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The COVID-19 Shock and Equity Shortfall: Firm-level Evidence from Italy

Elena Carletti[♣], Tommaso Oliviero[♦], Marco Pagano[♥], Loriana Pelizzon[♠] and Marti G. Subrahmanyam[*]

Abstract

We forecast the drop in profits and the equity shortfall triggered by the COVID-19 lockdown, using a representative sample of 80,972 Italian firms. A 3-month lockdown entails an aggregate yearly drop in profits of about 10% of GDP and results in financial distress for 17% of the sample firms, employing 8.8% of the sample employees. Distress is more frequent for small and medium-sized enterprises, for firms with high pre-COVID-19 leverage, and those belonging to the Manufacturing and Wholesale Trading sectors. Listed companies are less likely to enter distress, while there is no clear correlation between distress rates and family firm ownership.

JEL Classification: G01, G32, G33.

Keywords: COVID-19, pandemics, losses, distress, equity, recapitalization.

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> "Is giving the already overleveraged corporate sector loans to infinity a good idea? [...] Might we all then be better off if these loans were fast converted into equity — strengthening corporate balance sheets and leaving the government with a portfolio of equity stakes along the way?" (Merryn Somerset Webb, *Financial Times*, 1 May 2020)

> "We have a huge opportunity now to replace government lending to companies in the Covid-19 crisis with equity purchases. Indeed, at current ultra-low interest rates, governments could create instantaneous sovereign wealth funds very cheaply." (Martin Wolf, *Financial Times*, 5 May 2020)

1 Introduction

All great economic crises pose two equally important challenges: they drain the liquidity necessary for the functioning of firms, and burn equity capital. Of these two, the first poses the most immediate challenge today: due to the COVID-19 shock, and the resulting lockdown, many companies have seen their revenues vanish even while their costs continue to accrue and, therefore, find themselves in a liquidity crisis. Liquidity support, however valuable to enable such firms to survive in the short term, is far from sufficient in the medium and long term. Indeed, as additional liquidity reaches companies in the form of debt, it tends to increase their indebtedness and default risk, thus generating debt overhang, which is known to deter firm investment (see Myers (1997) and Hennessy et al. (2007)), and to slow down the pace at which the economy recovers from crises (Kalemli-Ozcan et al., 2019).

This highlights the importance of assessing the magnitude of the firm equity erosion inflicted by the COVID-19 shock and, at least as importantly, its distribution across firms and sectors of the economy, to determine which ones are most likely to become under-capitalized or even distressed. Differently from typical macroeconomic shocks, the COVID-19 shock has hit different sectors with widely different severity: some firms have been severely affected by the lockdown and the social distancing requirements triggered by the pandemic, while others – such as those in high-tech industries – have even thrived in the midst of the lockdown. Clearly, assessing both the magnitude of the firm equity erosion and its distribution across firms in the ongoing crisis is a key pre-requisite to understanding the size and distribution of the equity injection required to rebalance the capital structure of firms, as the crisis abates.

In this paper, we attempt such a detailed assessment for Italy, the first economy in Europe to be seriously affected by the COVID-19 outbreak, and one of the most stressed since then. Importantly, we base our forecast of the net income losses due to the lockdown on a large, representative sample of 80,972 Italian firms, which accounts for a substantial proportion of the Italian economy. Drawing on such a large data set, mostly composed of privately-owned firms, enables us not only

to quantify the overall changes in firm leverage and the consequent distress due to the lockdown, but also to identify the characteristics of the most severely affected firms in terms of size, pre-crisis leverage, ownership structure, sector and location. Our analysis is based on 2018 data, which are the latest available.

We forecast that the firms in our sample would face an aggregate annual profit drop of €170 billion (roughly 10% of GDP in 2018) after a three-month lockdown. For the sub-sample of firms predicted to incur losses, the aggregate equity erosion is projected to amount to €117 billion – roughly 7% of Italian GDP in 2018. We predict the shock to force about 13,500 firms (i.e., 17% of the total) into negative net worth territory; overcoming the equity shortfall of these distressed firms would require an equity injection of €31 billion. The companies predicted to have negative net worth by the end of the year employ slightly over 800,000 workers, that is, 8.8% of the employees of our sample firms. If all of these firms were to go bankrupt, the resulting employment drop would exceed that occurred between 2007 and 2013, as a result of the financial crisis and of the ensuing sovereign debt crisis.

We hasten to emphasize that our exercise is fraught with difficulties, since the crisis may still unfold in manifold ways. The main unknown in our analysis is whether the economy will experience a sharp but short recession, with a fast rebound in 2021, or rather a scenario leading to a depressed economy for years to come, or some intermediate variant. To some extent, the eventual outcome depends on how the pandemic itself develops: while the initial lockdown has lasted for almost three months, possible subsequent waves of the epidemic may require further lockdown periods, possibly more limited in scope than the initial lockdown in March 2020. Therefore, in our exercise, we consider a range of possible scenarios, which differ in their assumptions about the duration of the lockdown, so as to allow for a possible resurgence of the disease.

To identify the effects of the COVID-19 shock, we assume that it induces a drop in firm revenues in each sector that is proportional to the fraction of value added forgone in the corresponding industrial sector as a result of the lockdown, while taking into account wage subsidies paid to inactive workers and reduced tax payments. This fraction is based on information regarding how essential each sector is to the population as deemed by the government, and how much its activity depends on close physical contact between workers and with customers. Based on the firms' estimated profit reduction, we calculate the resulting equity erosion for all firms, as well as the equity shortfall for the subsample of distressed firms, i.e., those ending up with negative book value of equity (net worth), as well as their distribution by firm characteristics.

Our results suggest that if all distressed firms were allowed to go bankrupt and be liquidated, the resulting increase in unemployment would be very large. This raises the question of whether

our prediction is too pessimistic. On the one hand, our forecasts might indeed be regarded as an upper bound, since the liquidity injections and guarantee programs enacted by the Italian government – currently amounting to €530 billion – may enable many of these firms to avoid bankruptcy and survive at least for some time, even though they may have negative net worth, in book terms. Other firms may be able to raise fresh equity capital, or to restructure their debt so as to return to solvency, particularly if they can access profitable growth opportunities.

On the other hand, however, our methodology could be questioned for resting on premises that are too optimistic, as we do not consider the supply-chain spillover effects between sectors due to the lockdown, the drop in demand likely to materialize once the lockdown is lifted, nor the increase in firms' costs due to social distancing requirements. In fact, our calculations assume that firms revert to their normal pre-COVID-19 revenue and cost structures *immediately* after the lifting of the lockdown while, in practice, they are most likely to do so only gradually, especially in sectors where social distancing rules are more problematic to enforce, such as Retail Trade and Tourism.

Insofar as the sectors most affected by the lockdown were to revert only gradually to their pre-COVID-19 levels after the lockdown is lifted, the forecasted equity funding needed to recapitalize Italian firms would rapidly escalate beyond the above-reported figures. This is because the shortfall grows non-linearly in the duration of the lockdown due to the convex characteristics of equity (i.e., its limited liability feature), even though the drop in profits is assumed to grow linearly in the lockdown duration. The predicted increase in the shortfall is particularly large for near-distressed companies with thin equity cushions. Indeed, if the reversion to near-normalcy is not immediate as assumed in our computations, then our estimates for the six-months lockdown scenario would be the most appropriate, implying a profit reduction of €321 billions (18% of the GDP in 2018) and a total equity erosion of €259 billions. This would push more than 30% of firms into distress with a total equity shortfall equal to €126 billion.

We also find that the COVID-19 shock would affect different firms with greatly disparate severity. Large companies are predicted to fare better than small and medium-sized enterprises (SMEs) for any assumed duration of the lockdown as they are generally better capitalized to start with: a three-month lockdown is predicted to lead to a 18.1% default rate for small firms, and a 14.4% default rate for medium-size ones, against only 6.4% for large firms. As small firms are under-represented in our sample, this provides an additional reason to suspect that our predictions may well under-estimate the impact of the COVID-19 shock on the frequency of distress and its consequences for employment.

Our results show that the firms that are projected to enter distress are typically not only

smaller, but are also characterized by lower profitability, lower capitalization and worse access to the equity market (publicly listed companies being far less likely to enter distress). Moreover, such firms are generally much more labor intensive than other firms, as they have far more employees relative to total assets, and a cost structure where labor costs weigh relatively more in total costs. These characteristics of the sample have two important implications. First, an equity injection that would bring these firms back to their pre-COVID-19 levels may still not address their inherent financial fragility, and potentially leave them exposed to a second round of external shocks. Second, as these firms are very labor intensive, their demise would imply many redundancies, with severe knock-on effects on demand, and indeed, the whole economy.

The predicted effects of the lockdown on firms' profits and equity differ vastly across industries. The profit drop is concentrated in Manufacturing and Wholesale Trading, which are respectively the first and third sectors by total assets and number of employees in Italy. Within Manufacturing, the most severely hurt sub-sectors are Fabricated Metal Products, Industrial and Commercial Machinery, Computer Equipment, and Transportation Equipment. Perhaps surprisingly, the profits and equity levels of firms in the Recreation Services and Tourism sectors are relatively lightly affected by the lockdown in our analysis. This may be the case because these sectors are highly labor intensive; consequently, most of their labor cost, i.e., their wage bill, was covered by public wage subsidies during the lockdown period, insofar as they were inactive. However, the profitability of these sectors may also be affected by social distancing policies for a longer time than other sectors, due to the lower physical distance between employees and customers in these sectors and, in general, by sluggish consumer demand for extended periods.

At a geographical level, the losses from the lockdown are more concentrated in the Northern regions, where most of Italian manufacturing firms, especially the largest ones, are headquartered. However, it should be emphasized that our results may well under-predict the extent to which profits and equity levels will drop for firms located in Central and Southern Italy. The reason is that in the industrial structures of these regions, Recreation and Tourism loom larger than in Northern Italy, which, as just explained, may take much longer to recover than Manufacturing, an effect which is not explicitly accounted for in our estimates.

The paper proceeds as follows. Section 2 describes the data, and Section 3 outlines our methodology. Section 4 presents our results for the whole sample, while Section 5 illustrates how they vary depending on various firm characteristics. Section 6 discusses the policy issues raised by our findings, and Section 7 concludes.

2 Data

We select all the non-financial Italian companies present in the ORBIS database of Bureau van Dijk that were active, employed more than 10 workers, and had at least €2 million of total assets in 2018. Hence, we exclude firms classified as micro-enterprises by the EU, mainly for consistency with the standard international definitions of small, medium and large companies, but also because data quality is typically worse for micro-enterprises.[1] Moreover, we retain in our sample only companies for which accounting data are available for 2017 and 2018. These screens in the construction of our dataset lead to a sample of 83,621 companies, for each of which we have balance sheet data for the period 2017-18.[2] We focus on accounting data for 2018 because, at the time of writing, 2019 data are available only for a few companies.

We eliminate from our sample all firms with negative equity both in 2017 and 2018, as well as those for which the sum of Net Income in 2018 and Equity at the end of 2017 is negative: the rationale is that we aim to investigate the impact of the COVID-19 shock on solvent firms and, therefore, we exclude from our sample firms that would have been in distress in any case, even absent the COVID-19 shock. Thus, our evaluation provides an assessment of the *incremental* effect of the COVID-19 shock on the financial performance and distress of Italian firms, and *not* its total effect, which would include the normal vicissitudes of firm performance.

In addition to the overall sample, we analyze sub-samples stratified by firm size, sector, leverage, ownership, and geographical location of firm headquarters. Firms are classified by size, based on EU definitions, into three sub-samples of small, medium-sized and large. Sectors and geographical areas are defined in line with the Italian National Institute of Statistics (ISTAT). Sectors are defined at the first SIC digit level but, for the manufacturing sector, a major segment of the economy, they are further broken down into finer sub-sectors.

We merge the balance sheet data for our sample firms with data on the forgone fraction of value added in each sector j due to the lockdown, which we denote by λ_j. To construct this variable, we start from the list of "essential" and "non-essential" sectors and sub-sectors as defined in governmental decrees (DPCM of 9, 11 and 22 March, and MISE decree of 25 March 2020): essential sectors and sub-sectors were allowed to continue operating even during the lockdown, while non-essential ones were allowed to operate only by tele-working. The government identi-

[1] Small firms are defined as those with less than 50 employees. Medium-sized firms are defined as those with between 50 and 250 employees. Large firms are defined as those with more than 250 employees and balance sheet totals of more than €43 million. See the classification by the EU Commission at https://ec.europa.eu/growth/smes/business-friendly-environment/sme-definition_en.

[2] Specifically, we downloaded the following financial items: Total Assets, Shareholders' Funds, Operating Revenue, Number of Employees, Net Income, Return on Equity (ROE), Financing Expenses, Employee Costs, Cash and Cash Equivalents, Debt, and Equity (Net Worth).

fied essential sectors and sub-sectors at the 4-digit classification level (according to their ATECO 2007 codes). Hence, λ_j is defined as the value added produced by sector j's non-essential sub-sectors divided by the total value added of sector j, net of the fraction of those sub-sectors' value added generated by tele-working employees. The data sources used to compute the fraction of the value added in each sector and sub-sector are drawn from national accounting data (produced by ISTAT), while the fraction of tele-working employees in each sector and sub-sector is based on Labor Force Survey data, as well as from the Professional Sample Survey (INAPP).

The values of λ_j for each sector are reported in Table 1. The table shows that the sectors most severely affected by the lockdown are Other Services (80.6%), Recreation Services (74.2%), Restaurants and Tourism (62.1%), Manufacturing (48.7%) and Construction (48.2%). We note the large variance within the Manufacturing and Construction sectors, as reported in the second and third panel of Table 1. In particular, within the Construction sector, we estimate a λ_j of 87.6% for General Contractors and Operations, and 5.2% for Heavy Construction. For Manufacturing, we estimate 84.5% for Furniture and Fixtures, and 5.3% for Chemicals and Allied Products. In Table 1, $\lambda_j = 0$ for some sectors, namely, Energy and Gas, Water, Waste, Transportation, and Health, as these sectors were considered essential by the government and, therefore, exempted altogether from the lockdown.

The distribution of firms differs widely across sectors and sub-sectors, as shown by the second column of Table 1. This aspect has an important bearing on our analysis. For example, the Restaurants and Tourism sector is significantly affected by the lockdown, but only includes 3,086 firms, accounting for less than 4% of our sample. Conversely, Manufacturing, which is, on average, less affected by the lockdown than Restaurants and Tourism, represents more than 37% of the firms in our sample. As we shall see, the severity of the predicted equity shortfall reflects the combination of these two aspects, i.e., (i) the severity of the lockdown in each sector and (ii) the number and type of firms belonging to that sector.

After merging firm-level data with our measure of the lockdown's severity, and cleaning and filtering the resulting data, we are left with a final sample of 80,972 companies and 9.014 million of employees. The first column in Table 2 provides the summary statistics for the whole sample as of 2018: all data are in millions of euros, except for the number of employees that is stated in units. For completeness, we also provide summary statistics on Total Equity at the end of 2017.

Table 1: Fraction of Value Added and Number of Firms Affected by the Lockdown

This table provides data on the fraction of value added lost, λ_j, for sector j, and the number of firms in sector j. The fraction of forgone value added in each sector reflects the fraction of value added of "non-essential" sub-sectors in that sector (based on the lists contained in governmental decrees), net of the fraction of those sub-sectors' value added generated by tele-working employees. Data sources: national accounting data, firm sectoral data and Labor Force Survey data (ISTAT), and data from the Professional Sample Survey (INAPP).

Sector j	Fraction of Sector's Value Added Affected by Lockdown (λ_j)	No. of Firms in Sector j
Sectors		
Agriculture and Food	5.3	4,829
Business services	2	7,972
Communications	.3	239
Construction*	48.2	6,545
Education	2.2	295
Energy and Gas	0	1,796
Extraction	29.4	342
Health	0	1,158
Manufacturing**	48.7	30,457
Other services	80.6	1,758
Real Estate	5.2	811
Recreation Services	74.2	780
Restaurants and Tourism	62.1	3,086
Transportation	0	4,566
Wholesale Trade	42.1	16,338
***Construction**		
General Contractors and Operations	87.6	2,566
Special Trade Contractors	44.5	3,072
Heamy Construction, Except Building Construction	5.2	907
****Manufacturing**		
Apparel, Finished Products from Fabrics	69.9	1,070
Chemicals and Allied Products	5.3	1,634
Electronic and Other Electrical Equipment	38.7	1,870
Fabricated Metal Products	78.7	6,640
Furniture and Fixtures	84.5	1,070
Industrial and Commercial Machinery	64.2	5,509
Leather and Leather Products	89.4	546
Lumber and Wood Products, Except Furniture	79.6	896
Measuring, Photographic, Medical and Optical	40.4	699
Miscellaneous Manufacturing Industries	27.5	557
Paper and Allied Products	19.2	1,171
Petroleum Refining and Related Industries	29.4	103
Primary Metal Industries	78.7	1,463
Printing, Publishing and Allied Industries	48.7	979
Rubber and Miscellaneous Plastic Products	45.4	2,571
Stone, Clay, Glass, and Concrete Products	70.1	1,461
Textile Mill Products	68.1	1,291
Transportation Equipment	76.7	927

Table 2: Firm Characteristics: Whole Sample

This table provides summary financial information for our sample of 80,972 companies. All values are averages of 2018 balance sheet figures. Total Equity is reported both in 2018 and 2017. The summary statistics in column (1) concern the entire sample, those in column (2) concern firms that are projected to suffer equity erosion after a 3-month lockdown, and those in column (3) concern firms projected to be in distress (i.e, those predicted to face an equity shortfall at the end of 2018) after a 3-month lockdown. The source of our data is Orbis (Bureau Van Dijk). All figures in the table are in millions of euros. Number of employees are in units.

	Firms in 2018 (1)	Firms with equity erosion after a 3-month lockdown (2)	Firms in distress after a 3-month lockdown (3)
Total Assets	44.31	29.07	13.75
Total Equity	16.61	9.83	1.44
Total Equity (2017)	15.35	9.44	1.29
Operating revenues	36.52	29.98	25.16
Net Income	1.29	0.36	0.11
Total cost net of employees' costs and tax	29.41	25.60	22.69
Cost of employees	4.97	3.67	2.25
Taxation	0.60	0.35	0.11
Number of Employees	111.32	84.26	58.46
ROE	10.66	6.46	9.11
ROA - EBIT over Total assets (%)	6.25	4.34	3.57
Z-score	6.80	6.30	4.43
Total Equity over TA (%)	32.81	29.68	10.46
Net working capital over Total assets (%)	21.24	19.23	8.31
Cash over TA (%)	10.70	9.03	7.18
Observations	80,972	57,248	13,529

Tables 3, 4 and 5 provide the same summary statistics for the three sub-samples of large, medium-sized and small firms. The tables show that, on average, large, medium and small firms employ 1,544, 128 and 23 employees, respectively. Firms differ also in terms of their accounting ratios. In particular, equity capitalization (defined as Equity over Total Assets) is higher for large firms (38.12%) than for medium-sized and small ones (32.51% and 32.6%, respectively). Their lower capitalization makes small and medium firms potentially more fragile than large ones in the face of adverse shocks to their profitability. The Return on Equity (ROE) is higher in small firms (10.94%) and medium ones (10.22%) than in large firms (8.17%), but the difference narrows considering the Return on Assets (ROA, i.e., Earnings Before Interest and Taxes over Total Assets), which is, on average, 6.27% for small firms and 6.19% for large ones. However, Cash over Total Assets ranges from 10.97% for small firms to 8.91% for large ones, so that the former have a larger liquidity buffer.

Table 3: Characteristics of Large Firms

This table provides summary financial information for our sample of 3,461 large companies. Large firms are defined as those with more than 250 employees and balance sheet totals of more than €43 million. All values are averages of 2018 balance sheet figures. Total Equity is reported both in 2018 and 2017. The summary statistics in column (1) concern the sample of large firms, those in column (2) concern large firms that are projected to suffer equity erosion after a 3-month lockdown, and those in column (3) concern large firms projected to be in distress (i.e, those predicted to face an equity shortfall at the end of 2018) after a 3-month lockdown. The source of our data is Orbis (Bureau Van Dijk). All figures in the table are in millions of euros. Number of employees are in units.

	Firms in 2018 (1)	Firms with equity erosion after a 3-month lockdown (2)	Firms in distress after a 3-month lockdown (3)
Total Assets	703.64	496.51	279.18
Total Equity	257.16	172.18	30.41
Total Equity (2017)	244.43	168.16	29.98
Operating revenues	521.56	490.57	566.19
Net Income	19.58	5.30	0.08
Total cost net of employees' costs and tax	418.40	419.90	520.19
Cost of employees	72.08	58.77	44.15
Taxation	9.33	6.61	1.77
Number of Employees	1543.65	1287.72	1068.79
ROE	8.17	1.60	-4.41
ROA - EBIT over Total assets (%)	6.19	4.01	2.42
Z-score	6.75	6.20	4.20
Total Equity over TA (%)	38.12	35.13	14.40
Net working capital over Total assets (%)	17.24	15.03	4.06
Cash over TA (%)	8.91	7.42	5.62
Observations	3,416	1,860	219

Table 4: Characteristics of Medium Firms

This table provides summary financial information for our sample of 18,837 medium companies. Medium-sized firms are defined as those with between 50 and 250 employees. All values are averages of 2018 balance sheet figures. Total Equity is reported both in 2018 and 2017. The summary statistics in column (1) concern the sample of medium firms, those in column (2) concern medium firms that are projected to suffer equity erosion after a 3-month lockdown, and those in column (3) concern medium firms projected to be in distress (i.e, those predicted to face an equity shortfall at the end of 2018) after a 3-month lockdown. The source of our data is Orbis (Bureau Van Dijk). All figures in the table are in millions of euros. Number of employees are in units.

	Firms in 2018 (1)	Firms with equity erosion after a 3-month lockdown (2)	Firms in distress after a 3-month lockdown (3)
Total Assets	33.80	31.87	22.60
Total Equity	12.91	10.68	2.40
Total Equity (2017)	11.88	9.88	2.08
Operating revenues	35.65	35.63	40.49
Net Income	1.09	0.45	0.21
Total cost net of employees' costs and tax	28.73	29.93	35.89
Cost of employees	5.34	4.92	4.21
Taxation	0.48	0.33	0.18
Number of Employees	128.30	118.93	117.69
ROE	10.22	5.09	6.74
ROA - EBIT over Total assets (%)	6.22	4.33	3.49
Z-score	6.63	6.17	4.25
Total Equity over TA (%)	32.51	30.12	11.31
Net working capital over Total assets (%)	20.14	17.95	5.39
Cash over TA (%)	10.19	9.00	8.27
Observations	18,837	12,287	2,699

Table 5: Characteristics of Small Firms

This table provides summary financial information for our sample of 58,719 small companies. Small firms are defined as those with less than 50 employees and balance sheet total of more than €2 million. All values are averages of 2018 balance sheet figures. Total Equity is reported both in 2018 and 2017. The summary statistics in column (1) concern the sample of small firms, those in column (2) concern small firms that are projected to suffer equity erosion after a 3-month lockdown, and those in column (3) concern small firms projected to be in distress (i.e, those predicted to face an equity shortfall at the end of 2018) after a 3-month lockdown. The source of our data is Orbis (Bureau Van Dijk). All figures in the table are in millions of euros. Number of employees are in units.

	Firms in 2018 (1)	Firms with equity erosion after a 3-month lockdown (2)	Firms in distress after a 3-month lockdown (3)
Total Assets	9.33	8.10	6.02
Total Equity	3.80	2.57	0.61
Total Equity (2017)	3.14	2.47	0.50
Operating revenues	8.58	8.49	10.09
Net Income	0.28	0.12	0.08
Total cost net of employees' costs and tax	7.18	7.35	9.07
Cost of employees	0.98	0.93	0.89
Taxation	0.13	0.08	0.06
Number of Employees	22.55	22.44	22.54
ROE	10.94	7.06	10.00
ROA - EBIT over Total assets (%)	6.27	4.35	3.62
Z-score	6.86	6.34	4.48
Total Equity over TA (%)	32.60	29.33	10.16
Net working capital over Total assets (%)	21.82	19.78	9.14
Cash over TA (%)	10.97	9.10	6.93
Observations	58,719	43,101	10,611

Labor costs (Employee Cost) range from 0.98 to 72.08 million, on average, and correspond to an average cost per employee of €46,694 for large firms, and €43,555 for small firms. Hence, the cost per employee does not differ widely with firm size, implying that the labor cost subsidy per employee during lockdown is quite balanced across firm size sub-samples. However, total costs net of employees' cost and tax, scaled by operating revenues, are larger for small firms (about 83%) relative to medium-sized and large firms (slightly above 80%), indicating a higher operating leverage (fraction of fixed costs in total costs) for the smaller firms in our sample.

To better assess the creditworthiness of these different firms, we employ the Altman Z-score based on the yearly values of four key financial ratios according to the formula proposed by Altman et al. (2014) for firms for which only the book value of equity (as opposed to the market value) is available. This calculation also allows us to assess to what extent firm solvency deteriorates as a result of the COVID-19 shock. For each firm i in the sample, we measure the Altman Z-score, according to

$$z_{it} = 3.25 + 6.56 \cdot x_{1it} + 3.26 \cdot x_{2it} + 6.72 \cdot x_{3it} + 1.05 \cdot x_{4it}, \tag{1}$$

where x_{1it} is the ratio of the Working Capital of firm i to its Total Assets, x_{2t} is the ratio of Capital Reserves to Total Assets, x_{3t} is Earnings Before Interest and Taxes scaled by Total Assets, and x_{4t}

is the ratio of the Book Value of Equity to Total Liabilities, each measured in accounting year t[3]. Tables 3, 4 and 5 show that the Z-score is very similar across firm size classes, as it ranges from 6.75 for large firms, to 6.63 for the medium and 6.86 for the small firms. This indicates that, on average, there is no significant difference in terms of creditworthiness among the three types of firms that we investigate prior to the COVID-19 shock.

Comparing the number of firms and employees in our database with those reported by ISTAT for 2017 (the latest available data), it emerges that our sample under-represents small firms, as it does not include those with less than €2 million of Total Assets. ISTAT reports that firms with more than 9 employees (excluding Agriculture) have 7,808,000 employees, of which 40.5% are in small firms, 24.6% in medium firms, and 35% in large firms. In our sample, the share of employees working in small firms is only 15.3%, while the shares of employees in medium and large firms are 27.0% and 57.7% respectively, as illustrated by Figure 1. The figure also reports the allocation of Total Assets in our sample, which largely mirrors that of employees, i.e., 15.1%, 18.3% and 66.5% for small, medium and large firms respectively.

Figure 1: Shares of Total Assets and Employees in Large, Medium-Sized and Small Firms

The figure shows the proportions of large, medium-sized, and small firms in our sample, as defined by European Commission, in terms of total assets and employees. The source of our data is Orbis (Bureau Van Dijk) and the data are for 2018.

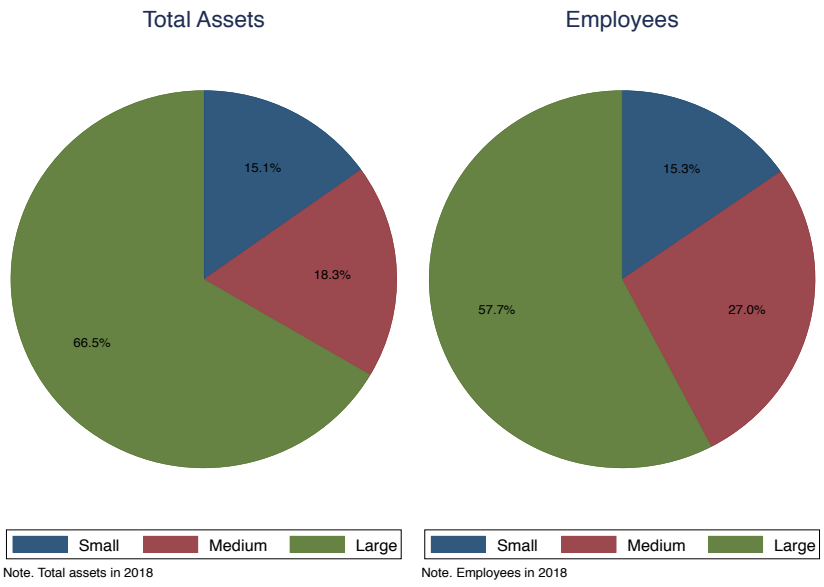


Figure 2 presents the distribution of Total Assets by sector: Manufacturing is the sector with the largest Total Assets (829 billion), followed by Business Services (618 billion). It is also the sector featuring the largest number of employees (2,441,000), again followed by Business Services

[3]See Altman et al. (2020) for the calibration of the Z-score model to Italian firms.

(2,161,000), as shown in Figure 3.

Figure 2: Total Assets by Sector

The figure shows the total assets by sector, in our sample, from national accounting and firm sectoral data as defined by ISTAT. The source of our data is Orbis (Bureau Van Dijk) and the data are for 2018.

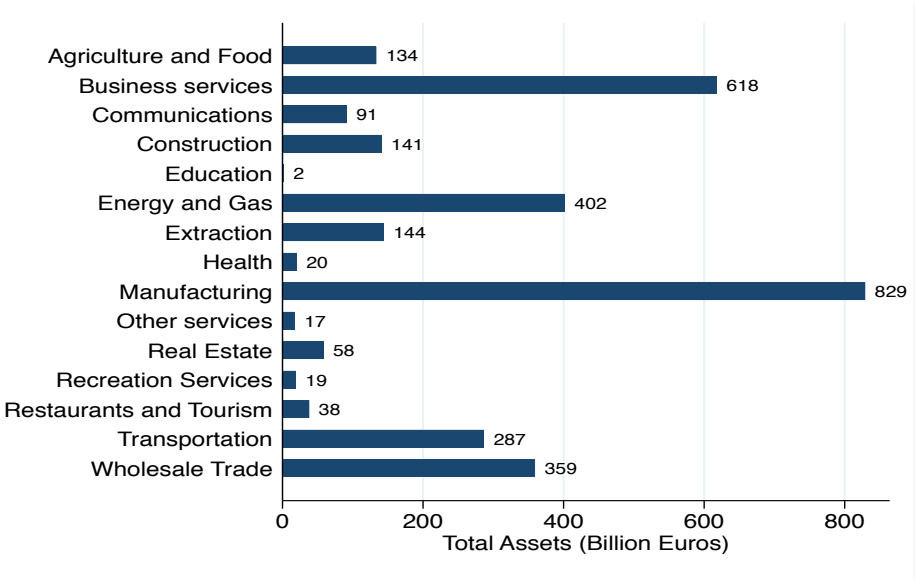
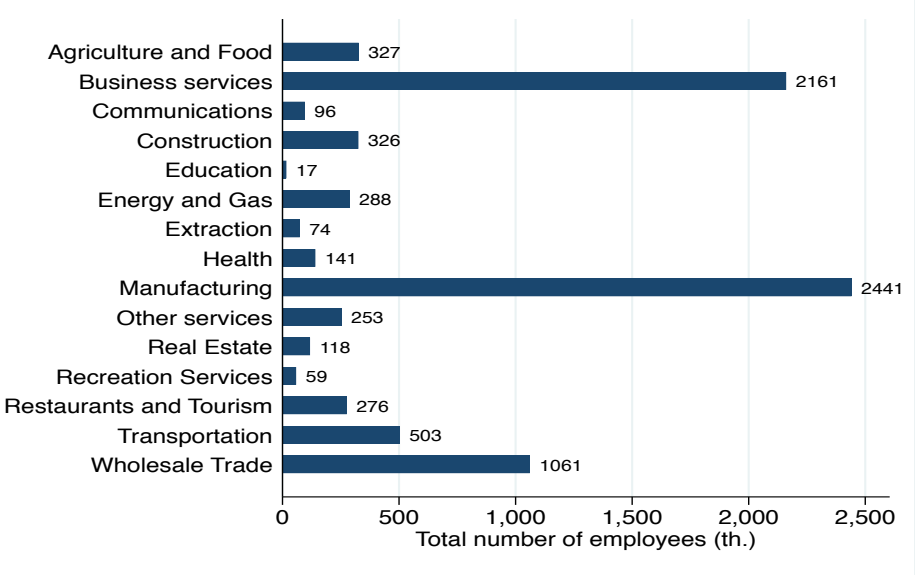


Figure 3: Number of Employees by Sector

The figure shows the number of employees by sector, in our sample, from national accounting and firm sectoral data as defined by ISTAT. The source of our data is Orbis (Bureau Van Dijk) and the data are for 2018.



3 Methodology

Based on the above dataset, we estimate the net income losses due to the lockdown for each company in our sample. The key idea is to use 2018 balance sheet data for firms present in the ORBIS database at the end of 2017, and featuring a positive book value, and then simulate the impact of the COVID-19 lockdown on their operating revenues, labor and non-labor costs, taxes and profits.[4] This approach has the disadvantage of basing our analysis on the Italian economic conditions in 2018, rather than in 2020, but has several advantages. First, the difference between the economic situation in Italy in 2018, and that at the beginning of 2020 before the COVID-19 shock was rather small due to anemic economic growth. GDP growth was 0.8% in 2018 and 0.3% in 2019, and its 2020 forecast by ISTAT was 0.6%. Therefore, the economic outlook and also the values we observe are roughly similar between 2018 and the projections for 2020.

Second, simulating the COVID-19 shock based on actual historical data, rather than forecasts, provides an immediate counterfactual to evaluate the equity injections required to restore firms' solvency following the COVID-19 shock. This rules out confounding factors due to estimation errors that may affect the forecast of balance-sheet variables in 2020, absent the COVID-19 shock. Third, our approach is simple and intuitive: we effectively simulate what would have happened if the 2020 COVID-19 shock had occurred in an economic situation identical to that of 2018.

We proceed as follows. For firms in sectors unaffected by the lockdown, we consider the actual profits realized in 2018, equal to operating revenues y_i minus labor costs w_i, non-labor costs z_i and taxes τ_i:

$$\pi_i = y_i - w_i - z_i - \tau_i, \tag{2}$$

In contrast, in sectors affected by the lockdown, both revenues and costs are assumed to be lower: on the one hand, the operating revenues of firm i in sector j are assumed to drop by the fraction of the sector j's value-added affected by the lockdown (i.e., the fraction λ_j shown in Table 1); on the other hand, the labor costs of firms operating in these sectors are correspondingly reduced, the wages of inactive employees being covered by the Italian government under its "Cassa Integrazione Guadagni"(CIG) scheme. We capture this labor cost subsidy to affected companies by assuming that in sector j, firms save a fraction λ_j of their wage costs w_i. Non-labor costs, z_i, include both fixed costs and material costs before taxes, and are assumed not to vary as a result of the COVID-19 shock.[5] Taxes τ_i are instead assumed to drop by the same fraction as operating

[4]Orbis defines Operating Revenues as the sum of Revenues from Goods Sold, Production, Revenues from Sale or Fixed assets and Material Sold, Other Operating Revenues, and Transfer of Operating Revenues.

[5]The assumption that material costs (and hence z_i) did not vary much even in sectors affected by the lockdown is reasonable, in view of the unanticipated and sudden nature of the COVID-19 shock. In a different vein, Schivardi et al. (2020) assume an elasticity of material costs with respect to sales in Italian firms equal to 0.5. We report the results

revenues for the duration of the lockdown. Hence, the yearly profit (or loss) for firm i in sector j, as a result of the shock, after X months of lockdown, is assumed to be:

$$\hat{\pi}_i(X) = (y_i - w_i - \tau_i)\left(1 - \frac{X}{12}\lambda_j\right) - z_i, \tag{3}$$

where the operating revenues y_i, the cost of employees w_i and taxes τ_i of firm i, are calculated by re-scaling each firm's revenues and variable costs in 2018 by the fraction of lockdown months $X/12$, multiplied by sector j's lockdown severity λ_j.

The annual profits of each company are simulated for six hypothetical scenarios featuring different lockdown durations – from 1 to 6 months. For each duration, the annual simulated profits of each firm based on equation (3) are the sum of its profits during the X lockdown months and those in the non-lockdown $12 - X$ months.[6] Based on these simulated profits, we calculate both the drop in profits relative to the non-lockdown scenario and the year-end equity erosion for each company in the sample, defined as the difference between its equity at the end of 2017 and its profit reduction associated with a hypothetical lockdown of X months in 2018. A firm is projected to be distressed if it is estimated to have negative net worth by the end of 2018, not by the end of the assumed lockdown period of X months. This implies that firms affected by the lockdown are assumed to go back to their normal level of revenues (and to lose eligibility for wage subsidies as well as tax reductions) as soon as the lockdown is lifted. Hence, assuming say a three-month lockdown, firms are predicted to have nine months of normal (i.e., no-COVID-19-affected) profits. As mentioned earlier, this assumption is doubtless optimistic and may well bias our estimates of the proportion of distressed firms downwards.

Reliance on end-of-2017 book values and on 2018 profit data may lead to overestimating the incidence of distress, as we neglect the profits in 2019 and 2020 that may have allowed firms to achieve somewhat higher equity cushion, had they not been distributed as dividends. Conversely, these assumptions may lead to an underestimate of the incidence of distress insofar as we ignore losses that firms may have experienced in 2019. However, sticking to 2018 realized data enables us to avoid making assumptions (and producing predictions) about the dynamics of profit and losses of these firms in 2019 and 2020.

We also calculate the percentage of companies forced into distress by the lockdown, i.e., those whose year-end projected cumulative losses exceed their initial equity, assuming a lockdown of X

based on this alternative assumption as a robustness check in the Online Annex.

[6]This assumes a uniform distribution of profits over the year and, therefore, neglects their seasonality, which may be important in some sectors such as Tourism. Of course, since the definition of the lockdown parameters themselves are estimates, this is not likely to be of any consequence for the first-order calculations that we are attempting, and would decline with the duration of the lockdown.

months. These are firms that, absent a re-capitalisation, are predicted to have year-end negative book value. Of course, these companies need not necessarily go bankrupt if they have access to liquidity in the form of bank loans or bond issuance, for instance as a result of government guarantees, or if they can persuade their creditors to restructure their liabilities, or if they can raise equity via new share issuance. It should also be noted that all our calculations are based on book values, and to the extent that market values deviate from the book values, a firm may have a negative net worth on a book basis, and yet be viable in the eyes of the market (or the opposite).

Finally, it is worth highlighting two other possible limitations of our methodology. For simplicity, we assume (i) the lockdown to be lifted simultaneously in all sectors and (ii) the profits of each firm to go back to "normal" as soon as the lockdown is lifted. In practice, the lockdown period may differ across sectors, being shorter in productive sectors where social distancing is less problematic. Moreover, revenues and profits are likely to revert to the pre-lockdown level only gradually, and at different speeds across sectors: in some, such as Tourism, they are likely to take much longer to recover than in others, again because social distancing requirements pose greater challenges. On the whole, the fact that the post-lockdown recovery is going to be gradual in most sectors suggests that the 3-month lockdown scenario that we present as our baseline should really be considered as a lower bound: predicted losses, equity shortfall and defaults may well be more accurately approximated by those that we report for a longer lockdown period.

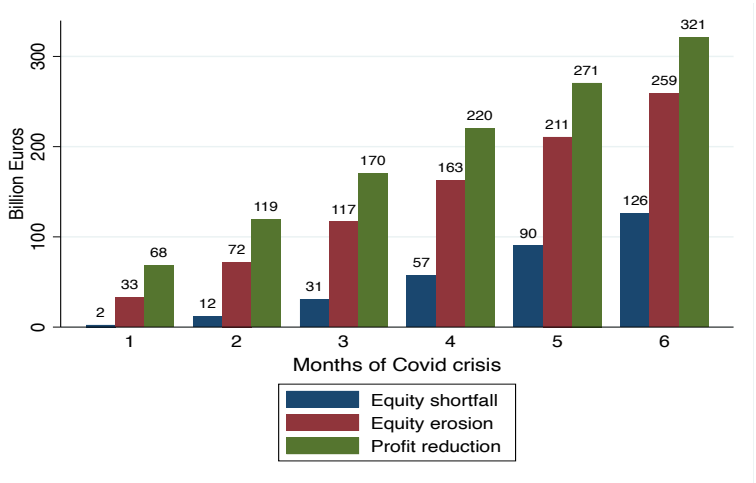
4 Aggregate Effect of the Lockdown

The main objective of this paper is to assess the extent to which the lockdown due to the COVID-19 pandemic eroded the equity of Italian firms by inflicting losses on them. Figure 4 presents our forecast of the change in profits and the resulting equity erosion (i.e., the reduction in firm equity due to losses) and equity shortfall (i.e., the amount of negative net worth of distressed companies) for the entire sample of firms, for alternative scenarios regarding the duration of the lockdown. Specifically, the green bars show the aggregate lockdown-induced reduction in profits for the whole sample relative to the profits under no-lockdown scenario (which coincide with those realized in 2018 – the counterfactual for our analysis). The red bars measure the aggregate equity erosion, i.e., the total losses for the sub-sample of firms that, according to our simulation, experience lockdown-induced losses and, thus, a reduction in the book value of their equity relative to the initial level (as of the end of 2017): hence, this is the total sum that would be required to restore firm equity to its value in a no-COVID-19 scenario. Finally, the blue bars measure the equity shortfall for the sub-sample of distressed firms, i.e., those that end up with negative year-end net worth, due to the lockdown: this can be thought as the total sum required to bring distressed

firms (barely) back to solvency.

Figure 4: Lockdown Effect on Profits and Equity: All Firms

The figure shows the annual financial projections for the whole sample of firms, as a function of the lockdown duration. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).



The figure shows that, after a three-month lockdown, the firms in our sample are projected to experience an annual drop in profits of €170 billion. Such a lockdown is sufficient to trigger an equity erosion of €117 billion, €86 billion of which arising in firms facing losses but retaining a positive year-end book value, and €31 billion of equity shortfall in distressed firms. As shown in Table 2, a three-month lockdown would erode the equity of 57,248 firms, i.e., 71% of our sample. Moreover, it would force as many as 13,529 firms into distress out of 80,972 (see column 3), implying a 17% default rate in the absence of any debt restructuring or equity injection.[7]

Since the firms predicted to enter distress employ 790,905 employees, i.e., almost 9% of the 9,013,803 employees in our sample, the employment drop resulting from their bankruptcy and liquidation would be of significant macroeconomic relevance. To put its magnitude in perspective, one should consider that between 2007 and 2013, i.e., the years of the financial crisis and of the subsequent sovereign debt crisis, employment dropped by about 774,000 units for a similar sample of Italian firms (i.e., those with at least 10 employees and belonging to the same sectors).[8] Hence, the employment drop predicted to result from a 3-month lockdown exceeds that resulting from close to six years of almost uninterrupted financial crisis.

[7]If we use the elasticity of material costs with respect to sales in Italian firms equal to 0.5 as in Schivardi et al. (2020) the impact of the COVID-19 shock on firm's profits and equity is milder than in our estimates. For example, the fraction of distressed companies resulting from a 3-month lockdown drops from 17% to 11%.

[8]This estimate is based on Bank of Italy data, drawn from the Appendix to the 2013 Bank of Italy Annual Report, Table a9.9, and on ISTAT industry-level data.

Figure 4 also shows that a six-month lockdown would entail a €321 billion drop in aggregate yearly profits, a €259 billion equity erosion for the whole sample, and a €126 equity shortfall for distressed firms. In fact, the equity shortfall grows non-linearly as a function of lockdown duration, especially for distressed companies, even though profits decrease linearly by construction, given our assumption that the impact of the lockdown on profits is uniformly distributed across months. After four months, the predicted equity shortfall for distressed companies is 84% larger than that predicted after three months, but it becomes 190% larger after five months, and 306% larger after six. This is due to the optionality of the equity contract, i.e., to the limited-liability option enjoyed by shareholders.

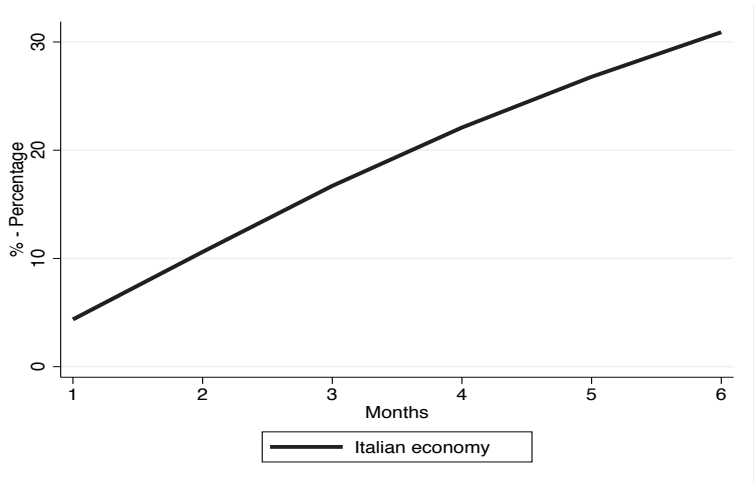
By the same token, the distress rate is also increasing in lockdown duration, as shown by Figure 5: a six-month lockdown would force about 33% of firms into financial distress (i.e., more than 26,000 companies in our sample), almost twice as large as the distress rate predicted for a three-month lockdown.[9] While such a long lockdown period may be considered unrealistic, a full immediate recovery of economic activity after *three months* (as is assumed in our 3-month lock-down scenario) is also quite unrealistic. As underscored for example by Philip Lane, the ECB's chief economist, "it is likely to take at least *three years* for the Eurozone economy to fully recover from the extraordinary and severe shock of the coronavirus crisis" (emphasis added).[10] In line with this possibility, one could also interpret a longer period of lock-down as capturing a more prolonged period of stress in terms of weaker demand, and thus lower revenues. Note, however, that once the lockdown is lifted, firms may no longer benefit from the same advantages as during the crisis, in terms of reduced workers' payments or lower taxes. From this perspective, the losses produced by our simulations even for a six-month lockdown may be underestimated, in particular for highly labor-intensive firms.

[9] Recall that the distress rates shown in Figure 5 are *exclusively* due to the lockdown associated with the COVID-19 shock; absent this shock, no firm would be distressed, as our sample only includes firms with positive (beginning- and end-of-year) book equity.

[10] "Eurozone recovery to take three years, warns ECB's chief economist", Financial Times, 1 May 2020.

Figure 5: Distress Rate by Lockdown Duration

The figure shows the distress rates for the whole sample of firms as a function of the lockdown duration. Distress rate is defined as the fraction of firms in the sample whose annual losses after X months of lockdown exceed total beginning-of-year equity (taken to be equal to its book value at the end of 2017). Data source: Orbis (Bureau Van Dijk).



5 Distributional Effects of the Lockdown

The evidence presented in Section 4 gauges the size of firms' aggregate losses resulting from the lockdown and the resulting aggregate equity erosion. However, understanding how losses are distributed across firms is equally important, as it determines which of them are most likely to become under-capitalized or even distressed. As such, it is also a pre-requisite to guide any policy aimed at injecting equity in firms so as to rebalance the capital structure of the most affected ones.

Table 2 provides a first indication of how firm characteristics affect the impact of the COVID-19 shock on firm losses and equity. First, comparing the second and third columns of the table highlights the role of firm size: the firms suffering equity erosion (column 2), and especially those ending up in distress (column 3), are mostly small. That small firms are more likely to enter distress after a three-month lockdown can also be inferred from column 3 of Tables 3, 4 and 5.

Moreover, the descriptive statistics in Table 2 indicate that firms ending in distress are less capitalized than the larger group of those that suffer equity erosion due to the lockdown: the former were already highly indebted even in the absence of the COVID-19 shock, with an Equity-Total Assets ratio of 10.46%, while the corresponding figure for the latter is 29.68%. Being highly leveraged to begin with, distressed firms earn an average ROE of 9.11% but an average ROA equal to only 3.57%, i.e., about half the whole sample average, and have a Z-score of 4.43, corresponding to 65% of the average Z-score in the whole sample.[11]

[11]This finding is not unique to Italian firms: the average U.S. firm going into distress after the COVID-19 outbreak already had a junk bond rating (B+) before the outbreak, to be compared with an A rating for the average firm, while

Table 2 also reveals that distressed firms are much more labor intensive than other firms: they have far more employees relative to total assets, and a cost structure where labor costs weigh relatively more in total costs (net of employees' costs). Hence, their demise would imply massive redundancies.

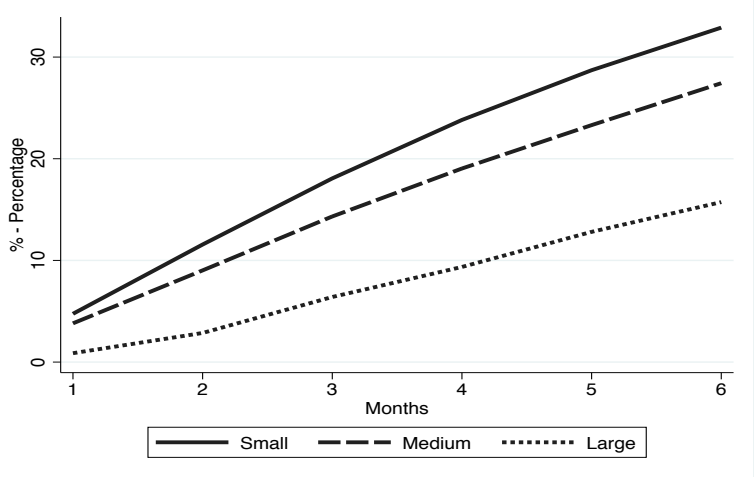
In what follows, we analyze in greater depth how the effects of the COVID-19 shock vary depending on firm size, leverage, ownership, listing status, industry and location, considering different scenarios about the lockdown duration.

5.1 Firm Size

Figure 6 confirms that the impact of the lockdown differs widely for large, medium and small firms: after a three-month lockdown, the distress rate is 6.4% for large firms, while it equals 14.3% for medium firms and 18.1% for small firms. In all the lockdown scenarios considered, the distress rate of small firms exceeds that of other firms, ranging from 4.7% for a one-month lockdown to 33% for a six-month one. The second most affected firms are medium ones, with a distress rate between 3.8% and 27%, and the least affected are large firms, with a distress rate ranging from 0.9% to 15.7%, depending on the duration of the lockdown.

Figure 6: Distress Rate by Lockdown Duration and Firm Size

The figure shows the distress rates for the groups of large, medium and small firms as a function of the lockdown duration. Distress rate is defined as the fraction of firms whose annual losses after X months of lockdown exceed total beginning-of-year equity (taken to be equal to its book value at the end of 2017). Data source: Orbis (Bureau Van Dijk).



The impact of the lockdown on profit reduction and equity erosion also differs widely across the sub-samples of large, medium and small firms, as shown by Figures 7, 8 and 9: large compa-

those that only experienced only equity erosion have an A rating. These figures are based on 94 Chapter 11 bankruptcy filings, 2010-2013. Sources: Compustat, Company Filings and S&P. We thank E.Altman for providing us these data.

nies suffer a considerably larger aggregate drop in profits and equity erosion than either medium-size or small companies. Yet, being initially better capitalized, they do not suffer a commensurately larger equity shortfall: indeed, their equity shortfall after a 3-month lockdown (€10 billion) is the same as for medium-size firms, and slightly lower than for small firms (€11 billion).

Figure 7: Lockdown Effect on Profits and Equity: Large Firms

The figure shows the annual financial projections for large firms, defined as those with more than 250 employees and balance sheet total of more than €43 million, as a function of the lockdown duration. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).

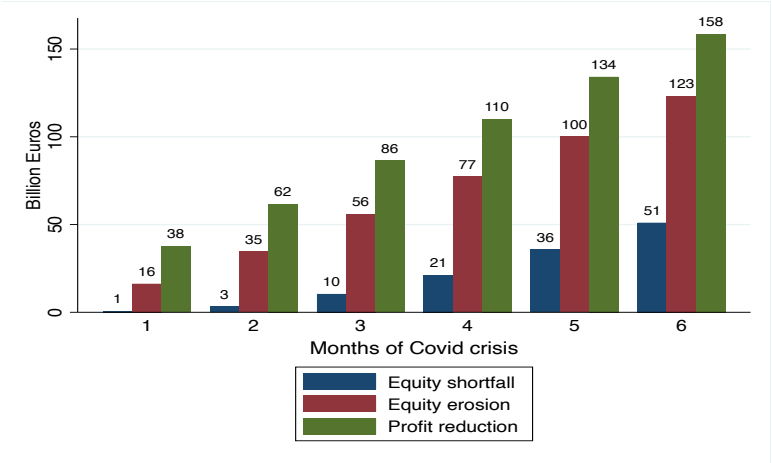


Figure 8: Lockdown Effect on Profits and Equity: Medium-Sized Firms

The figure shows the annual financial projections for medium-sized firms, defined as those with between 50 and 250 employees, as a function of the lockdown duration. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).

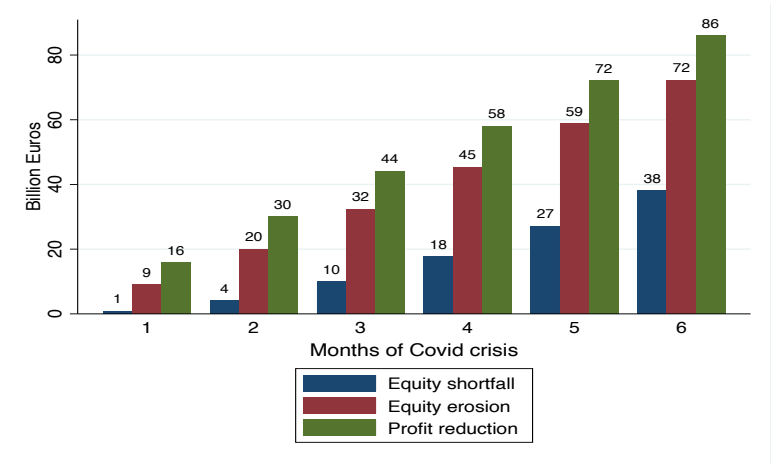
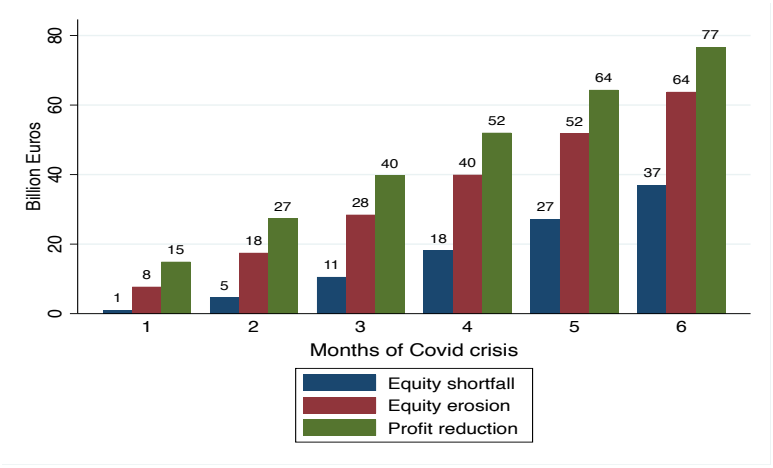


Figure 9: Lockdown Effect on Profits and Equity: Small Firms

The figure shows the annual financial projections for small firms, defined as those with less than 50 employees and balance sheet total of more than €2 million, as a function of the lockdown duration. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).



Since the equity shortfall of distressed companies after a three-month lockdown is forecast to be comparable (about €10 billion) for each of the three size classes, a policy maker may be interested in knowing what would be the employment consequences of allocating this sum to the recapitalization of large, medium or small companies.

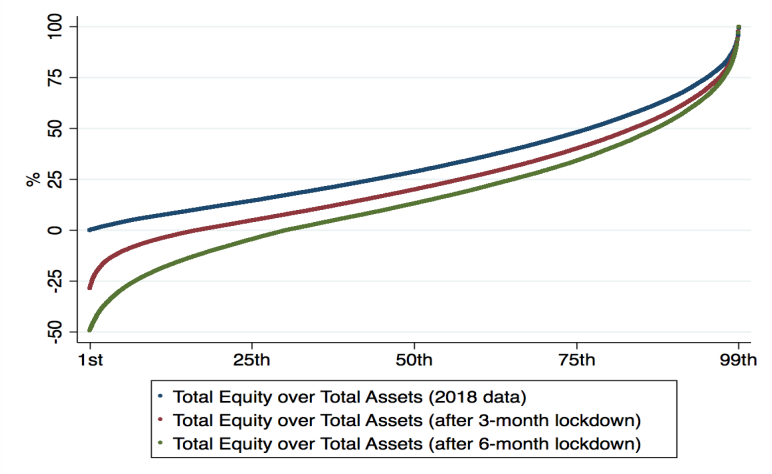
In principle, the answer is ambiguous, since in our data SMEs feature greater labor intensity (defined by the ratio of employment to total assets) than large companies but also lower total assets: the first characteristic would imply that a euro of public funding should have a more favorable impact on employment if allocated to rescuing distressed SMEs, but the second implies that the total size of SMEs (in terms of total assets) is smaller, and therefore rescuing them translates in a smaller increase in employment (for given labor intensity). The first of these two effects appears to dominate in the comparison between medium-sized and large firms, and only slightly in that between small and large ones: of the 790,905 employees employed by firms that would be in distress after a three-month lockdown, 29% belong to large firms, 40% to medium size firms, and 31% to small firms, based on the data shown in column 3 of Tables 3, 4 and 5. Hence, the same equity injection is predicted to have a significantly larger employment effect if directed to medium-sized companies than to large ones, and a slightly larger one if directed to small firms.

5.2 Leverage

As noted above, the descriptive statistics of Table 2 suggest that the virus outbreak affected mostly firms that were already significantly less creditworthy.[12] Figure 10 confirms that the impact of the lockdown-induced equity erosion on firm solvency is larger for less capitalized firms: the figure plots the distribution of leverage of all our sample firms in the no-shock scenario (the blue line), based on our simulations for a 3-month lockdown (the red line) and for a 6-month lockdown (the green line). In the baseline no-shock scenario, based on actual 2018 data, all firms have positive equity (by construction), so that leverage (calculated as Equity over Total assets) ranges from almost zero to 100%, with the median firm featuring a 29% leverage, and firms at the 25^{th} and the 75^{th} featuring 15% and 48%, respectively. In the 3-month lockdown scenario, a significant fraction of firms enters into distress, as shown also by Figure 4. Median leverage drops to 20% and for firms at the 25^{th} and at 75^{th} percentile leverage becomes 4.6% and 40%, respectively. In 6-month lockdown scenario, more than 25% of firms would be in distress, the median firm would become highly indebted with a leverage ratio of 11%, and 75% of firms have a leverage below 27%. Therefore, Figure 10 underscores that, following the COVID-19 shock, Italian firms are likely to emerge with a more fragile capital structure if they were to receive public support entirely in the form of debt financing or loan guarantees as opposed to equity injections – the more so the longer the more persistent the lockdown.

Figure 10: Firms Leverage Distribution

The figure shows the leverage distribution without the COVID-19 shock, in the 3-months lockdown scenario and in the 6-months lockdown scenario. Leverage is defined as the ration of Equity to Total Assets. Extreme values have been trimmed. Data source: Orbis (Bureau Van Dijk).



[12]This dovetails with the evidence by Ramelli and Wagner (2020) and Fahlenbrach et al. (2020) that more levered companies have featured a worse stock market performance during the outbreak of the COVID-19 pandemic.

5.3 Listing Status and Share Ownership

In principle, companies may overcome the equity erosion triggered by the COVID-19 crisis by issuing fresh equity. Clearly, this is easier and cheaper for firms whose shares are already listed on the stock market, and therefore enjoy greater liquidity and better reputation with investors, owing to more stringent disclosure requirements. But even private companies may face different costs in issuing external equity and have different incentives to do so, depending on their ownership structure and control: tightly held family firms are typically regarded by investors as being more exposed to agency problems due to the extraction of private benefits of control than non-family ones; by the same token, family firms' controlling shareholders are generally less inclined to issue external equity, to avoid diluting their control rights. Hence, given these differences in the cost or propensity to issue external equity, it is worth investigating whether the COVID-19 shock is predicted to affect differently listed and non-listed firms, or family and non-family ones.

In our sample most firms are private: only 221 companies are listed on the stock exchange (Borsa Italiana), either in its main segment (Mercato Telematico Azionario or MTA) where the largest companies are present, or in the alternative investment market (AIM), where SMEs are typically listed. According to our classification, 141 of these companies are large, 54 medium and 26 small. Compared to private companies, listed companies are, on average, larger and better capitalized (see the Online Annex). Hence, it is not surprising that the distress rate of listed companies is significantly lower than that of the private companies present in our sample, as shown in the upper panel of Figure 11: after a 3-month lockdown, the distress rate of publicly listed companies is about 1% against 17% for private firms. In fact, their distress rate is substantially lower even compared to large companies as a whole (6.4%). This probably stems from their greater capitalization, which in turn may reflect their lower cost in raising external equity, in line with the evidence provided by Erel et al. (2012). By the same token, private firms, which face greater obstacles to raising external equity, are also those that would be in greater need of an equity infusion to offset the losses suffered in the COVID-19 crisis. This underscores the importance of firms' access to the stock market to enhance their resilience to crises.[13]

We also explore whether in our sample the impact of the COVID-19 shock differs between family and non-family firms, by matching our data with a family-firm dummy variable provided by the CERVED firm register. This dummy variable equals 1, if the majority of a firm's voting shares is in the hands of an individual or a group of persons linked by family ties, and 0, otherwise. This dummy variable is available for 71,828 firms out of 80,972 in our sample.

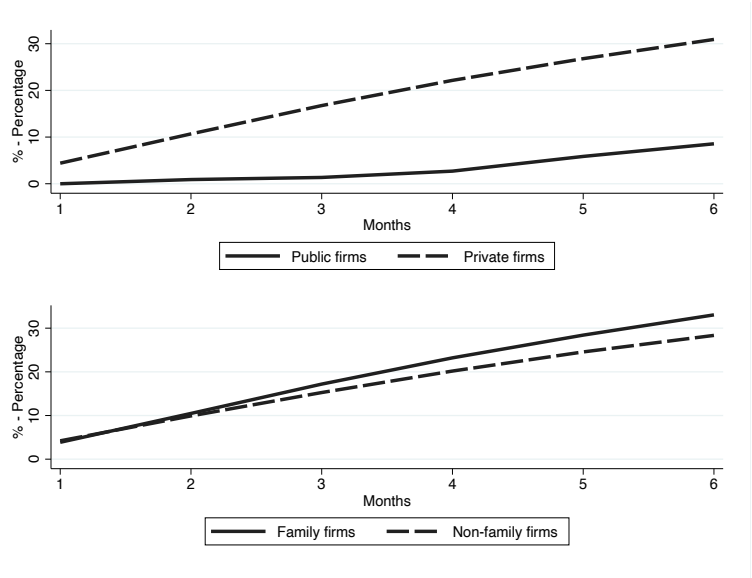
In line with the literature, we find that family firms represent a large share of Italian compa-

[13]The literature also highlights that firms' access to the stock market enhances employment (Borisov et al., 2020).

nies, especially among small firms: for the sample of 71,828 companies for which the family-firm dummy is available, about 60% of firms are classified as family (26% among large, 48% among medium and 66% among small). Family firms are smaller than non-family ones, even within the sub-sample of small firms. However, surprisingly family firms do not display significant differences in leverage, profitability and risk (as measured by the Z-score) with respect to non-family firms (see the Online Annex). This may explain why our forecast of the profit reduction, equity erosion and equity shortfall for family firms and their probability of default does not differ significantly from that of non-family ones. Indeed, as Figure 11 shows, after a 3-month lockdown there is only a tiny (yet significant) difference in distress rate between family and non-family firms. After a three-month lockdown, the distress rate of family firms exceeds that of non-family ones by 1.5%, a difference that widens to 4% for a six-month lockdown.

Figure 11: Distress Rate by Lockdown Duration: Share Ownership and Listing Status

The upper panel of the figure shows the distress rates for the sub-samples of public and private firms, and the lower panel shows the distress rates for the sub-samples of family and non-family firms, as a function of the lockdown duration. Distress rate is defined as the fraction of firms whose annual losses after X months of lockdown exceed total beginning-of-year equity (taken to be equal to its book value at the end of 2017). Data source: Orbis (Bureau Van Dijk).



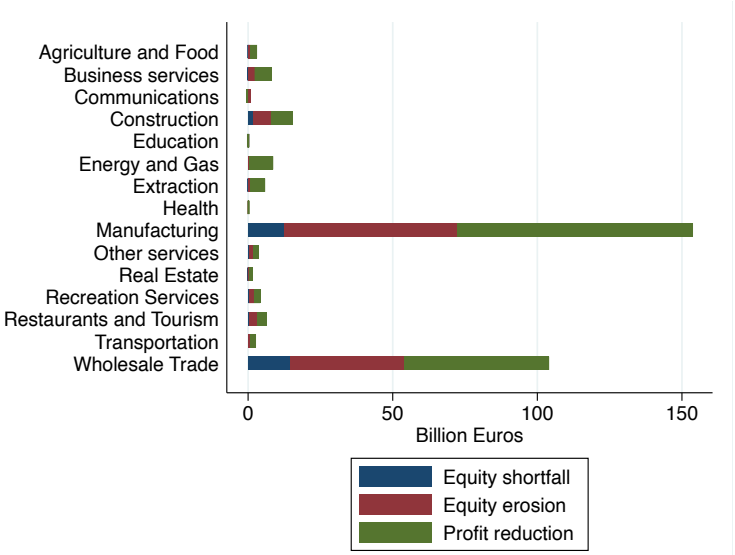
5.4 Sectors

Unlike typical macroeconomic shocks, the COVID-19 shock has hit different sectors with widely different severity: sectors deemed to be non-essential by the government and with low teleworking capabilities have been severely affected, while the others have been mostly spared by the lockdown. So one should expect the distribution of losses and equity erosion to be highly skewed towards the former sectors.

Figure 12 presents the breakdown of the lockdown effects by sectors at the ATECO 2007 level-1 classification level. The figure shows that the drop in profits and equity erosion is concentrated in Manufacturing, Wholesale Trading, and, to a far smaller extent, Construction and Business Services. Importantly, these sectors also happen to be the top four ones by number of employees.

Figure 12: Lockdown Effect on Profits and Equity by Sector after a 3-Month Lockdown

The figure shows the annual projections for equity and profit shortfalls by sector. The sector definitions are from national accounting and firm sectoral data as defined by ISTAT. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).



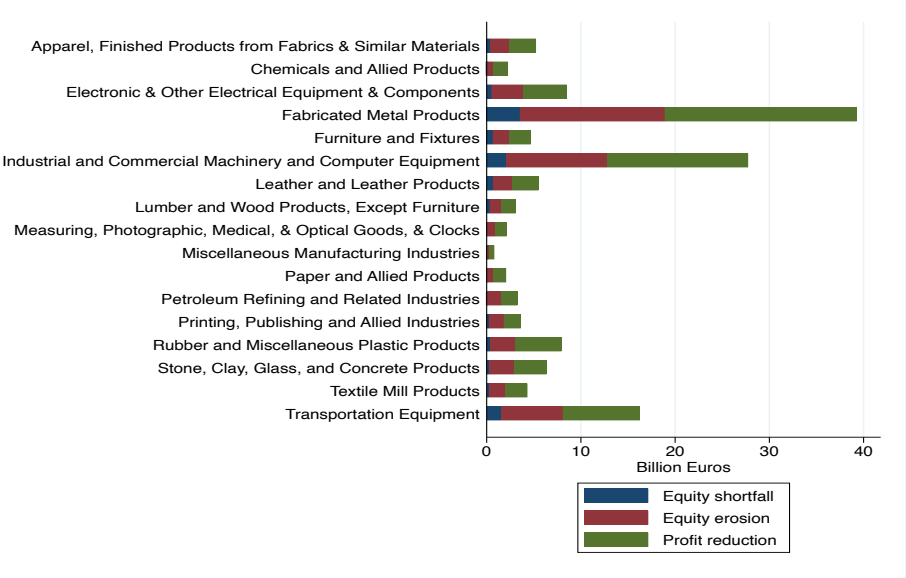
Surprisingly, the drop in profits and the equity erosion in the Recreation Services and Tourism sectors are comparatively small. This is probably because these are labor-intensive sectors with low fixed costs and hence, though severely hit by the lockdown, most of their labor costs during the lockdown are covered by the wage subsidy paid to inactive workers. However, going forward, these sectors may be more affected by social distancing than others and thus be subject to an longer effective lockdown than others. This may outweigh the less severe impact on their profits early in the lockdown months. Moreover, as stressed above, even if the lockdown is severe for the Recreation Services and Restaurant and Tourism sectors (respectively, 74.2% and 62.1%), relatively few firms in our sample belong to these sectors (4.8%), probably due to the prevalence of micro-firms (namely, those with less than 10 employees), which are not included in our sample.

Figure 13 presents results at the ATECO 2007 level-2 classification level, for sub-sectors within Manufacturing: the sub-sectors that suffer the largest drop in profits are Fabricated Metal Prod-

ucts, Industrial and Commercial Machinery and Computer Equipment, and Transportation Equipment. These sub-sectors are also those with the largest equity erosion and shortfall.

Figure 13: Lockdown Effect on Profits and Equity by Manufacturing Sub-sectors after a 3-Month Lockdown

The figure shows the annual projections for equity and profit shortfalls by sub-sectors of the manufacturing sector. The sector and sub-sector definitions are from national accounting and firm sectoral data as defined by ISTAT. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).



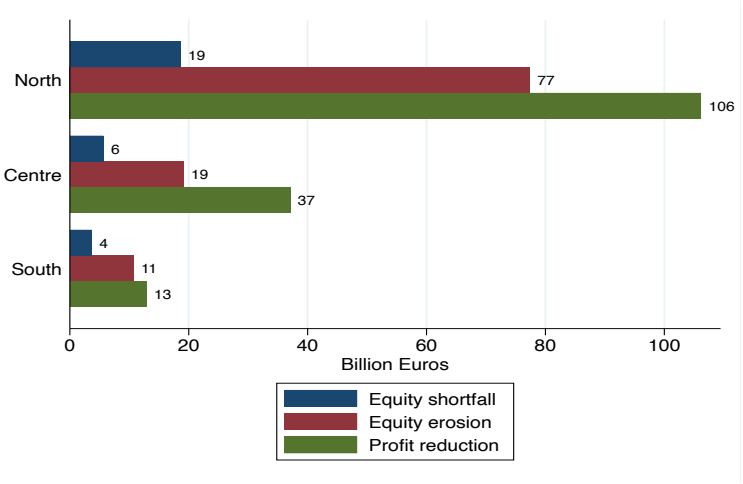
5.5 Geography

Figure 14 shows that most of the profit and equity shortfalls refer to firms located in Northern Italy, in contrast to firms in the South being the lowest. This reflects the geographical distribution of economic activity within the country, rather than the impact of the COVID-19 shock itself, since we model the impact of the lockdown as geographically homogeneous, as it has actually been at least until early May 2020 (the time of this writing). However, the effects of social distancing policies may persist much longer for economic activity in Southern (and to some extent Central) regions, where Tourism and Retail Trade are proportionately more important than Manufacturing and Business Services, and are likely to revert to the pre-crisis activity level much more slowly. Hence, the persistence of the COVID-19 shock may eventually turn out to be greater in the South, and to some extent in the Center, than in the North of the country relative to the current forecast. Our estimates fail to account for this, being predicated on the assumptions that the lockdown would be lifted simultaneously in all sectors and geographical areas, and that economic activity

would immediately revert to pre-crisis levels in all of them.

Figure 14: Lockdown Effect on Profits and Equity by Geographic Area after a 3-Month Lockdown

The figure shows the annual projections for equity and profit shortfalls by geographic area. The geographic area definitions are from national accounting and firm sectoral data as defined by ISTAT. Profit reduction is defined as the difference between firms' actual annual profits in 2018 and their projected end-of-the-year profits after X months of lockdown. Equity erosion is defined as the sum of all firms' end-of-the-year losses after X months of lockdown. Equity shortfall is defined as the amount of negative net worth for all the firms with end-of-year negative equity after X months of lockdown. Data source: Orbis (Bureau Van Dijk).



6 Discussion: Policy Implications

So far, the issue of firm equity erosion due to the crisis has received limited attention by policy makers. In most countries, public policies have aimed mostly at countering the recessionary impact of the COVID-19 shock by providing liquidity to companies, either directly, or through the banking system. For instance, in March 2020, the European Central Bank (ECB) eased the conditions of its Targeted Longer-Term Refinancing Operations (TLTRO III) to support firms' access to bank credit, enlarged the list of corporate collateral eligible assets, and expanded the range of assets eligible for its purchases under the Corporate Sector Purchase Program (CSPP) to include non-financial commercial paper. At the same time, several Eurozone governments offered export guarantees, liquidity assistance, and credit lines to firms, through their respective national development banks, ranging from 38.6% of GDP in Germany and 29.8% of GDP in Italy, to 14% in France and 9.1% in Spain (Anderson et al., 2020).

Policies meant to address corporate solvency have been, so far, very sparse. The German federal government has allocated €100 billion to inject equity and buy stakes in (large) companies affected by the COVID-19 shock via the Economic Stabilisation Funds (i.e., Wirtschaftssta-

bilisierungsfonds - "WSF"), €50 billion in direct grants to distressed one-person businesses and micro-enterprises, and €2 billion to expand venture capital financing to start-ups, new technology companies and small businesses. This federal funding is complemented by €33.5 billion funded by the States of Bavaria, Hesse and Baden-Wuerttemberg. But these seemingly large equity injections, which amount to 5.4% of GDP, are less than 1/7 of the liquidity being provided by the German government in the form of debt (38.6% of GDP). Meanwhile, the equity injections provided to firms by other Eurozone governments pale in comparison to the German figures, in particular due to the existing significant sovereign debt obligations in some of these countries. But these policy developments are still fluid as we write.

The recently announced "Solvency Support Instrument" within the "Next Generation EU" proposal of the European Commission (EC) is a step in the right direction as it "mobilise[s] private resources to provide urgent support to otherwise healthy companies", especially favoring Member States that are less able to recapitalize companies through State aid. The EC envisages "a budget of €31 billion, aiming to unlock more than 300 billion in solvency support". The EC estimates that the recapitalization needs to be between €720 billion (baseline GDP forecast scenario) and €1.2 trillion (stress scenario of 15.5% recession in 2020).[14]

Even though the evidence in this paper is based on Italian firms, many of the insights from our analysis are likely to be relevant for firms in other countries: the current crisis is not just draining firm liquidity, but is also eroding the equity capital of firms, especially those belonging to less pandemic-resilient industries, i.e., those more severely affected by lockdown, and featuring greater pre-crisis leverage and smaller size. For many of these firms, restoring their financial health would call for a robust equity infusion. The question arises as to whether such an infusion would call for government intervention and, if so, how such intervention ought to be designed.

Some of the firms whose equity is eroded by the ongoing crisis might be able to raise the necessary new equity funding in the public capital market: indeed, Halling et al. (2020) document that, even though equity issues slowed considerably during the first four weeks of the pandemic, they accelerated again in the subsequent period. Moreover, our evidence shows that listed firms are the least fragile in the COVID-19 crisis, and, therefore, those that least need public support. These firms may also be better able to rebalance their capital structure by negotiating with their respective creditors so as to restructure their debt obligations, and thus restore their incentives to invest again, once the crisis abates. This is because publicly listed firms can more easily issue new equity and thus induce their creditors to accept a restructuring of their claims. In such cases,

[14]See the Communication by the European Commission titled "Europe's moment: Repair and Prepare for the Next Generation", Questions and Answers: Solvency Support Instrument, https://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52020DC0456from=EN.

the main social inefficiency could arise from the legal and financial costs of bankruptcy, which may unduly delay debt restructuring, as argued by Brunnermeier and Krishnamurthy (2020). However, despite this social cost, there is no clear case for the government to intervene with an equity injection funded with taxpayers' money for firms with alternative funding sources, since government entities have no superior ability relative to the market to select growth firms, or negotiate with creditors.

For other firms, however, capital market imperfections make raising fresh equity expensive or even impossible, either because the firms are too small to access public markets or because their growth prospects may not be sufficiently bright to warrant debt restructuring. This may well be the case for many unlisted SMEs, which indeed seem to be worst hit according to our evidence. If these firms ultimately end up in financial distress, they would likely face liquidation and would be forced to lay off their workforce, with attendant multiplier effects on the economy. Given the severity and scope of the COVID-19 shock, this might cause a wave of SME bankruptcies and, therefore, a large spurt in unemployment, as suggested by our simulations. In fact, supply-chain interconnections are likely to accentuate the chain reaction between firms, amplifying the incidence of bankruptcies even further, compared to our estimates. Hence, there is a case for the government stepping in to provide much-needed equity rather than debt finance, on the grounds of economic efficiency, as suggested by Somerset Webb's and Martin Wolf's quotes at the start of this paper.

However, this public intervention raises several additional questions. First, which firms should the government target with its equity injections? Second, how much equity should it provide to each sector, and to each firm? Third, what specific contractual form should the equity funding take (outright grants or subventions, voting common equity, non-voting common equity, preferred equity, hybrid instruments such as convertible debt, debt with warrants attached)? Fourth, should this equity participation have a predefined time span, and what exit strategies should be envisaged for the government as a shareholder, and at what price?

The evidence presented above does suggest that the government is likely to face a dilemma in answering the first two questions – not just in the context of Italy but most likely also in other countries. The social objective of supporting employment calls for equity injections being directed mainly at the companies in distress, not only because these are at the highest risk of ending up in bankruptcy but also because they are often the most labor-intensive. Hence, their liquidation would lead to a greater impact on employment, and the social fabric, generally. However, our data indicate that these are also the firms that already had, by far, the most fragile balance sheets

even prior to, and in the absence of, the COVID-19 crisis.[15] Hence, on the one hand, returning these firms to their equity levels prior to the crisis would not necessarily restore them to sound health: such an equity injection risks leaving them still vulnerable to external shocks. On the other hand, providing them with a more generous equity injection would clearly require escalating the necessary funding well beyond the sums implied by our projections. One would then have to ask whether such large sums would not be better invested in firms that hold greater promise of growth, profitability, and job creation, including new firms employing new technologies and business models.

This dilemma is made even harder to resolve by the fact that the response to the COVID-19 shock may require a permanent shift of resources away from sectors more exposed to health and environmental risks to those that are more resilient to such risks. Indeed the evidence in Pagano et al. (2020) suggests that capital markets charge higher risk premia for equity financing to the former industries than to the latter. Hence, if public equity injections were directed preferentially to the worst hit sectors – for instance bailing out airlines or hotel companies – they may end up posing an obstacle to a necessary reallocation of capital and labor. Such interventions may impede the shift of the economy towards more resilient and environmentally sustainable sectors in the post-COVID-19 scenario (Guerriero et al., 2020) by throwing good money after bad in backing erstwhile fragile sectors that are unable to sustain themselves without support.

The fact that most of the firms that would need a public equity injection are private SMEs also raises the issue of how the government might inject equity in such companies and eventually exit such investment: valuing equity stakes in many unlisted SMEs and managing them would require the skills of private equity investors on a massive scale. Moreover, such firms, especially those controlled by family owners, are likely to resist surrendering part of their highly prized control rights to the State. Hence, one efficient way to inject public capital in such firms would be for the government to underwrite non-voting preferred convertible shares, as argued by Megginson and Fotak (2020): the lack of voting rights would make such an instrument more acceptable to family firms, while their convertibility would enable the government to exit its investments at preset financial terms within a known horizon, for instance allowing conversion after a few years into bonds with face value equal to the initial sum. An alternative approach, which would perhaps be easier to implement for smaller firms, is the one suggested by Boot et al. (2020). This approach consists of the government, either at the level of individual countries or at supra-national

[15] One may see this statement as contradicting the central finding by Schivardi et al. (2020) that "the bulk of liquidity needs during the crisis comes from firms that were financially sound before crisis, as the shock hit firms with an intensity which is independent from their financial conditions" (p. 20). However, there is no real contradiction, as our argument concerns the capitalization needs of firms, which are obviously correlated with their *pre-crisis* leverage ex ante, unlike their liquidity needs consequent to the COVID-19 crisis.

level (such as the European Union), taking equity stakes in these SMEs in exchange for higher tax payments in the future. Of course, these higher taxes would be paid only by firms that turn out to be profitable in the future, while those that fail would not make such payments. Hence, the government would end up taking a (risky) equity claim in a large, diversified portfolio of SMEs.

7 Conclusions

In this paper we forecast the impact of the COVID-19 shock on the profits and equity levels of Italian firms by exploiting their different exposure to the lockdown resulting from government-mandated health restrictions during the pandemic. We show that the losses inflicted by the COVID-19 shock on Italian firms are likely to produce a sizeable erosion of their equity, to the point that, absent any recapitalization or debt restructuring, a 3-month lockdown would entail an aggregate yearly drop in profits of about 10% of GDP and result in financial distress for 17% of the sample firms, employing 8.8% of the sample employees, based on 2018 data.

We also find that the effects of the COVID-19 shock differ greatly depending on firm characteristics: distress is predicted to be more frequent for small and medium-sized enterprises, for firms with high previous leverage, and those belonging to the Manufacturing and Wholesale Trading sectors. Listed companies are less likely to enter distress, while there is no clear correlation between distress rates and family firm ownership.

Hence, our analysis suggests substantial effects of the virus outbreak in terms of widespread bankruptcies and layoffs and, consequently, potential long-term damage to the economic fabric of the country. Public liquidity provisions via debt financing, currently encouraged by the loan guarantees provided by the Italian government, will simply not do: providing more debt to already highly indebted firms is throwing good money after bad, as it will temporarily keep them alive without restoring their solvency. However, we also highlight that several important issues remain unaddressed in the design of public policies aimed at recapitalizing distressed companies, regarding the allocation of public equity injections across firms and sectors, as well as the contractual form, duration and exit strategy of public equity funding.

While our analysis presents broad-brush evidence of the impact of the crisis at the levels of firm size, leverage, ownership structure, listing status, sector and location, concrete policy interventions would call for an analysis based on more up-to-date and granular firm-level data. Of equal importance, they would require detailed modelling and measurement of supply-chain effects across sectors and demand-side feedback effects.

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