation (including those from the Centrale dei Rischi (Central Credit Register), Central Guarantee Fund/Medio Credito

have liquidity and capital shortfalls too; they have had access to most of the support measures activated in the past few months.

The model used to obtain the estimates extends the model developed by Schivardi[5] and is based on the projection of cash flows and profits for 2020, taking into account the COVID-19 shock and the main support measures introduced by the 'Cure Italy', 'Liquidity', 'Relaunch' and 'August' decrees (in particular, the extension of the furlough scheme 'Cassa Integrazione Guadagni' (CIG), tax deferrals, the debt moratoriums, public guarantee schemes for loans, and the grants to SMEs) approved between March and August.[6] Cash flow projections are based on the actual dynamics of sales (at the Ateco 2-digit industry level) until July 2020 and on a calibration for the remaining months of the year that aligns the aggregate growth rate of value added of the firms in the sample to the GDP growth rate for the entire Italian economy in 2020, forecast last July by the Bank of Italy. Further details on the methodology, the macroeconomic scenario, the technical hypotheses and the public support measures considered in the analysis are given in Appendix A.

For a correct interpretation of the results, it is critical to be mindful of the key features and limitations of the estimation procedure.

- The estimation of balance sheets for 2020 is based on 2018 accounting data, the last year for which complete information is available for all firms, and on an updating procedure reflecting mainly sectoral information. Therefore, the results cannot take into account the idiosyncratic dynamics of each firm and should be considered essentially as an aggregate evaluation, even if based on individual data.
- The projection of cash flows for 2020 would signal many firms as being exposed to liquidity risk or in distress even without the shock due to the pandemic. For some of these firms it is a situation to be expected, due to, for example, investment expenses; in normal times, it would have been covered by higher debt. This observation is coherent with the static nature of the analysis, which cannot take into account the measures that the firms might have taken to cope with the higher liquidity need. Moreover, the analysis suggests that the number of firms having a liquidity shortfall exclusively due to the COVID-19 emergency is lower than the estimated one.

The results show that this year, without the support measures introduced by the Government, the large fall in turnover would have generated an aggregate liquidity shortfall equal to around €48 billion for around 142, 000 firms (19 per cent of the total sample) and a sharp reduction in profits which would have made around 100, 000 firms undercapitalized (13.8 per cent of the total). Instead, thanks to the support measures, around 42,000 (out of 142,000) firms would be able to satisfy their liquidity needs, while the liquidity shortfall of the remaining 100,000 would go down to €33 billion. The measures would reduce the number of potentially undercapitalized firms to around 80,000.

The liquidity shortfall can be satisfied by increasing indebtedness, also using public guarantee schemes for loans. To take this possibility into account, the dynamics of the use of credit granted between February and July and the amount of credit lines available in July have been examined: in this way, a further 55,000 firms would be able to satisfy their liquidity shortfall using credit, thus reducing liquidity needs to around €28 billion on aggregate. The residual shortfall after including the credit already granted could also be satisfied with new guaranteed loans, up to the maximum amount

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Centrale and SACE). The sample includes corporations that issue balance sheets according to both the 'industrial transformation' rules and the 'real estate' rules.

[5] See F. Schivardi, 'Come evitare il contagio finanziario delle imprese', www.lavoce.info, 24 March 2020.

[6] As a consequence, the additional measures enacted in the recent 'Relief' Decree are not considered in the analysis.

for each firm established in the Decrees. This possibility would reduce the aggregate shortfall to €17 billion for around 32,000 firms.

After taking into account the beneficial effects of the support measures, for the total sample of companies the aggregate profit in 2020 would be €29 billion, around two thirds lower than in 2018 (latest available data); the most affected sectors would be hotels, restaurants, and artistic and entertainment activities.

Leverage, measured by the ratio between financial debts and their sum with equity, would increase by between 1 and 2 percentage points (around 44-45 per cent); the increase would be larger, by around 6 and 10 percentage points, in the most affected sectors. Depending on the hypotheses on the possibility to increase debt to cover liquidity shortfalls, the one-year ahead probability of default would increase by between 3 and 4.4 per cent, around 1 percentage point higher compared with the pre-crisis figure. The consequence would be a significant reclassification of companies towards higher risk classes: the share of financial debt held by riskier borrowers (those with a probability of default above 5 per cent) would be 23 per cent, compared with 13 per cent before the pandemic outbreak.

Public funds available through the Decrees considered in this note are huge. In 2020, they included more than €20 billion for furlough schemes and nearly €8 billion for grants. The effective use of these measures has been extensive, but not complete.[7] The results of the estimate show that the support measures contributed significantly to containing the impact of the pandemic on Italian firms. Moreover, they suggest that the measures also benefited firms that would have been in difficulties independently of the pandemic, a result difficult to avoid due to the urgency for activating interventions and the objective difficulty in identifying precisely the firms actually affected.

1. Firms' liquidity shortfall and its coverage

The analysis presented in this section provides firm-level estimates of: i) the amount of liquidity shortfall associated with the firms' cash flows dynamic and consistent with the macroeconomic scenario of the pandemic (see introduction); ii) the number of firms with a liquidity shortfall and their employees; and iii) the number of firms with their liquidity shortfalls resolved thanks to the government support measures.

In the absence of government intervention, by the end of December the number of firms with liquidity needs would have been about 142,000 (Table 1; column 'Firms in liquidity shortfall') and the number of employees involved could reach 2.3 million (column 'Employees'); the overall liquidity needs would total €48 billion.[8] As already highlighted, about 110,000 firms would have had a liquidity shortfall even if the shock had not happened (row 'without COVID').

The main measures introduced by the 'Cure Italy', 'Liquidity', 'Relaunch' and 'August' decrees have provided effective support in reducing firms' liquidity needs from €48 to €33 billion (column 'Amount of liquidity shortfall'); the number of firms and their liquidity needs have reached lower levels than those that we would have recorded in the absence of the COVID-19 shock.

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[7] According to preliminary INPS data, in the first half of 2020, firms would have effectively used less than half of the CIG hours requested. According to our information on grants, by July 14, around €4.3 billion had been provided to around 1.4 million beneficiaries, representing around two thirds of the potential beneficiaries estimated in the technical report accompanying the 'Relaunch' Decree. The public guarantee schemes were used on a large scale, but far from the maximum amount theoretically available (€500 billion).

[8] Thanks to the improvement in the macroeconomic scenario and to the use of operating cost elasticities estimated at the sectoral level, these estimates for firms' liquidity needs are lower than the previous ones dated April and July respectively.

Table 1 – Firms' liquidity shortfall, the effects of support measures and the use of bank credit

	Firms with a liquidity shortfall	%firms with a liquidity shortfall [1]	Employees (thousands)	Amount of liquidity shortfall (€ billions)	Firms relieved from liquidity shortfall	of which: % with a liquidity shortfall due to COVID-19
Overall sample	747,423		9,279			
Operating firms in 2020	729,280		9,186			
With a liquidity shortfall:						
Without COVID	109,881	15.1	1,271	40.1		
With COVID but without support measures	141,599	19.4	2,264	48.1		
With wage supplementation for 9 weeks	136,104	18.7	2,079	46.4	5,495	87.1
SMEs with moratorium (Sept. 2020)	124,643	17.1	2,105	39.4	16,956	34.9
Cure Italy (CI) and Liquidity (Liq)	119,455	16.4	1,928	37.8	22,144	43.8
CI + Liq + wage supplementation for 18 weeks	118,362	16.2	1,879	37.3	23,237	45.3
With CI + Liq + tax deferrals	119,051	16.3	1,920	37.8	22,548	44.5
With CI + Liq + rent contribution	116,208	15.9	1,888	37.1	25,391	50.1
With CI + Liq + grants	112,194	15.4	1,892	37.5	29,405	48.2
CI + Liq + Relaunch (Rel)	107,672	14.8	1,803	36.3	33,927	52.8
With decrees + wage supplementation for 9 months	106,951	14.7	1,741	35.9	34,648	53.5
With decrees + moratorium for SMEs for 9 months	100,232	13.7	1,748	34.3	41,367	45
CI + Liq + Rel + August	99,498	13.6	1,686	33.4	42,101	45.7
Change in bank credit between February and July and use of margins available on credit lines in July 2020	44,999	6.2	1,030	28.4	96,600	- [2]
Additional bank loans within guarantee schemes	32,243	4.4	353	17.1	109,356	- [2]

Source: Calculations based on data from Cerved Group, the Central Credit Register, INPS, Mediocredito Centrale and SACE.
(1) The ratio is computed using the number of firms operating in 2020. - (2) Consideration of the change in banks' credit implies that some firms would record an increase in their liquidity needs, with the possibility of being classified as having a liquidity shortfall. These instances complicate the interpretation of the share of firms with a liquidity shortfall and they are therefore not reported.

The overall support provided by government measures may mitigate liquidity needs for about 42,000 firms (column 'Firms relieved from liquidity shortfall'); of which about 20,000 had a liquidity shortfall exclusively because of the COVID-19 shock. About 99,500 firms would still have a liquidity shortfall, of which about half would have experienced liquidity problems even without the crisis.

Consideration of the change in bank credit drawn by firms between July and February, which also includes new bank loans guaranteed under the Central Guarantee Fund (CGF) and by SACE, and the margins available on credit lines in July 2020, would cover liquidity shortfalls for about 55,000 firms. The residual liquidity need would be €28 billion for about 45,000 firms and one million employees. Those firms that are eligible for the public guarantee schemes may cover their liquidity needs by increasing their indebtedness levels, albeit within the legal thresholds established for the different

schemes.[9] In this instance, 32,000 firms would be left with liquidity needs and the amount of the liquidity shortfall would total €17 billion[10] mostly concentrated amongst micro and large firms (Table 2).[11]

The share of firms left with a liquidity shortfall, even after considering support measures and the access to guaranteed loans, is higher amongst micro firms (Table 2). This result highlights that the financial conditions of firms not included in our sample, mostly small firms, could be more severe than that envisaged in our estimates.

Table 2 – Firms with a residual liquidity shortfall, distribution by size classes

Size class	Number of firms	Firms with residual liquidity shortfall	Amount of liquidity shortfall	% firms with residual liquidity shortfall
Micro	567,986	29,089	6.3	5.1
Small	129,033	2,511	3.5	1.9
Medium	26,204	481	2.4	1.8
Large	6,057	162	4.8	2.7
Total	729,280	32,243	17.1	4.4

Source: Calculations based on data from Cerved Group, the Central Credit Register, INPS, Mediocredito Centrale and SACE.
Note: the estimated liquidity shortfall includes the use of cash items from 2018 financial statements.

2. The effects on firms' equity

According to the new Italian regulatory framework for insolvency and bankruptcy (see the Business Crisis and Insolvency Code), a firm is in a state of crisis whenever its equity falls below the minimum amount indicated by the law (undercapitalization). Table 3 shows the number of undercapitalized firms, the number of their employees and the total equity deficit. The table shows the estimates based on a model for the evolution of equity that considers just balance sheet profit or losses (accounting method), which is the sum of the variables that may or may not correspond to cash flows. Therefore, policy measures that only affect cash flows but not accounting profits, such as debt moratoriums, do not influence the evolution of equity. An alternative to the accounting method is to only include statement items with corresponding cash flows in the dynamics of equity income (economic method, see Table B1 in the Appendix). The methodological differences between the two approaches are described in Appendix A.

Without considering the policy measures enacted by the Italian government, about 101,000 firms (13.8 per cent of the firms in the sample), employing about 1.2 million workers, would have been in a state of crisis by the end of 2020, with an aggregate equity deficit of about €28 billion. The measures adopted by the Italian government – implemented under Decree Laws 18/2020 ('Cure Italy'), 23/2020 ('Liquidity'), 34/2020 ('Relaunch') and 104/2020 ('August') – would reduce the number of undercapitalized firms to 88,000, about 12 per cent of all firms, with an aggregate equity deficit of about €27 billion. Decree Law 34/2020 ('Relaunch') is particularly effective in reducing the number of

[9] The use of bank loans to cover their liquidity needs implies a deterioration in their leverage that might pose problems for their solvency in the future.

[10] About 13,000 of these firms, for a total liquidity need of €9.6 billion, already had non-performing loans in February 2020.

[11] According to the classification adopted by the European Commission, micro firms employ fewer than 10 employees and have annual revenues or total assets not exceeding €2 million.

firms in a state of crisis, thanks to direct grants and to the further extension of short-term work schemes.

About 90 per cent of firms exiting from a state of crisis thanks to policy measures, were undercapitalized because of the pandemic (see column 'of which: % in crisis because of COVID' in the table). It is important to note that, even without the pandemic, about 70,000 firms (9.6 per cent of the sample) would have been in a state of crisis at the end of 2020, with an aggregate equity deficit of about €23 billion. Taken together, these results suggest that policy measures were targeted to firms affected the most by the pandemic, which had lower equity needs than firms that would have been in a state of crisis anyway. Nonetheless, policy measures would not be enough to take the number of undercapitalized firms (and aggregate equity deficit) to the level estimated in the absence of the pandemic.

Table 3 – COVID-19 and Undercapitalization (*accounting method*)

	Undercapitalized Firms	% Operating Firms in 2018[1]	Workforce (thousands)	Equity Deficit (€ billions)	Firms no longer in a State of Crisis	of which: % in Crisis because of COVID
All firms in the sample	747,423		9,279			
All firms active in 2020	729,280		9,186			
Undercapitalized:						
in 2018	51,797	6.9	335	14		
without COVID	69,900	9.6	547	23		
With COVID but without support measures	100,684	13.8	1,168	28		
CIG for 9 weeks	98,471	13.5	1,089	28	2,213	94.7
Debt moratorium (until Sept. 2020)	100,684	13.8	1,168	28	0	-
Decree Laws 18 and 23/2020	98,471	13.5	1,089	28	2,213	94.7
CIG for 9 weeks	95,777	13.1	953	27	4,907	92.1
IRAP	97,880	13.4	1,083	28	2,804	94.8
Rent refund	96,409	13.2	1,068	27	4,275	96.1
Direct grants	93,569	12.8	1,065	28	7,115	88.7
Decree Laws 18, 23 and 34/2020	88,520	12.1	905	27	12,164	88.3
CIG for 9 months	87,863	12.0	815	27	12,821	88.6
Debt Moratorium (until Dec. 2020)	88,520	12.1	905	27	12,164	88.3
Decree Laws 18, 23, 34 and 104/2020	87,.863	12.0	815	27	12,821	88.6

Source: Our calculations based on Cerved, Central Credit Register and INPS data.
Notes: (1) The percentage is calculated with respect to all firms active in 2020, with the exception of the row 'in 2018', where the reference population is the whole sample of all firms active in 2018.

3. The effects of the crisis on corporate balance sheets

The COVID-19 economic shock will have a harsh effect on corporate profitability. The reduction in turnover will be significant, but highly diversified among sectors: the accommodation and food services, art, entertainment and recreation, real estate, food and textile sectors are among the most affected. In the macroeconomic scenario described in the introduction, operating profitability, measured by the ratio between earnings before interest, taxes, depreciation and amortization (EBITDA) and revenues, equal to 8.9 percent in 2018, could fall by more than 1.7 percentage points with a 25 per cent drop in EBITDA. Net profitability, measured by return on equity (ROE), will stand at 2.5 per cent, almost 5 percentage points below the 2018 figure. Considering the amount of the expected

economic loss, the most affected sectors will be food services (total loss of €2 billion), accommodation (€1.7 billion), and travel agencies and tour operators (€1.7 billion).

Table 4 – Profitability evolution

Sector	Revenues Δ%	EBITDA Δ%	EBITDA margin (%)		ROE (%)	
			2020	pre-shock	2020	pre-shock
Agriculture	3.3	-14.9	6.6	8.0	0.5	2.1
Other manufacturing	-8.3	-25.0	7.4	9.0	3.7	9.3
Other services	-4.5	-18.7	12.6	14.8	2.9	6.9
Art, entertainment and recreation	-33.8	-106.1	-1.1	12.0	-25.1	1.6
Trade (wholesale and retail)	-3.5	-39.0	2.7	4.3	2.4	8.9
Construction	-3.2	-7.5	7.5	7.9	2.8	3.0
Energy and mining	-14.8	-5.7	12.9	11.7	4.5	9.8
Manufacture of machinery, motor vehicles and other transport equipment	-1.7	-14.4	7.5	8.6	4.3	7.5
Real estate	-12.4	-16.0	34.0	35.5	0.6	1.8
Food, textile, other industries	-10.1	-41.5	5.5	8.4	1.9	9.1
Accommodation and food services	-41.2	-140.2	-7.2	10.5	-16.7	3.3
Transportation and storage	-2.4	-7.6	13.3	14.1	4.1	6.1
Total	**-6.8**	**-24.7**	**7.2**	**8.9**	**2.5**	**7.1**

Source: Internal calculations based on Cerved data.
Notes: Cerved samples of 729,280 companies active in 2020. We exclude from the sample all firms that we know to have gone out of business in 2019.

The effects of the crisis on firms' leverage was estimated by adopting two different hypotheses regarding the possibility of covering the residual corporate liquidity needs after using cash and equivalents and undrawn margins on credit lines.

The first hypothesis (that we define as 'access to credit within the limits for credit guarantees') assumes that only companies that fulfil the requirements for accessing the guarantees provided by the Italian *Fondo di Garanzia* (Guarantee Fund) scheme (FCG) and by SACE can obtain new loans up to the established limits (the greater between 25 per cent of revenues and two times labour costs). Our estimate suggests that the additional amount of guaranteed loans would be €19 billion (of which €11 billion from the FCG and €8 billion from SACE). We also assume that the 32,000 companies that are unable to cover their residual liquidity needs may not be able to continue operating and, consequently, they would go into liquidation. These companies do not contribute to the calculation of leverage and the debt sustainability ratio, nor to the average default probability. In this hypothesis, the average capitalization of the corporations would be worse compared with 2018 (Table 5). We estimate an average increase of 1.2 percentage points in leverage, measured by the ratio between financial debts and their sum with equity. The increase in debt and the sharp decline in profitability[12] would cause a worsening of almost 3 percentage points in debt servicing capacity, measured by the ratio of interest expenses to EBITDA, and an increase in the debt-to-EBITDA ratio from 3.5 to 4.9 per cent.

[12] Total economy net profit would drop from about €82 billion to about €29 billion.

Table 5 – Leverage and debt sustainability evolution: access to credit within the limits for credit guarantees

Sector	Leverage (%)		Financial debt / EBITDA		Interest expenses / EBITDA (%)	
	2020	pre-shock	2020	pre-shock	2020	pre-shock
Agriculture	43.4	42.5	7.1	6.0	14.7	13.1
Other manufacturing	36.7	35.2	3.6	2.5	10.2	7.8
Other services	48.4	47.7	3.4	2.7	13.5	11.4
Art, entertainment and recreation	50.8	41.3	413.4	2.2	1837.2	12.1
Trade (wholesale and retail)	43.3	41.3	5.3	3.0	13.7	8.8
Construction	46.0	45.3	5.6	5.0	17.6	17.2
Energy and mining	46.1	46.6	5.0	4.9	13.1	13.2
Manufacture of machinery, motor vehicles and other transport equipment	34.2	31.0	3.1	2.2	8.2	7.1
Real estate	32.3	32.1	6.6	5.6	16.2	14.0
Food, textile, other industries	39.2	36.6	5.6	2.9	12.4	7.4
Accommodation and food services	47.7	41.6	EBITDA < 0	3.8	EBITDA < 0	11.2
Transportation and storage	66.6	67.1	7.8	7.0	10.0	9.5
Total	**43.6**	**42.4**	**4.9**	**3.5**	**12.9**	**10.0**

Source: Internal calculations based on Cerved data.
Notes: This sample only includes companies that have positive liquidity after the application of government support measures and the potential increase in debt from public guarantee schemes (696,889 companies).

The second hypothesis for the coverage of the residual corporate liquidity needs, on the other hand, assumes an unlimited debt capacity not constrained by companies' characteristics (that we define as 'unlimited access to credit'). In this case, by construction, no company would go out of business due to liquidity constraints,[13] and the increase in financial leverage would be more pronounced, equal to 1.6 percentage points (Table 6). Debt servicing capacity would worsen by nearly 4 percentage points while the financial debt-to-EBITDA ratio would rise from 3.8 to 5.6 per cent.

[13] The hypothesis that corporates can increase debt unconditionally keeps all the companies alive, including those that in the first hypothesis were not able to cover their liquidity needs. We note that their financial soundness in 2018 was worse than the average of corporates, as shown by the comparison between the pre-shock values in Table 6 (which includes them) and in Table 5 (which excludes them).

Table 6 – Leverage and debt sustainability evolution: 'unlimited access to credit'

Settore	Leverage (%)		Financial Debt / EBITDA		Interest expenses / EBITDA (%)	
	2020	pre-shock	2020	pre-shock	2020	pre-shock
Agriculture	45.2	43.9	8.6	6.9	17.9	15.2
Other manufacturing	37.6	35.7	3.9	2.6	11.0	8.3
Other services	51.0	49.4	3.9	2.8	16.7	13.6
Art, entertainment and recreation	53.2	43.0	EBITDA < 0	2.5	EBITDA < 0	13.2
Trade (wholesale and retail)	44.8	42.4	6.1	3.3	15.9	9.7
Construction	52.6	50.9	8.4	7.0	24.6	22.7
Energy and mining	47.6	48.1	5.0	4.6	14.3	13.5
Manufacture of machinery, motor vehicles and other transport equipment	35.1	31.7	3.2	2.3	9.2	7.9
Real estate	37.2	36.2	9.0	7.2	23.6	19.8
Food, textile, other industries	40.1	37.3	5.9	3.0	13.5	7.9
Accommodation and food services	51.3	44.9	EBITDA < 0	4.4	EBITDA < 0	12.6
Transportation and storage	59.0	58.6	8.2	7.1	11.8	10.9
Total	**45.2**	**43.6**	**5.6**	**3.8**	**15.2**	**11.5**

Source: Internal calculations based on Cerved data.
Notes: Cerved samples of 729,280 companies active in 2020. We exclude from the sample all firms that we know to have gone out of business in 2019.

In both scenarios, the average financial soundness of Italian non-financial corporates would be better than their condition after the sovereign debt crisis, in which leverage was 53 per cent on average and the ratio between interest expenses and EBITDA was 26 per cent.

4. Deterioration of corporates' risk profile

Decreasing profitability and increasing debt levels due to the pandemic will result in a deterioration of firms' creditworthiness (Table 7). Thanks to the Bank of Italy's In-House Credit Assessment System[14] (ICAS), the projection for the balance sheets allowed us to estimate the one-year default probability for a sample of 270,000 firms at the end of 2020, representing more than 70 per cent of all joint-stock company revenues.

In the hypothesis of access to credit within the limits for credit guarantees, default probability would increase by almost 0.6 percentage points, from 2.4 to 3 per cent. This estimate does not include the 13,000 firms (4.9 per cent of total) that would not be able to satisfy their liquidity needs and for which the default probability would therefore be equal to 100 per cent. The default probability would be higher in the accommodation and food service sector, increasing by almost 2.5 percentage points, from 3.2 to 5.5 per cent, and in art, entertainment and recreation, increasing by 1 point, from 3.1 to 4.1 per cent.

In the hypothesis of unlimited access to credit, default probability could increase to 4.4 per cent, almost one percentage point above the expected default rate before the COVID-19 shock. Again, the accommodation and food service and art, entertainment and recreation sectors would be the most affected, together with the real estate sector.

[14] The Bank of Italy's ICAS, definitively approved by the ECB Governing Council in July 2013, is its in-house system for assessing the credit risk of loans used as collateral in monetary policy operations.

Table 7 – Evolution of default probability (PD) (percentages)

Sector	access to credit within the limits for credit guarantees		unlimited access to credit	
	pre-shock	2020	pre-shock	2020
Agriculture	3.1	3.9	4.3	5.7
Other manufacturing	1.7	2.0	2.3	2.8
Other services	1.9	2.5	2.6	3.3
Art, entertainment and recreation	3.1	4.1	4.4	6.0
Trade (wholesale and retail)	2.3	2.7	3.0	3.6
Construction	3.8	4.1	6.0	6.9
Energy and mining	2.4	3.1	3.5	5.2
Manufacture of machinery, motor vehicles and other transport equipment	1.5	1.8	1.9	2.5
Real estate	3.1	3.9	5.2	6.8
Food, textile, other industries	1.9	2.7	2.7	3.8
Accommodation and food services	3.2	5.5	4.3	7.3
Transportation and storage	2.4	2.9	3.0	3.6
Total	**2.4**	**3.0**	**3.5**	**4.4**

Source: Our calculations based on Cerved and Financial Register data.
Note: The table reports the average default probability by sector. Calculations based on the ICAS sample, 268,379 firms in the unlimited access to credit scenario and 255,251 in the access to credit within the limits for credit guarantees scenario (13,028 firms leave the sample and could be liquidated).

Under both hypotheses, default probabilities would be lower than the maximum reached during the sovereign debt crisis (5.4 per cent in 2015), in line with a more solid financial and capital position.

The pandemic's negative effects are more evident/obvious when one considers the riskier tail of the distribution. By dividing the sample based on the creditworthiness classes used by the Eurosystem (Credit Quality Step or CQS),[15] we can see an increase in the number of firms belonging to the riskiest class (CQS 8, with a default probability higher than 5 per cent), from 10 per cent before the shock to 12.2 per cent (32,000 firms representing 16.1 per cent of all the financial debt stock) in the hypothesis of access to credit within the limits for credit guarantees. In this case, however, 5 per cent of firms, representing more than 10 per cent of all financial debt stock, would not be able to satisfy their liquidity needs and would be forced to liquidate. On the other hand, the unlimited access to credit scenario envisages a more pronounced increase in the share of riskier firms that would rise to 16.4 per cent (44,000 firms); these firms hold 22.9 per cent of financial debt stock, i.e. €168 billion, compared with 12.7 per cent before the shock.

[15] The Credit Quality Step distribution refers to the Eurosystem harmonized rating scale. In particular, CQSs are defined by the following threshold for default probability (PD): CQS 1-2, PD up to 0.1 per cent; CQS 3, PD up to 0.4 per cent; CQS4, PD up to 1 per cent; CQS 5, PD up to 1.5 per cent, CQS 6, PD up to 3 per cent; CQS 7 PD up to 5 per cent; and CQS 8, PD greater than 5 per cent. Loans to firms up to CQS 3 (investment grade) are individually accepted as collateral in the general framework of monetary policy, loans to firms up to CQS 5 are individually accepted as collateral in the Bank of Italy's temporary framework for Additional Credit Claims (ACC), whereas loans to firms riskier than CQS 5 are accepted as a portfolio of credits (until May 25 2020 there was a limit of 10 per cent on the PD).

Table 8 – Riskier firms and debt at risk (percentages)

	access to credit within the limits for credit guarantees				unlimited access to credit	
	Share of riskier firms[(a)]	Share of debt to riskier firms	Share of illiquid firm[(b)]	Share of debt to illiquid firms	Share of riskier firms[(a)]	Share of debt to riskier firms
Pre-shock	10,0	12,7			10,0	12,7
2020	12,2	16,1	4,9	10,2	16,4	22,9

Source: Our calculations based on Cerved and Financial Register data.
Notes: Calculation based on ICAS sample, 255,251 firms in the access to credit within the limits for credit guarantees scenario and 268,379 firms in the unlimited access to credit scenario. (a) The share of debt to riskier firms refers to firms with a PD higher than 5 per cent and (b) the share of illiquid firms refers to firms unable to satisfy their liquidity needs and that would consequently go into liquidation.

Appendix A – Methodological notes

A1. The evolution of liquidity and equity

The estimates provided in this note are based on a simple model of the evolution of firm liquidity and equity in the presence of revenue shocks, almost exclusively based on accounting variables that can be observed in annual balance sheets and income statements.

End-of-year liquidity is given by beginning-of-year liquidity plus cash flow. From an accounting point of view, end-of-year equity can be computed as beginning-of-year equity plus profits or losses ('accounting method'). However, in some analyses we use cash flow to predict future equity as well ('economic method'). Each of these methods has advantages and drawbacks. Initial equity is an accounting variable, so that the accounting method produces an accounting estimate starting from an accounting variable. Nonetheless, especially during crises, variations in income statement variables may show anomalous responses to revenue shocks. If this is the case, the accounting value of equity we will observe in 2020 balance sheets may not entirely reflect the firm's capital adequacy in the medium run; this issue is mitigated when using the economic method. On the other hand, the accounting value of equity retains its importance as it represents the firm's soundness in the short term, affecting for instance its ability to access loans and its credit standing.

Cash flow in year t equals

$$CF_t = r_t - c_t - \ell_t - \iota_t - \tau_t + x_t,$$

where r_t denotes firm revenues, c_t direct costs,[16] ℓ_t labour costs, ι_t financial expenditures (interest and principal payments), τ_t corporate taxes and x_t other income statement items to which cash inflows or outflows correspond. Thus, the evolution of liquidity is described by $L_{t+1} = L_t + CF_t$.

According to the economic method, the evolution of equity is given by $E_{t+1} = E_t + CF_t^e$. The major difference between the measure of cash flow used to compute liquidity (CF_t) and that used for equity (CF_t^e) is that ι_t includes principal payments in CF_t but not in CF_t^e. The reason for this distinction is that principal payments do not constitute an income statement item, to which cash flow used in the computation of equity through the economic method is limited by assumption.

According to the accounting method, the evolution of equity is $E_{t+1}^a = E_t + \pi_t$, where π_t are profits or losses in year t. Denoting with z_t all income statement voices to which no cash flow corresponds (e.g., depreciation and amortization), we have $\pi_t = CF_t^e + z_t$, so that

$$E_{t+1}^a = E_t + CF_t^e + z_t = E_{t+1} + z_t.$$

Notice that z_t can be either positive or negative, so that there is no ex-ante ordering between E_{t+1} and E_{t+1}^a.

Individual information on variations in firms' credit available in the Italian Credit Register (CR) is also used to evaluate the ability of firms to cover liquidity needs. Variations in credit are set to zero for the 330,000 firms not registered in the CR. For the remaining 400,000, we consider the evolution of credit drawn between February (the last month before the COVID-19 crisis) and July 2020 (the latest month for which these data are available). Both credit lines and term loans are included, while discount loans are not. Variations in these are strongly correlated with changes in revenues, so that by excluding them we avoid a double counting of cash flow reductions through both revenues and self-liquidating loans.

[16] We call 'direct costs' all those relating to the use of factors except labour (e.g., materials and services).

From now on, we illustrate the methodological details, taking the liquidity model $L_{t+1} = L_t + CF_t$ as reference. All observations extend to both models of equity evolution. To estimate firms' liquidity and equity after the COVID-19 shock, we first model the impact of the pandemic on the individual components of the income statement. In particular, we assume that COVID-19 only had a *direct* impact on revenues, and that this shock to revenues is indirectly transmitted to the other components of CF_t. Specifically, we assume that shocks to revenues are only transmitted to direct and labour costs, while all other variables can only be affected by government interventions after the shock has occurred.[17]

Our most recent accounting data refer to 2018. Revenue shocks are specified on a monthly basis (see Section 2 of this Appendix). In the absence of the COVID-19 shock, the projected value of liquidity at the end of 2020 would be $L_{2020} = L_{2018} + CF_{2018}$. The COVID-19 shock modifies firms' revenues in month m of 2020 from r_{2018m} to $r_{2020m} = (1 + g_m)r_{2018m}$.[18] A change $g_{c,m} = \eta_c g_m$ in direct costs and $g_{\ell,m} = \eta_\ell g_m$ in labour costs corresponds to a shock g_m to revenues. Thus, in the presence of the COVID-19 shock, the cash flow for 2020 is modified to

$$CF_{2020} = \sum_m (1 + g_m)r_{2018m} - (1 + \eta_c g_m)c_{2018m} - (1 + \eta_\ell g_m)\ell_{2018m} - \iota_{2018m} - \tau_{2018m} + x_{2018m}\,.$$

Estimates of the elasticities η_c and η_ℓ are obtained at the level of (macro-) sectors of economic activity.[19] For each sector s, we use balance sheet data for the period 2010-18 to estimate the elasticity of direct and labour costs to revenues ($\eta_{y,s}$ for $y \in \{c, \ell\}$), using the following equation

$$\log y_{i,t} = \eta_{y,s(i)} \log r_{i,t} + \gamma X_{i,t-1} + \theta_t + \zeta_i + \varepsilon_{i,t}\,,$$

where $s(i)$ is firm i's sector, $X_{i,t-1}$ is total assets in year $t-1$, and θ_t and ζ_i are year and firm fixed effects respectively. The observations are weighted by firm size (measured by total assets in year t). Table A.1 illustrates the estimated elasticities.

Table A.1 – Estimated elasticities by sector of economic activity

Sector (1)	**Direct costs**	**Labour costs**
A	0.81	0.37
BC	0.88	0.56
DE	1.11	0.32
F	1.04	0.28
G	0.93	0.55
H	1.39	0.26
I	0.71	0.90
IMMO (2)	0.80	0.15

[17] The tax component (τ_t) represents the corporate taxes due in the current year, which mostly depend on the previous year's profits only, and are therefore not affected by current revenues. VAT and labour taxes, which do depend on current revenues, are included in direct costs c and labour costs ℓ respectively. The simplifying assumption of zero elasticity of interest expenditures to revenues is not far from the elasticity estimated by the same methodology used for direct and labor costs (see below), which is less than 0.2 on average.

[18] All non-shocked monthly variables are equal to the original yearly value divided by 12.

[19] These sectors are: agriculture, forestry and fishing (A); mining, quarrying and manufacturing (BC); utilities (DE); construction (F); wholesale and retail trade (G); transportation and storage (H); accommodation and food service activities (I); information and communication (J); finance and insurance, real estate, professional, scientific and technical activities, support services (KN); public administration, social security, education and health (OQ); arts, entertainment and recreation (R); other services (S).

J	0.92	0.66
KN	0.69	0.51
OQ	0.79	0.97
R	0.87	0.46
S	0.71	0.84

Source: Our calculations based on Cerved data.
Notes: (1) Sector labels are defined in footnote 20. – (2) A category of firms with special balance sheet formats ('real estate and property management companies') are grouped under a single sector label ('IMMO'), independently of their NACE classification.

A2. Macroeconomic scenario and shocks to firms' revenues

Using high-frequency information on firms' revenues from several sources, we are able to obtain, for every month m from January to July 2020, the actual growth of revenues with respect to the corresponding month in 2019 for sector j ($g_{m,j}$).[20] This value is applied to all firms operating in sector j.

For the remaining months (August to December 2020), variations in revenues must be forecast. In our model, the growth rates with respect to the corresponding month of 2019 ($g_{m,j}, m \in \{8, \dots, 12\}$) are set equal to

$$g_{m,j} = \alpha_j + \beta \log m \,,$$

where α_j and β are calibrated so that[21]

(i) the growth rate in July matches the one observed in the actual data on firm revenues variations (i.e., $g_{7,j} = \alpha_j + \beta \log 7$);

(ii) the aggregate growth of value added for firms in our sample matches the aggregate growth in private sector value added consistent with the GDP growth forecasts published by the Bank of Italy for the Italian economy in July 2020.[22]

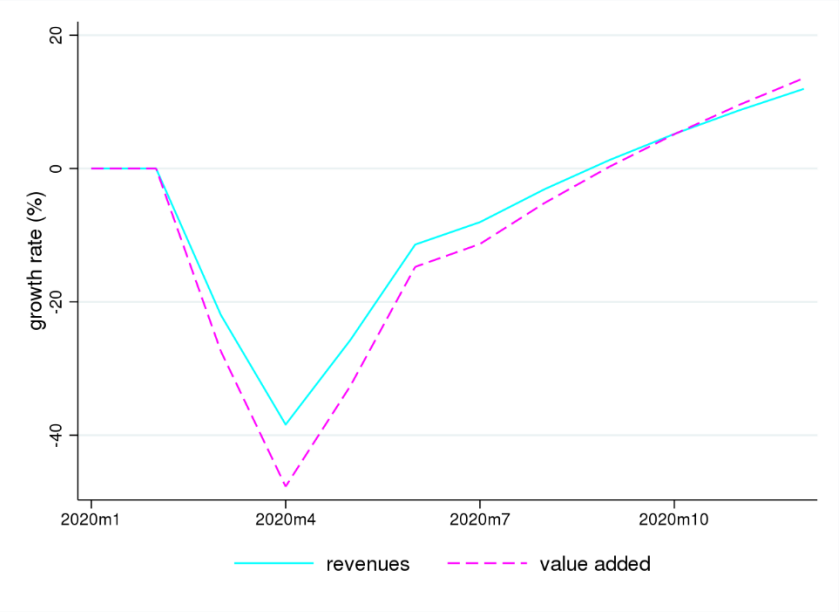
In firms' income statements, value added is the difference between revenues (r_t) and direct costs (c_t). In order to calibrate revenue shocks with a reference GDP growth rate, we use our estimate of the elasticity of direct costs to variations in revenue. Through this, we transfer shocks to revenues to (monthly) direct costs, to obtain a (monthly) shocked value added. These values are derived from the observed data for the months up to July, and depend on our choice of β for the following months, $m \in \{8, \dots, 12\}$. Summing up all months provides a growth rate for aggregate value added that depends on β. We then choose β so that the aggregate value added growth rate is consistent with the GDP growth rate forecast. This makes each projected sectoral growth rate of revenues for months $m \in \{8, \dots, 12\}$, in line with the global estimates for GDP growth.

The Bank of Italy produced two estimates of GDP growth, each corresponding to a baseline and a more pessimistic scenario. This note is entirely based on the first scenario. Figure A.1 reports the aggregate monthly growth rates of revenues and value added resulting from our calibration. Notice that our specification leads to a positive growth rate forecast for 2020 Q4 (with respect to the corresponding quarter in 2019). Because of differences in how accounting value added and macroeconomic value added are computed and of the restrictions imposed by our linear model of elasticities

[20] Notice that this sectoral partition ($\{j\}$) is a refinement of the one used to compute elasticities ($\{s\}$).
[21] Thus, by choosing this specification, we establish that the time trend of revenue shocks is common across sectors, but that levels may differ.
[22] Bank of Italy, *Economic Bulletin*, 3, 2020.

to revenues, in our setting, observed revenues data would lead to a larger decline in value added in 2020 Q2 with respect to the Bank of Italy's macroeconomic forecast. Hence, projected revenues and value added in the second half of the year must be positive enough to compensate the more negative performance in the second quarter.

Figure A.1 – Growth rates of revenues and value added



Source: Our calculations based on ISTAT data.

A3. The effect of government measures

Our analysis provides predictions of end-of-2020 firm liquidity and equity under the COVID-19 shock. Furthermore, we also quantify the potential effects of several measures enacted by the Italian government to counteract the pandemic's impact on the economy. In what follows, we illustrate our modelling choices for how these policies affect firms' accounting variables.

Short-time work schemes. The Italian government repeatedly extended the possibility for firms to reduce hours worked under the protection of part-time work schemes (labelled 'CIG' in this analysis, standing for cassa integrazione guadagni (wage supplementation), even though the extension also involved other wage-supporting tools). These instruments allow firms facing a decline in revenues to reduce labour costs at a greater rate than they can through ordinary channels (e.g. layoffs or non-renewal of temporary contracts). We model the presence of part-time work schemes by increasing the elasticity of labour costs to *negative* variations in revenues. However, since such tools cannot be used for all workers, we limit the value of this modified elasticity to 0.8. If a sector already has a 'natural' labour cost elasticity greater than 0.8, that value is retained even in the presence of the CIG. Hence the growth rate of labour costs for firms in sector a in any month m in which the CIG is available is

$$d\ell = \begin{cases} \eta_{\ell,s(a)} g_{m,a}, & \text{if} \quad g_{m,a} \geq 0 \\ \max\{0.8, \eta_{\ell,s(a)}\}\, g_{m,a}, & \text{if} \quad g_{m,a} < 0 \end{cases}$$

where $s(a)$ is the macro-sector (corresponding to the level of disaggregation at which elasticities are estimated) containing NACE 2-digit sector a.

Three policy interventions have enabled an increasingly extensive use of the CIG:

- Decree Laws 18/2020 ('Cure Italy') and 23/2020 ('Liquidity') enabled the use of the CIG throughout the months of March, April and May 2020.
- Decree Law 34/2020 ('Relaunch') extended the possibility to use the CIG to June and July.
- Decree Law 104/2020 ('August') extended this possibility until the end of 2020.

Debt moratorium. Debt moratoriums allow the payment of interest and capital instalments to be postponed for a period of time. We assume that when the moratorium ends, firms revert to their regular payment schemes and do not have to pay additional amounts on top of their regular instalments. Thus, a moratorium that extends for *n* months will reduce the total amount paid in the year by a proportion of *n*/12.

However, the debt moratoriums introduced by the Italian government have the following characteristics:

- they only apply to interest and capital payments *on long-term debt*;
- they only apply to SMEs that did not have non-performing loans as of 28 February 2020.

We assume that the proportion of financial expenses relating to long-term debt over total financial expenditure is equal to the proportion of the size of long-term debt over total debt (δ_{long}). If a moratorium is introduced for n months, the yearly amount of financial expenses is

$$\iota_t^{\text{mor}} = \left(1 - \frac{n}{12}\right)\iota_t + \frac{n}{12}\left(1 - \delta_{\text{long}}\right)\iota_t = \left(1 - \frac{n}{12}\delta_{\text{long}}\right)\iota_t$$

for eligible firms.

As happened with the CIG, the debt moratoriums were also progressively extended:

- Decree Law 18/2020 ('Cure Italy') introduce a debt moratorium to last until the end of September 2020 ($n = 7$).
- Decree Law 104/2020 ('August') extended the moratorium to the end of 2020 ($n = 10$).

We should recall that ι_t includes principal payments in exercises relating to liquidity, but not in those relating to equity.

Other measures. Decree Law 34/2020 ('Relaunch') contained several measures besides the extension of the CIG. First, firms whose revenues in the previous year were below €250 million obtain a refund on 40 per cent of production taxes ('IRAP'). Second, for the months of March, April and May 2020, firms that were subject to a decrease in revenues[23] of over 50 per cent in one/per month receive a direct contribution of 60 per cent of the amount of *rents* due that month. Third, firms whose revenues in the previous year were below €5million and were subject to a decrease in revenues of more than one third in April 2020[24] receive a direct grant in proportion to the loss of revenues

- 20 per cent of the loss if the previous year's revenues were below €400,000;
- 15 per cent of the loss if the previous year's revenues were between €400,000 and €1 million;
- 10 per cent of the loss if the previous year's revenues were between €1 and €5 million

These refunds, contributions, and grants are added directly to firms' cash flow.

[23] With respect to the corresponding month in 2019.
[24] With respect to April 2019.

Appendix B – Additional tables

Table B.1 – COVID-19 and undercapitalization (*economic method*)

	Undercapitalized Firms	% Operating Firms in 2018[1]	Workforce (thousands)	Equity Deficit (€ billions)	Firms no longer in a State of Crisis	of which: % in Crisis because of COVID
All firms in the sample	747.423		9.279			
All firms active in 2020	729.280		9.186			
Undercapitalized:						
in 2018	51.797	6,9	335	14		
without COVID	69.399	9,5	561	22		
With COVID but without support measures	89.385	12,3	1.053	25		
CIG for 9 weeks	87.809	12	997	25	1.576	89,5
Debt moratorium (until Sept. 2020)	88.353	12,1	1.047	25	1.032	59,1
Decree Laws 18 and 23/2020	86.806	11,9	991	25	2.579	76,7
CIG 9 for weeks	84.998	11,7	855	24	4.387	79,9
IRAP	86.605	11,9	988	25	2.780	78,1
Rent refund	84.602	11,6	961	24	4.783	86,0
Direct grants	82.961	11,4	973	24	6.424	78,2
Decree Laws 18, 23 and 34/2020	78.968	10,8	803	24	10.417	80,4
CIG for 9 months	78.426	10,8	720	23	10.959	80,9
Debt moratorium (until Dec. 2020)	78.610	10,8	801	24	10.775	78,8
Decree Laws 18, 23, 34 and 104/2020	78.059	10,7	718	23	11.326	79,3

Source: Our calculations based on Cerved, Central Credit Register and INPS data.
Notes: (1) The percentage is calculated with respect to all firms active in 2020, with the exception of the row 'in 2018' where the reference population is the whole sample of all firms active in 2018.