Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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The COVID-19 pandemic provides a once-in-a-lifetime opportunity to learn more about how businesses are affected by and adapt to large-scale, unforeseen shocks. Our research examines the worries of a sample of Italian publicly traded companies about the spread of COVID-19. The information was gathered from a dataset employing text-based estimates of the main concerns listed companies have about the development of COVID-19 and other pandemic diseases. These data can be used to determine whether companies stand to earn or lose money because of a particular outbreak. We concentrate on the data for Italy, which allows us to quantify which of the sample's Italian enterprises are more exposed and thus affected, the severity of risk perception, and the firm's attitude towards the shock exposure. We attempt to explain how firm perceptions of the COVID-19 crisis are correlated with various types of indicators related to economic and financial status, such as financial position (total debt exposure and short-term exposure), ROI, and ROE during the COVID-19 crisis, i.e. the main firms' responses to such a large shock.

1. Introduction

The COVID-19 pandemic provides a once-in-a-lifetime opportunity to examine how businesses respond to a large-scale, unforeseen macroeconomic shock. Dealing with this problem entails overcoming three major obstacles: first, how to determine if firms are affected by a certain outbreak, second, determining the intensity of a firm's exposure to the shock, and third, determining the nature of the shock that firms face, such as whether the shock causes demand contraction, supply disruption, or credit tightening. As a result, having such measurements is essential for understanding the microeconomic consequences of macroeconomic shocks and designing more effective policy responses.

The firmllevelrisk database by Hassan et al. (2020a) is a dataset that allows for similar Covid measurements. The authors present a firm-level measure of demand and supply shock exposure connected to COVID-19 that is based on a two-step text classification algorithm. The firmllevelrisk dataset, in particular, gives users access to text-based measures of the main worries listed companies have about the development of COVID-19 and other epidemic diseases. This methodological tool, which uses word-based patterns to identify whether a COVID-19 linked text fragment discusses a particular topic, is extremely novel and has a wide range of applications.
These data can be used to determine whether companies stand to earn or lose money as a result of a particular outbreak. The measurements in the firm-level risk dataset are based on a two-step text classification approach. First, the authors determine how exposed companies are to the COVID-19 epidemic by tracking the number of times the disease is discussed in publicly traded companies’ quarterly earnings conference calls with market participants in the United States and over 80 other countries. Hassan et al. (2019, 2020a) verified this technique in the context of quantifying a firm’s exposure to political risk, Brexit, and shocks such as the Fukushima nuclear catastrophe and the COVID-19 disease.

Once the authors identify those firms exposed to COVID-19 at a given point in time, they then take the details of the conversation in their transcripts to categorize systematically the perceived firm-level impact of the shock by using a new automatic pattern-based method for classifying the content of discussions in conference calls related to COVID-19. Hence, the data provide measures of exposure to epidemic diseases by tools developed in earlier work (Hassan et al., 2019, 2020a), and provide measures of epidemic diseases’ overall impact on the mean (sentiment) and the variance (risk) of the firm’s prospects. Hence, after identifying the Covid Exposure at a certain point in time, they categorize how the firms perceive the risk due to the pandemic refining the exposures to the pandemic diseases by measuring the impact of the pandemic on the firms’ prospects creating a measure of the sentiment (the mean of the firms’ prospect) and the risk perceived (the variance of the firms’ prospect). This allows distinguishing between the winners and the losers from the shock (with the authors distinguishing between the positive or negative tone of the discussion in earning call). We could also access data related to the indicators measuring the direct exogenous impact of the pandemic on the firm’s demand and supply.

The data show that the scale of exposure to coronavirus is unprecedented compared with earlier outbreaks, spans all major economies, and is pervasive across all industries.

We focus on the data which allow us to quantify which Italian firms in the sample are more exposed and hence affected, the intensity of risk perception and the firm’s sentiment about exposure to the shock. These data enable us to identify which firms expect to lose or gain from a given epidemic. Merging these data with firm-level balance sheet data taken from AIDA (Bureau van Dijk) for the same span of time for Italian firms we seek to explain how firm perceptions about COVID-19 are correlated with different types of indicators: those related to financial status like the level of indebtedness, ROI (Return on Investments), and ROE (Return on Equity) during the COVID-19 crisis, seeking to detect correlation in the firms’ main responses to the shock in question. Having a firm-level measure, as opposed to an aggregate measure, is important in view of the wide-ranging experiences of firms dealing with the pandemic.

By using these new data and evidence we were able to measure to what extent COVID-19 affected Italian firms, to gauge the impact on different geographical areas and on different sectors, also checking for the role of supply and demand shocks in each sector. Overall, our descriptive statistics confirm the high degree of heterogeneity of the Italian system and the differences between companies in terms of exposure.

Controlling for structural variables, such as firms’ age, size, and for other driving factors such as productivity and average length of firms’ debt exposure, we also assess with an econometric analysis the relative importance of COVID exposure, risk and sentiment on the changes in different types of firms’ responses we observe related to the economic and financial status, like the financial position, ROI, and ROE.

We hope that in-depth understanding of the various ways in which an epidemic affects firms may help develop effective (especially in the short-run) government intervention policies. Supply-side disruptions should be met with specific tools which are less appropriate for demand or finance-related shocks. For instance, monetary and fiscal policy can compensate for shortfalls in demand but are much less effective in addressing the economic disruption of supply shocks (Hassan et al., 2020a). Besides, the extraordinary nature of the current COVID-19 crisis might have rendered existing models and policy remedies ineffective (Adda, 2016; Barro et al., 2020).

The remainder of this paper is structured as follows. Section 1 provides the literature background. Section 2 describes the survey data, focusing on the variables that we used to check how firms were affected by and responded to the COVID-19 pandemic. Section 3 provides descriptive evidence on how expected exposure to COVID-19 differs with respect to other diseases, and how it evolved across time, regions and sectors. In Section 4 we present evidence on how COVID-19 expectations have influenced the general business outlook of Italian firms. Some conclusions follow.

2. Literature background

This paper contributes to a growing literature on the economics of COVID-19 mainly related to the studies which emphasize how credit lines are central to the transmission of macroeconomic shocks to firms. Credit market access and liquidity consequences of the COVID-19 pandemic are crucial in our analysis in accordance with an extensive literature (Hassan et al., 2020a; Au et al., 2020; Ferrando, 2020; Kargar et al., 2020; Ozik et al., 2020; Greenwald et al., 2020).

For Italy a quite instructive event study analysis also focusing on credit constraints is provided by Balduzzi et al. (2020). They investigate the economic effects of the COVID-19 pandemic and the role played by credit constraints in the transmission mechanism, using a novel survey of expectations for sales and orders as well as plans for prices, employment and investment of Italian firms, taken just before and after the outbreak. The authors find that the search for and availability of liquidity is a key determinant of firms’ plans. Credit constraints amplify the effects of the COVID-19 generated shocks on factor demand and sales and higher prices, relative to unconstrained firms. According to the authors, the supply shocks are slightly more important in the aggregate. Most firms revise downward their expectations for sales, orders, employment and investment, while prices are expected to increase at a faster rate, with geographical and sectoral heterogeneity in the size of the effects.
Our study also takes its cue from papers on the impact and transmission of COVID-19 on equity returns (Alfaro et al., 2018; Bretscher et al., 2020) and the study by Ramelli and Wagner (2020) on US stock prices and corporate conference calls. According to this evidence, originally investors negatively priced internationally oriented firms. However, as the virus spread in Western countries, leverage and internal liquidity emerged as more important value drivers. Another strand of the literature examines firm-level variation in COVID-19-induced stock returns. Ding et al. (2020) use data on COVID-19 cases from the Johns Hopkins University Coronavirus COVID-19 Global Cases database, to measure changes in stock prices, which at the beginning of the COVID-19 pandemic generally plummeted. Croce et al. (2020) use high-frequency data from Twitter to measure epidemic contagion risk in financial markets. Our work is also related to other recent papers that study the effect of the COVID-19 pandemic on the expectations of firms. Baker et al. (2020a) show that survey-based expectation uncertainty of firms increased substantially in the US and the UK. Bloom et al. (2020) use a survey from the UK to show that many firms, especially from the tourism and restaurant industry, expect a substantial impact of the pandemic on their sales. Hassan et al. (2020a) find that firms’ primary concerns during the early phase of the COVID-19 pandemic seemed to be lack of demand, disruption of supply chains and increasing uncertainty.

Buchheim et al. (2020) show that the COVID-19 crisis hit firms by surprise. However, as documented in this study, firms’ expectations regarding the length of the restrictions constitute an important determinant of their business outlook. After controlling for the initial impact of the crisis, firms that expect the shutdown to last for longer than four months report a higher expected decline in revenues due to the COVID-19 crisis than firms expecting the shutdown to last for less than two months. Firms’ expectations on the further dynamics of the COVID-19 pandemic are also an important determinant of the strength of the crisis response and mitigation strategies. Specifically, firms that expect the shutdown to last for more than four months are more likely to implement strong responses to reduce fixed costs such as dismissing employees or cancelling investment projects than firms that expect a quick return to normalcy. However, firms that had been in bad shape before the crisis, as measured by their pre-crisis business situation, report that they were stronger hit by the COVID-19 crisis by April 2020, even controlling for the strength of the initial crisis impact. This is reflected in expectations of higher crisis-induced revenue losses and the choice of strong mitigation strategies.

It is also important to mention those studies measuring whether the economic consequences of COVID-19 were driven by demand shock or by a supply one (Guerrieri et al., 2020; Baqae and Farhi, 2020; Beksa et al., 2020; Fornaro and Wolf, 2020; Faria-e-Castro, 2020). The analysis of the type of shock and its consequences is also crucial in some studies, which tried to integrate epidemic models of the spread of a disease with conventional macroeconomic models to study the optimal policy response of governments (Atkeson, 2020; Eichenbaum et al., 2020).

It is also worth mentioning the implications for the Coronavirus Pandemic depicted by previous epidemic events. Barro et al. (2020) derive lessons from the “Spanish flu” for the coronavirus’s potential effects on mortality and economic activity. The flu death rate correspond in their regression analysis to declines of 6 percent for GDP and 8 percent for private consumption comparable to those last seen during the global Great Recession of 2008–2009. The results also show that the 1918–20 pandemic was accompanied by substantial short-term declines in realized real returns on stocks and short-term government bonds. Besides, as documented by Tut (2021) a strong and statistically positive relationship between the onset of an epidemic disease and corporate cash holdings was observed for COVID-19 pandemic while no impact on cash holdings from the other epidemics under consideration was found (SARS, H1N1, Ebola and Zika virus).

A common feature of the different strands of literature is the notable heterogeneity observed across firms.

3. Data

The firmlevelrisk dataset uses transcripts of quarterly earnings conference calls held by publicly listed firms to construct our measures of firm-level exposure to epidemic diseases. Earnings calls are key corporate events on the investor relations agenda and allow financial analysts and other market participants to listen to senior management presenting their views on the company’s state of affairs, ask these company officials questions about the firm’s financial performance over the past quarter and discuss current developments (Hollander et al., 2010). These transcripts are available from the Refinitiv Eikon database which collects the complete set of 333,626 English language transcripts from January 1, 2002 to September 30, 2021 for 12,849 firms headquartered in 85 countries. As epidemic diseases potentially have a global impact, these data cover a significant proportion of firms around the globe.

The measures we use are based on a text-classification method developed by Hassan et al. (2020a). The methodology proceeds in two steps: first, the authors identify the exposure of firms to the outbreak of COVID-19 by counting the number of times, if any, the disease is mentioned in the earnings call. Then, building on this measure of disease exposure, the authors also construct metrics of risk and

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1 As for previous epidemics, Hassan et al. (2020a) build the exposure of firms to the outbreak of COVID-19 by counting the number of times, if any, the disease is mentioned in the earnings call. Then, building on this measure of disease exposure, the authors also construct metrics of risk and
Thus Hassan et al. (2020a) construct three main measures of COVID-19 exposure that we have used in this paper: first, Exposure to COVID-19 is measured, counting the number of times the coronavirus disease is mentioned in quarterly earnings calls, with the number then being divided by the total number of words in the transcript. Second, they construct a measure of Covid Risk by counting the word combinations within an interval of 10 words before and after the synonyms of the words “risk” and “uncertainty”. Finally, they construct a measure of Covid Sentiment to determine whether the COVID-19 outbreak is considered to be “good” or “bad” for the firm with the same procedure used for the risk variable, but in this case, without being conditional on proximity with the word “risk”, but on positive- or negative-tone words (Hassan et al., 2020a, pp. 16). The tone of the discussions allows the authors to construct two sub-measures (Covid Negative Sentiment and Covid Positive Sentiment) based on negative or positive sentiment words. Furthermore, using these firm level measures of voice over COVID-19, the authors isolate from these concerns the extent to which a firm is exposed to exogenous COVID-19 demand and supply shocks and examine the degree to which the documented valuation effects can be attributed to each of these two shocks.2

The firm level risk database, as stated above, covers the reaction to COVID-19 shocks of firms headquartered in more than 80 countries. We focus on the 110 firms located in 12 Italian regions that host earning conferences in the 2019–2021 period.3 Summary statistics on the main variables we used to measure firms’ exposure to the COVID-19 outbreak are provided in Table 1, comparing exposure and perceived risk for Italian firms, with their equivalent for all the firms in the full sample (Table 1 – Panel A). We also present summary statistics for the quarterly sample (Panel B) restricted to firms for which there were earnings calls in 2020 to see how the perceived risk for Italian firms changed during 2020.

This table shows the mean, median, standard deviation, and the number of observations for the COVID variables used in the regression analysis. Columns 1 to 4 refer to the Italian sample; and columns 5 to 8 to the sample of all firms in the dataset. The unit of the data is firm-quarter 2019–2021, and firm quarterly data (year = 2020), in panels A and B respectively. All epidemic variables are calculated as defined in Section 2. In Panel B, the quarterly sample is restricted to firms for which we have earnings calls in 2020 to show firms’ concerns about the pandemic grew over the year.

We use financial statement data for Italian firms from AIDA (BVD), including data on total debts, long and short terms debts, debts with banks and with suppliers, firms’ ROE and ROI; we also use the location of the firm’s headquarters, size, age and productivity. The summary statistics on balance sheet data for the firms in our sample are presented in Table 2 from which it may be seen that firms in our sample show on average both an adequate return on invested equity (6.4%) and positive operational profitability of the total invested capital (2.2%).

4. Exposure to epidemic diseases: Descriptive evidence

In this section, we use the measures developed by Hassan et al. (2020a) on the firm-level exposure to several epidemic diseases (i.e., COVID-19, SARS, H1N1, Ebola, and Zika) to document several stylized facts.

Compared to the most harmful prior epidemics, the COVID-19 crisis appears to be unprecedented in the breadth and intensity of its firm-level impact, as the data on firm-level risk suggest. The adverse effects of other pandemic events, such as SARS and H1N1, were mostly confined to firms in specific regions and sectors. The extent to which these previous pandemics affected both expectations and behaviour of firms in the sample was reflected also by the importance of this topic in the firms’ discussions where the previous epidemics never occupied more than 20 percent. Conversely, COVID-19 is at present a major topic of discussion for virtually all firms in all parts of the world.

In Fig. 1, we plot the time-series of the percentage of transcripts in which a given disease is mentioned in a quarter separately for COVID-19, SARS, H1N1, Ebola and Zika respectively (moving from the top panel to the bottom) for both Italian firms (left) and firms headquartered in all other countries (right).

The frequency at which the epidemics appear in earning calls closely follows the infection rates for each of the diseases. For example, SARS, according to the WHO, was first recognized in February 2003 (although the outbreak was

sentiment, termed DiseaseRisk and DiseaseSentiment, respectively (Hassan et al., 2019, 2020a). The former is developed starting from the measure of exposure by conditioning on the proximity to synonyms for “risk” or “uncertainty” and counting the number of words (word combinations) related to a specific disease that are used in the neighbourhood of 10 words before and after such a synonym. The authors obtain a list of synonyms for risk and uncertainty from the Oxford English Dictionary.

Second, to gauge whether a disease outbreak is considered good or bad news to the firm, a measure of shocks to the firm’s prospects is built. Accordingly, the construction of epidemic disease sentiment, denoted DiseaseSentiment, closely follows the procedure for DiseaseRisk in that it counts the words associated with the disease; however, instead of conditioning on the proximity to words associated with risk, this time the authors condition on positive- or negative-tone words. These positive (such as “good”, “strong”, “great”) and negative-tone words (such as “lose”, “decline”, and “difficult”) are obtained from Loughran and McDonald (2011).2

The method consists of identifying whether the pandemic improved or deteriorated demand for the firm. The authors accomplish this task by simply using their sentiment dictionary to determine whether negative- or positive-tone words (again, using Loughran and McDonald, 2011’s sentiment dictionary) are used in conjunction with discussions of COVID-19’s effect on demand. Specifically, for COVID-19-related sentence triples, they count positive minus negative tone words in the sentence that identifies the topic, and average this across all sentence triples about the topic within an earnings call transcript. In detail, Tone(s) returns the sum of positive words if the sentence contains positive but not negative words; it returns the negative of the sum of negative words if the sentence contains negative but not positive words; and it returns zero if the sentence contains both positive and negative words. COVID-19 Negative supply shocks are defined similarly but with Tone(s) only returning the integer count of negative sentiment words if the sentence that identifies the supply topic contains negative but not positive sentiment words.3

The firms in our sample are located in Emilia Romagna (9 firms), Friuli-Venezia Giulia (4), Lazio (15), Liguria (3), Lombardy (53), Molise (1), Piedmont (7), Puglia (1), Sardinia (2), Tuscany (3), Umbria (4), and Veneto (10).
Fig. 1. Percentage of earnings calls discussing epidemic diseases.
Notes: This figure plots the percentage of earnings calls discussing epidemic diseases (COVID-19, SARS, H1N1, Ebola, Zika), by quarter from January 2003 through December 2021, in Italy (panel a) and in the Rest of the World (panel b).
Source: Authors’ calculation based on firmlevelrisk data.
Table 1
Summary statistics of COVID-19 related variables.
Source: Authors’ own calculations based on the firm level risk database.

Panel A — Sample (2019–2021, quarterly data)

|                      | Italian firms | All firms |
|----------------------|---------------|-----------|
|                      | N  | Mean  | SD   | No. of firms | N  | Mean  | SD   | No. of firms |
| Covid Exposure       | 461 | 1.09  | 1.08 | 111          | 46,602 | 1.10  | 1.20 | 7598         |
| Covid Risk           | 461 | 0.05  | 0.12 | 111          | 46,602 | 0.07  | 0.16 | 7598         |
| Covid Net Sentiment  | 461 | −0.16 | 0.49 | 111          | 46,602 | −0.14 | 0.52 | 7598         |
| Covid Negative Sentiment | 461 | −0.16 | 0.49 | 111          | 46,602 | 0.43  | 0.60 | 7598         |
| Covid Positive Sentiment | 461 | 0.26  | 0.37 | 111          | 46,602 | 0.29  | 0.44 | 7598         |

Panel B — Quarterly data (year = 2020)

|                      | Italian firms | All firms |
|----------------------|---------------|-----------|
|                      | N  | Mean  | SD   | No. of firms | N  | Mean  | SD   | No. of firms |
| Covid Exposure       | 54  | 0.55  | 0.61 | 16           | 5,969 | 0.40  | 0.65 | 5931         |
| Covid Risk           | 54  | 0.06  | 0.21 | 16           | 5,969 | 0.04  | 0.12 | 5931         |
| Covid Net Sentiment  | 54  | −0.13 | 0.26 | 16           | 5,969 | −0.07 | 0.27 | 5931         |
| Covid Negative Sentiment | 54  | 0.20  | 0.29 | 16           | 5,969 | 0.14  | 0.31 | 5931         |
| Covid Positive Sentiment | 54  | 0.07  | 0.13 | 16           | 5,969 | 0.06  | 0.18 | 5931         |

In Panel A, we display the mean, median, standard deviation and the number of observations for the variables used in the regression analysis. In Panel B, the sample is restricted only to the firms that hosted an earnings call in 2020.

Table 2
Summary statistics of firms’ characteristics.
Source: Authors’ calculations based on the AIDA database on the years 2019–2020.

| Variable                  | Obs | Mean   | Min   | Max   |
|---------------------------|-----|--------|-------|-------|
| Age                       | 380 | 43.02  | 0.00  | 190.00|
| No. of employees          | 380 | 6327.96| 0.00  | 136,928.00|
| Value added per employee  | 380 | 1084.18| −682.39| 13,170.30|
| Debts (total)             | 380 | 6007.96| 0.16  | 96,849.04|
| Debts (short-term)        | 380 | 2909.70| 0.16  | 85,289.10|
| Financial debts (short-term) | 380 | 347.05| 0.00  | 67,126.41|
| Commercial debts (short-term) | 380 | 441.22| 0.07  | 4,377.20|
| ROI                       | 380 | 2.33   | −28.96| 29.17 |
| ROE                       | 380 | 5.51   | −146.62| 148.36|

The value of debts is shown in thousands of Euros. Age is expressed as years from the foundation.
later traced back to November 2002), and the epidemic ended in July 2003. Accordingly, for both Italian and non-Italian firms, discussions of SARS in earnings conference calls peak in the first quarter of 2003 and rapidly subside after the epidemic ends. Moreover, SARS, a disease caused by a coronavirus and sharing some aspects with COVID-19, appears as a subject in just under 5% of the earnings calls in the first quarter of 2020. Furthermore, Fig. (a.1) suggests the exceptional nature of COVID-19, both for firms located in Italy and for those that are not (Fig. (b.1)). Indeed, around 40% of transcripts of the first quarter of 2020 discuss the outbreak of COVID-19, and then almost all the transcripts in 2021, showing a much larger proportion than any other previous epidemic (for example, SARS, which is the closest, shows a percentage slightly over 20%). Moreover, Fig. 2 plots the (average) percentage of earnings calls discussing the COVID-19 epidemic, showing how quickly and intensively COVID-19 affected the activity of Italian firms, entering almost all the earnings calls hosted in the first months of 2021, compared with the same period of 2020.

Considerable variation at the sector level is shown in Fig. A.1 in Appendix A. The need for governments to react, especially in the first part of 2020, to the outbreak of the pandemic through restrictive and immediate measures (like curfews or lockdowns), had the effect of forcing small businesses to close or to limit opening hours. Thus, high COVID-19 risk is found in sectors such as bars, bakeries and similar establishments. However, despite the cross-cutting nature of the shock linked to the pandemic, the perceived risk associated with it is much lower in sectors related to transportation, telecommunications and refinery activities.

Furthermore, also the average sentiment towards COVID-19 is very volatile across sectors for Italian firms. In Fig. A.2 in the Appendix, we find that the average sentiment of firms varies across different sectors. Consistent with cancelled air routes and closed borders that most of the countries experienced during the pandemic, Italian firms operating in the sector of air transport and related services show the most negative outlook about the pandemic since it severely impacted on air travel and the demand for related services.

Conversely, some sectors also showed on average a less negative outlook linked to the pandemic since some of them saw their businesses expand. This is the case of, for example, firms operating in basic pharmaceutical equipment (for example face masks, sterilized gloves, hygiene products) or firms operating in telecommunications as people increasingly work from home. This trend is also confirmed at the international level: Hassan et al. (2020b) found firms in the telecommunications and tech firms to be the least pessimistic, perhaps sustained by working-from-home orders issued by many governments and the accompanying investments required in software and hardware solutions. Indeed, most of the Big Tech companies, indeed, such as Apple and Netflix, as well as Microsoft and Intel, generally discuss the impact of COVID-19 with a markedly positive, rather than negative, tone.

The demand and supply shocks also hit the sectors differently. The variation in the extent to which firms exhibit negative net demand (Fig. A.3) and negative supply shocks (Fig. A.4) differs across sectors with industrial goods and services sectors, on average, experiencing negative net demand shocks. An important negative net demand shock is observed in basic pharmaceutical products. Besides, due to the large-scale restrictions imposed on travel, an important negative net demand shock is also observed in the air transportation sector. By contrast, postal services and bars, in
addition to medical preparations and medical articles, exhibit a large positive demand shock. As for the negative supply shocks, electricity production, digital payments, the financial industry, the real estate sector, the automotive and the manufacture of medicines and pharmaceutical preparations, exhibit the lowest shocks, as opposed to life insurance, industrial goods, air transport, construction and services such as bars.

### 5. Effects of firm-level COVID-19 exposure

#### 5.1. Estimation strategy

In this section, we investigate whether the COVID-19 outbreak and Italian firms' exposure, risk and sentiment to COVID-19 impacted on credit behaviour, leading to a variation in the debt exposure of Italian firms and in other asset status indicators (ROE and ROI). Intuitively, we would expect greater exposure to COVID-19 to lead in the first event and more rapidly to an increase in firm debt given that the shock appears to limit business opportunities that would allow firms to increase their returns. For the same reason, also the perceived risk could be positively correlated with firms' total debts. However, we would expect the risk sentiment to be a measure of the increased uncertainty that firms have with respect to the future. Hence, they are expected to be less prone to incur short-term debt. Moreover, we test for the impact the ROE and the ROI. We use fixed effect OLS and in all regressions, standard errors are clustered at the firm level.
Our empirical approach relies on the estimation of the following equation:

\[ Y_{i,t} = \alpha + \beta_1 \text{COVID19}_{i,t} + c_{i,t} + \phi_i + \delta_t + \varepsilon_{i,t} \]  

(1)

in which the subscripts \( i \) and \( t \) identify the firm and the year; the dependent variable \( (Y_{i,t}) \) is alternatively the (log) total amount of debt, the short-term debt (distinguishing between short-term trade payables and bank debts); then, we look at two indicators of firms’ performance such as the ROI and ROE. In our equation, \( \text{COVID19}_{i,t} \) is the annual average coronavirus either Exposure, Sentiment, or Risk score. Further, we split COVID-19 Sentiment into Negative and Positive, to document (if any) the association between positive (negative) COVID-19 news and debt and returns.

We include in the model some standard controls \( (c_{i,t}) \) like the natural logarithm of firms’ age, the number of employees, as a control for the size of the firm, labour productivity, and time fixed \( (\delta_t) \) and firm level fixed effects to control for firm specific characteristics \( (\phi_i) \).

We explore whether COVID-19 exposure, sentiment and/or risk can account for variations in our dependent variables for Italian firms. Exposure does not have an ex-ante clear prediction but given that the shock appears to have increased uncertainty and worsened the outlook for the average firm, it is most likely negatively associated with returns. A positive sentiment about an epidemic should be associated with an increase in returns, whereas a higher perceived risk is expected to be negatively associated with it.

Finally, as standard least squares regression techniques provide summary point estimates that calculate the average effect of the independent variables on the ‘average firm’, by focusing on the “average firm”, this could cover some important characteristics of the underlying relationship. For this reason, we go a bit further in analysing how firms’ perceptions of the COVID-19 outbreak could have been related to their behaviour implementing a quantile regression.

In the next section, we present results for the FE and the quantile regression estimations.
5.2. Results

COVID Exposure identifies the exposure of firms to the outbreak of COVID-19 by counting the number of times, if any, the disease is mentioned in the quarterly earnings conference call of 111 publicly listed Italian firms. The analysis focuses on the debt of the companies in question as a proxy of perceived risk and sentiment. First, we analyse the effect of Exposure, Risk and Sentiment (Net, Positive, and Negative) on the overall debt level. Subsequently, the analysis is carried out on the short-term debts, in particular by distinguishing financial payables (debt to banks) and trade payables (debt to suppliers).

Then, we consider two indicators of firm profitability and equity to show how COVID-19 related risk concerns could be related to these indicators. First, we consider the ROI, which is the ratio between the operating income and the total capital invested, and, then, the ROE, calculated as the ratio between net income and equity. These indicators give a useful outlook about the composition of the liabilities of the balance sheet, industrial profitability, and the profitability of the equity, respectively.

From the results in Table 3, regarding industrial (ROI) and equity profitability (ROE), the perceived risk linked to COVID-19 has a negative correlation with both types of profitability; this could be due to a decrease in income probably due to the increase in the costs (both commercial and financial) without a corresponding increase in revenues. The reduction in returns might depend on sales drops but also on some inefficiencies in the net working capital (such as stock of raw materials, and liquidity shortages due to cash flow problems and bank restrictions).

The negative correlation between Covid Exposure and the ROI could be explained by a decrease in operating profitability translating into increased difficulty experienced by firms in paying off their debts.
Accordingly, the Negative Sentiment is negatively correlated with the ROE, whilst the Positive Sentiment positively affects. This could be linked to the direct effect of the Negative Sentiment on firms' profitability: firms could fear a long-lasting increase in their (debt) costs, both with a severe uncertainty about the timing of the possible recovery from the shock in terms of revenues. Conversely, the positive correlation between the Positive Sentiment and the ROE can be interpreted as a possible increase in shareholders' confidence and a consequent better performance in terms of equity profitability.

Having identified those firms exposed to COVID-19, looking at the results related to the perceived impact of the shock which the firms reveal in their earnings calls, we then consider whether our results derive from investors' expectations regarding the firm's risk, as captured by COVID-19 Risk, or by revising their expectations of future cash flows, as measured by COVID-19 Sentiment.

Decomposing COVID-19 exposure into risk and sentiment components suggests that the perception of COVID-19 risk is correlated with increases in total debt while it shows a (although not significant) reduction in short-term debt. Although negative sentiment related to the COVID-19 outbreak does not significantly explain firms' recourse to debt, the signs are in line with the hypothesis that a negative sentiment induces a negative relation with short-term debt. This could be due to the exogenous nature of the COVID-19 shock, and to a perceived uncertainty about its time span, i.e., the lack of confidence that the firms in the sample have with respect to the time span needed to recover from the shock linked to the pandemic. Therefore, an increase in total debt could be an initial reaction to the uncertainty linked to the shock while firms might be less confident in covering short-term liquidity shortage with borrowing. As regards firm size (number of employees) and productivity (value added), larger and more productive firms show positive correlations with their total debt.

Focusing on the firms' short term debt exposure, being the COVID-19 outbreak more likely to influence the behaviour of firms in the short-run, we then distinguish between the owner of the debt which could yield more insight on how firms decide to react. In Table 4, indeed, we separately consider the firms' short-term debt exposure according to the nature of the debt, i.e., whether the increase could occur in the commercial (towards suppliers) or financial (towards banks) debt.

Looking at the results, the COVID Risk measure seems to be negatively related with short-term debt, both towards suppliers and towards banks, in the latter case also significantly. Reducing debt towards the suppliers could mean that the firms in our sample could try not to halt production in the years of the pandemic, attempting at least to keep operating management as efficient as possible. Focusing on the core activity, indeed, seems to have been the most efficient way to survive the shock caused by the pandemic. To sum up, our measures of COVID-19 exposure and risk contain information relevant to firms' indebtedness behaviour during the coronavirus pandemic although significant COVID-19 heterogeneity in response is also observed in our panel of firms.

As said, we want to go a bit further in analysing how firms' perceptions of the COVID-19 outbreak could have been related to their behaviour regarding the variables we analysed so far. So, at this stage, we implement a quantile regression, estimating Eq. (1) at several percentage points of the distribution, to have a more complete picture of this relationship (Coad and Rao, 2008).

We present in Fig. 3 and in Fig. 4, quantile regression results for the COVID-19 variables together with their confidence intervals. The numerical results for quantile regression estimation are reported in Table B.1 and in Table B.2 of Appendix.

The quantile regression curves show that the value of the estimated coefficient on COVID-19 variables varies over the distribution of our dependent variables. In Fig. 4, we present the coefficients for the dependent variables of Total debts, ROI, and ROE. The covid exposure reaction to different thresholds of distribution of the Total debts shows a pattern increasing up to the 60% quantile, and above the 80% quantile, while decreasing between these two range of the distribution. The coefficient on risk over total debt is indeed negative and significant (albeit weakly) when we evaluate the quantile regression up to the 75% quantile of the total debt while increasing in the top 25% distribution. For firms in the upper quantile of the ROI, the coefficient on Covid exposure is constant and decreasing in the top of the distribution. Conversely, the coefficient on Covid Risk shows a decreasing coefficient on increasing quantiles of ROI, while the coefficient is increasing for firms having Positive sentiment towards the outbreak. The same happens for the ROE indicator.

Finally, when we consider the short-term debt exposure (Fig. 2) we find that the correlation with the short-term debts towards suppliers is more pronounced when we evaluate the quantile regression solution at the median firm (i.e., at the 50% quantile).

6. Conclusions

The pandemic constitutes a laboratory to study the firms' response to a huge exogenous shock that heavily affected both the supply and demand side of the economy. To our knowledge, this paper provides the first evidence on how Italian firms responded in terms of credit behaviour to the shutdown of a significant share of economic activity.

We used data extracted from a global sample of firms and based on quarterly earnings conference calls of Italian firms during which managers discuss with market participants the release of their earnings. These calls are able to measure each Italian firm's exposure to the pandemic, what firms face as they respond to the challenges of the pandemic and the level of exposure to demand and/or supply shocks associated with epidemic diseases.

We use measures of the exposure of individual firms to epidemic diseases, including the firm's exposure, sentiment, and risk related to the coronavirus pandemic. It is crucial to understand the firm-level impact of such an unprecedented worldwide strong economic shock.

Our main findings are as follows:
COVID-19 is unique since it affected virtually all firms in all parts of the word at once (with 100 percent of firms discussing its impact in their calls).

On aggregate, COVID-19 simultaneously increases firm-level uncertainty and worsens the business outlook of most firms.

Time-series patterns of COVID exposure, risk and sentiment, show large differences between geographical regions, industries and across firms (e.g. the Tech sector versus the Transportation sector where there was an unprecedented collapse in demand).

COVID-19 outbreak and Italian Firms Exposure, risk and sentiment to COVID-19 impacted on credit behaviour, leading to a variation in the debt exposure of Italian firms and in other asset status indicators (ROE and ROI).

The perceived risk, linked to the increased uncertainty that firms have with respect to the future, impacted on firms’ choice in terms of time horizon of their debt exposure: they emerged as less inclined to incurring in short-term debt.

The COVID risk measure is negatively correlated with short-term debt both towards suppliers and banks.

Reducing debt towards suppliers could mean that the firms in our sample sought not to stop production in the years of the pandemic, trying at least to keep operating management as efficient as possible.

Covid-19 exposure is negatively related to the ROI which might be explained by a decrease in operating profitability translating into increased difficulty experienced by firms in paying off their debts.

The perceived risk linked to COVID-19 has a negative correlation with both industrial and equity profitability due to the increase in costs (both commercial and financial) without a corresponding increase in revenues.

A positive correlation between the Positive Sentiment and the ROE can be interpreted as a possible increase in shareholder confidence and a consequent better performance in terms of equity profitability.

Our results add important insights into the credit behaviour of Italian firms. As documented in ISTAT (2021) the fall in internal and external demand led to a sudden shortage of liquidity and seriously constrained the firms’ capacity to finance their activities. Faced with such a deep, far-reaching crisis, extraordinary measures of support were adopted to support the margins of liquidity of firms, to bear the impact on financial engagement and to relaunch business activity at the end of the emergency. It is worth mentioning that the impact of these policies was crucial in allowing a recovery of credit demand and supply, inverting the downward trend in 2018–2019 in line with the weakened business cycle. Credit demand, driven by the fall in interest rates and by the support to investment in the period 2018–2020, rose further in 2020 due to the state support to guarantee credit and support the search for liquidity, the need of debt restructuring and refunding of previous debt.

Recourse to debt is crucial to gauge the effect of the COVID-19 outbreak on expectations of firms’ sales and orders and on firms’ employment, investment, and price plans (Balduzzi et al., 2020; Acharya and Steffen, 2020), as financial frictions shape the effects of the shocks generated by the COVID-19 pandemic. More indebted firms display a relatively more pessimistic outlook for sales and orders, and therefore plan to reduce employment and investment more than unconstrained firms. In addition, previous evidence supports the view that credit-constrained firms plan to increase prices more (or to decrease prices less) than unconstrained firms. This result is consistent with a markup strategy by financially constrained firms aimed at boosting internal sources of funds even at the cost of future losses of their customer base.

The increase in the recourse to debt might be due to higher recourse to credit or to lower liquidity i.e. to a reduction of the net working capital. In this case, it would suggest that firms cannot generate enough liquidity to service short-term debts. However, we found no impact of our model variables on the net working capital. Hence, according to our model, we cannot support the hypothesis of a decrease in liquidity.

COVID-19, in contrast to earlier epidemics (in which demand shocks dominate), presents a simultaneous shock to both demand and supply for most sectors. The unique feature of the data used in this paper is that they are able also to reveal, at the firm level, whether COVID-19 is a shock to the supply side or to the demand side of the firm. This undertaking is important as it shows how our approach can help inform theories about how demand and supply factors explain changes in stock valuations and in many economic areas.

An essential target of any future analysis would be to obtain from this preliminary study of firm sector and regional impact of the pandemic further insights into policy implications.

For this purpose, in future analysis, we intend to ascertain the relative importance of demand and supply shocks in detail with regard to coronavirus. The origin of shocks perceived will allow us to document firm outcomes and mitigation strategies related to investment and hiring. On the supply side, it will be important to make predictions around the propagation of the shock via supply chains. Part of the economic crisis in the wake of the pandemic is also clearly attributable to shortfalls in demand, which can also be addressed with appropriate monetary and fiscal policy.

Such topics are directly relevant to policymakers. Previous studies suggest that the length of the shutdown and the time course for reopening the economy are key indicators of how firms choose to deal with the crisis. That said, the crisis amplified pre-crisis vulnerabilities such as a high level of previous credit constraints. As firms’ pre-crisis situation and their expectations about the shutdown duration shaped their business outlook and their strategies to counteract the crisis, this suggests that already weak firms may need more public assistance to survive the crisis.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.
Appendix A. Heterogeneity in the perceived COVID-19 risk across sectors

In this section, we show how the COVID-19 outbreak has affected the sectors differently and how the concerns associated with the pandemic are differently reflected in the companies’ earning calls in different sectors classified according to the ATECO2007 Classification (6 digit). In Fig. A.1, we show the Average COVID-19 Risk by sector. High volatility is also shown by the average sentiment towards Covid-19 in Fig. A.2. The same heterogeneity across sectors is found in the net demand (Fig. A.3) and supply shocks (Fig. A.4). All the figures in Appendix A of the Appendix are more extensively commented in the main text.

Appendix B. Quantile regression results

In this Section, we present the results of the quantile regression estimation of Eq. (1). In Tables B.1 and B.2 are presented the coefficients and the standard errors for the 10%, 25%, 50%, 75% and 90% quantiles.

Fig. A.1. Average of COVID-19 Risk by sector.
This figure plots average COVID-19 Risk (i.e., the average number of Covid-related terms near risk synonyms per sentence) by sector across all earnings calls held by Italian firms in the indicated sector between January and December 2020. The sector classification is based on the ATECO2007 Classification (6 digit).
Source: Authors’ calculation on firmlevelrisk database.
**Fig. A.2.** Average of COVID-19 (Net) Sentiment by sector.

This figure plots average COVID-19 Net Sentiment (i.e., the average difference per sentence of positive and negative sentiment words near COVID-related terms) by sector across all earnings calls held by Italian firms in the indicated sector between January and December 2020. The sector classification is based on the ATECO2007 Classification (6 digit).

*Source:* Authors’ calculations based on firmlevelrisk database.
Fig. A.3. Average COVID-19 negative net demand shock by sector (*100).
This figure plots the sector averages of COVID-19 negative (net) demand shocks for all Italian firms with earnings calls between January and December 2020. The sector classification is based on ATECO2007 classification (6 digit).
Source: Authors’ calculations based on the firmlevelrisk database.

Fig. A.4. Average COVID-19 negative supply shock by sector (*100).
This figure plots the sector averages of the COVID-19 negative supply shock for all Italian firms with earnings calls between January and December 2020. The sector classification is based on the ATECO2007 classification (6 digit).
Source: Authors’ calculations based on the firmlevelrisk database.
|                | (1)       | (2)       | (3)       | (4)       | (5)       |
|----------------|-----------|-----------|-----------|-----------|-----------|
| **Total debt (ln)** |           |           |           |           |           |
| Covid Exposure   | −0.111    | −0.073    | −0.685    | −0.022    | −0.018    |
|                | (0.655)   | (0.289)   | (0.429)   | (0.247)   | (0.025)   |
| COVID Risk       | 0.673     | 2.707     | −1.608    | −2.082    | −3.764*   |
|                | (2.626)   | (3.035)   | (1.608)   | (1.660)   | (1.895)   |
| COVID Net Sentiment | −0.515   | 1.246*    | 0.987     | 0.254     | 0.254     |
|                | (0.970)   | (0.700)   | (0.611)   | (0.688)   | (0.025)   |
| COVID Positive Sentiment | −1.945*  | 1.579     | 0.374     | −0.073    | −0.034    |
|                | (1.081)   | (1.014)   | (1.206)   | (0.947)   | (0.058)   |
| COVID Negative Sentiment | −0.254   | −1.067*   | −3.138*   | −0.430    | −0.036    |
|                | (1.260)   | (0.635)   | (0.674)   | (0.623)   | (0.052)   |
| Controls       | ✓         | ✓         | ✓         | ✓         | ✓         |
| Observations   | 315       | 315       | 315       | 315       | 315       |
| Adj R-squared  | 0.598     | 0.596     | 0.600     | 0.844     | 0.844     |
|                |           |           |           |           |           |
| **ROI**        |           |           |           |           |           |
| Covid Exposure | −0.959    | −0.386    | −0.588    | 3.818     | 6.985     |
|                | (1.118)   | (1.109)   | (1.028)   | (3.992)   | (5.814)   |
| COVID Risk     | −4.393    | −1.310    | −10.100   | −13.392   | −19.867   |
|                | (4.745)   | (8.161)   | (6.852)   | (6.757)   | (12.385)  |
| COVID Net Sentiment | −4.773*  | 0.268     | 6.385***  | −1.849    | −57.683***|
|                | (2.744)   | (1.757)   | (2.185)   | (5.158)   | (12.225)  |
| COVID Positive Sentiment | −6.940   | 2.046     | −12.333***| −14.448** | −40.652***|
|                | (5.309)   | (2.791)   | (3.006)   | (6.329)   | (14.900)  |
| COVID Negative Sentiment | 3.614    | 1.505     | −3.206    | 10.561*   | 23.711**  |
|                | (2.330)   | (2.897)   | (2.383)   | (6.161)   | (9.194)   |
| Controls       | ✓         | ✓         | ✓         | ✓         | ✓         |
| Observations   | 294       | 294       | 294       | 294       | 294       |
| Adj R-squared  | 0.447     | 0.449     | 0.521     | 0.621     | 0.633     |
|                |           |           |           |           |           |
| **ROE**        |           |           |           |           |           |
| Covid Exposure | 5.911     | −3.296    | 2.107     | 2.524     | 6.880     |
|                | (7.757)   | (3.659)   | (3.694)   | (4.324)   | (5.505)   |
| COVID Risk     | 36.636    | 22.172    | −70.782***| −55.057***| −26.659   |
|                | (39.127)  | (29.009)  | (25.955)  | (23.456)  | (29.990)  |
| COVID Net Sentiment | 1.518    | 2.919     | 0.707     | 5.509     | 13.121    |
|                | (10.450)  | (5.584)   | (5.522)   | (6.856)   | (13.083)  |
| COVID Positive Sentiment | 12.712   | 15.157    | 19.811*   | 26.696*   | 57.780*   |
|                | (14.583)  | (9.289)   | (10.908)  | (15.868)  | (29.392)  |
| COVID Negative Sentiment | 0.769    | −0.418    | 3.196     | −1.180    | −3.996    |
|                | (11.676)  | (5.079)   | (4.618)   | (5.857)   | (9.648)   |
| Controls       | ✓         | ✓         | ✓         | ✓         | ✓         |
| Observations   | 360       | 360       | 360       | 360       | 360       |
| Adj R-squared  | 0.226     | 0.222     | 0.376     | 0.387     | 0.406     |

Notes: The coefficient and standard errors on main interest variables reported for the 10%, 25%, 50%, 75% and 90% quantiles. Controls and FE as in Eq. (1) are included. ***,** and * indicate significance at the 1%, 5% and 10% level, respectively.
Table B.2
Quantile regression estimation of Eq. (1): Short term debt, Bank and commercial debts.

|                          | (1) | (2) | (3) | (4) | (5) |
|--------------------------|-----|-----|-----|-----|-----|
|                          | q = 0.10 | q = 0.25 | q = 0.50 | q = 0.75 | q = 0.90 |
| **Short term debt**      |     |     |     |     |     |
| Covid Exposure           | 0.664 (0.534) | −0.345 (0.436) | 0.038 (0.239) | 0.230 (0.216) | −0.051 (0.058) |
| Covid Risk               | −2.016 (2.359) | −2.916 (2.741) | −1.137 (2.753) | −2.252 (1.787) | −3.194* (1.652) |
| Covid Net Sentiment      | −0.112 (1.036) | 1.230* (0.680) | −0.057 (0.810) | −0.794 (0.625) | −0.076 (0.113) |
| Covid Positive Sentiment | 0.521 (1.194) | 1.381 (1.175) | 0.605 (1.137) | −0.419 (0.371) | −0.205 (0.226) |
| Covid Negative Sentiment | 0.453 (1.195) | −1.149 (0.770) | 0.413 (0.703) | 0.995 (0.782) | 0.007 (0.091) |
| Controls                 | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Observations             | 315 | 315 | 315 | 315 | 315 |
| Adj R-squared            | 0.551 | 0.545 | 0.544 | 0.603 | 0.605 |

| **Short term debt (Banks)** |     |     |     |     |     |
| Covid Exposure           | 1.957 (3.266) | 0.559 (0.975) | −0.020 (0.771) | 0.410 (0.623) | 1.711* (0.927) |
| Covid Risk               | −17.539 (17.786) | −23.286 (21.124) | 0.176 (6.355) | −3.249 (6.260) | −4.469 (6.653) |
| Covid Net Sentiment      | 2.301 (6.104) | −0.070 (2.155) | 0.698 (1.551) | −1.720 (1.525) | −0.069 (0.782) |
| Covid Positive Sentiment | 7.440 (10.970) | 1.780 (3.326) | 1.789 (1.973) | −1.026 (1.298) | 2.059 (1.999) |
| Covid Negative Sentiment | 0.208 (3.951) | 0.973 (2.259) | −0.166 (2.007) | 2.059 (1.999) | 0.451 (1.272) |
| Controls                 | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Observations             | 271 | 271 | 271 | 271 | 271 |
| Adj R-squared            | 0.269 | 0.266 | 0.264 | 0.419 | 0.416 |

| **Short term debt (Suppliers)** |     |     |     |     |     |
| Covid Exposure           | 0.773 (0.475) | 0.154 (0.304) | 0.113 (0.149) | 0.101 (0.142) | −0.182 (0.288) |
| Covid Risk               | 5.807** (2.851) | 2.957 (2.057) | −3.169 (2.174) | −4.359 (2.734) | −1.497* (0.840) |
| Covid Net Sentiment      | −0.131 (0.562) | 1.142 (0.850) | −0.505 (0.348) | 0.083 (0.375) | −0.563 (0.438) |
| Covid Positive Sentiment | 1.872 (1.122) | 1.979 (1.247) | 0.821* (0.459) | 0.620 (0.356) | 0.666 (0.324) |
| Covid Negative Sentiment | 1.210 (1.106) | −0.692 (0.687) | 0.375 (0.536) | 0.375 (0.536) | 0.375 (0.536) |
| Controls                 | ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ ✓ |
| Observations             | 315 | 315 | 315 | 315 | 315 |
| Adj R-squared            | 0.794 | 0.793 | 0.795 | 0.720 | 0.721 |

Notes: The coefficient and standard errors on main interest variables reported for the 10%, 25%, 50%, 75% and 90% quantiles. Controls and FE as in Eq. (1) are included. ***, ** and * indicate significance at the 1%, 5% and 10% level, respectively.
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