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# Heterogeneous Shocks in the Covid-19 Pandemic: Panel Evidence from Italian Firms

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## ABSTRACT

This paper contributes to the policy discussion on Covid-19 by presenting real-time evidence on the magnitude of the shock for Italian firms. We take advantage of unique panel data on 7,800 companies between January 2020 –right before the pandemic– and March of the same year –in the midst of lockdown policies. We then exploit the revision in expectation within this short time window to capture the impact of firms’ idiosyncratic shock. Our analysis shows disproportionate effects for internationalized companies and provide some evidence on supply chain contagion. We also document stronger shocks for truly innovative companies and effects on long-run growth operating through the disruption of preexisting R&D plans.

JEL classification: D84, F00, O3.

Keywords: Covid-19, Firms, Expectations, Internationalization, Innovation, Global Value Chains.

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# 1 Introduction

The outbreak of the Covid-19 pandemic induced an unprecedented combination of supply and demand shocks for the global economy. While significant disruptions and job losses already took place, full effects of the crisis are far from being realized and the recession will likely persist long after the end of the emergency or the related shutdown policies (Gourinchas, 2020; Guerrieri et al., 2020). In this early stage of the crisis, prompt measures in support of the economy are of paramount importance to limit the disruption of key segments of the market and help firms to weather the storm.

This paper contributes to the policy discussion by presenting real-time evidence on the magnitude of the shock faced by Italian companies and, especially, by documenting heterogeneities that should be accounted for in the design of public interventions. While the focus on Italy is mainly driven by the unique features of our dataset, it is also relevant in its own because of the severe exposure to the pandemic (in terms of cumulative mortality) and the early timing of the self-isolation policies adopted (the first Western country).

Our analysis takes advantage of panel data on firms' behavior and performance between (late) January 2020 –one month before the first official cases of Covid-19 in Italy– and (late) March of the same year –two weeks after the introduction of the initial lockdown policies (March 11, then revised in March 22). We enrich the large amount of information available in the 2019-wave of the MET survey (24,000 observations) with an *ad hoc* survey monitoring the effects of the pandemic on the same set of companies (7,800 final estimating sample, see Section 2.1 for a discussion on selection issues).

We capture the effect of the idiosyncratic shock experienced by each company with the *revision* in its forward-looking expectations, computed as the difference between pre- and post-Covid expected sales on a one-year horizon. In other words, we rely on an event-study type of approach (short-window identification) and compare firms' future prospects around the burst of the epidemic. Additionally, we also exploit cross-sectional information on the perceived impact on shorter-term performances (sales at three months) or on employment and investment in tangible and intangible assets. We then regress a firm's revision in expectations on its internationalization status, innovativeness, and R&D activity (all reported in January 2020) together with an extensive set of controls capturing its condition in the onset of the crisis.

Our descriptive results document an aggregate shock that is particularly severe on a three-months horizon (-21%) but extremely negative also at 12 months (-16%). This is paired with a strong reduction in firms' expected investment in tangible and intangible assets (-15% and -13%, respectively) that is

likely going to have adverse consequences on long-run growth. On the other hand, the effect on employment appears to be milder, being limited to a 6.5%-aggregate drop (we elaborate more on this in Section 7).

Most importantly, our econometric exercise highlights significant heterogeneities in this effect. Even after controlling for the manager's perception of danger, past strategic choices explain much of how Italian firms are faring this first phase of the crisis. Our results point at a stronger shock for internationalized companies and firms that introduced product innovations in the recent past, characterized by a substantially-higher probability of severe reduction in expected future sales (respectively 10% and 8%). This is combined with worse future prospects on employment or investment in tangibles and intangibles. On the other hand, firms deeply involved in R&D activities are relatively less affected, with lower decrease in expected future sales (-7% probability of having very negative revisions in expectations) and better employment dynamics (+3%). This evidence implies a drastic change of direction compared to the recent financial and sovereign debt crises, whereby international connections and innovations represented a significant engine for the performance of Italian firms. Importantly, we also document disproportionate shocks for more complex forms of internationalization and provide some results on supply-chain contagion based on a firm-level proxy of involvement in Global Value Chains.

It is worth stressing that, while firms' expectation revisions are used as a measure for the impact of the shock, we do not necessarily regard them as an accurate prediction about future performances. Despite we perform some validation tests based on past waves of the survey (showing a strong correlation between expected and realized sales, see Section 3), the large uncertainty in this stage of the crisis will likely imply sizable forecast errors on future outcomes. Instead, our results have to be read as a warning about the greater difficulties for more dynamic companies in the onset of the Covid-19 crisis. This issue should be central in the design of proper policy measures to avoid the disruption of key investment that can impact long-run growth. In this regard, we show that, independently of their accuracy, current expectations have significant effects on managers' actual choices for future R&D investments. The revised R&D plans reported in March 2020 document an impressive effect of pandemic, with the disruption of 44% of the preexisting scheduled R&D projects (as of January of the same year). Coherently with previous results, this effect is substantially more pronounced for internationalized and innovative companies.

Although the analysis is mainly based on firm-level data, we also exploit the representativeness

of our sample to discuss the economic significance of the results in terms of the aggregate shock. In essence, we compare firms' revision in expectations with the counterfactual revision obtained by sequentially silencing the effect of the specific strategy (as estimated in the econometric analysis). Our findings suggest that the introduction of product innovations explains a significant fraction of the overall shock (roughly 13%), but firms' internationalization patterns play an even bigger role, being associated to one-fourth of the aggregate effect in the short run (17% on a one-year horizon).

The results of this paper speak to the empirical literature on the Covid-19 crisis.<sup>1</sup> Within this field, we are more closely related to those papers analyzing the nature and consequences of the turmoil. Among others, Hassan et al. (2020) exploit textual analysis on earnings call transcripts to construct firm-specific measures of the Covid-19 shock for US listed companies. They also identify major fears related to demand components, increased uncertainty, and disruption in supply chains. With a different perspective, Baker et al. (2020) and Andersen et al. (2020) use households' transaction data to study consumption behaviors. Finally, Baker et al. (2020) derive macro implications exploiting text-based uncertainty measures, while Barro et al. (2020) use data from the Spanish Flu to study the impact of death rate on economic outcomes.

The number of papers exploiting survey data is also sizable. Bartik et al. (2020) focus on US small businesses and document massive layoffs and closures as well as concerns about firms' financial fragility. With a different emphasis, Baert et al. (2020) and Coibion et al. (2020) investigate the expected impact on labor in Belgium and Netherlands.<sup>2</sup> Furthermore, Briscese et al. (2020) study how compliance with the self-isolation restrictions respond to the length of their possible extensions. We differ from all these papers in terms of research question and because we can also exploit survey information on pre-Covid conditions in a short-window identification strategy. Most importantly, this is the first analysis documenting heterogeneities along firms' internationalization and strategic choices.

Finally, our paper is also linked to the literature on supply chains in times of crisis. In analyzing the Great Trade collapse of 2009, Baldwin (2009) relates value-chain linkages with the synchronization of adverse shocks across countries and emphasize the role of input-output connections in the transmission of the turmoil. This issue was further analyzed by Bems et al. (2011) and Alessandria et al. (2011) who

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<sup>1</sup>For theoretical contributions see, among others, Eichenbaum et al. (2020), Faria-e Castro et al. (2020), and Guerrieri et al. (2020).

<sup>2</sup>Not directly related to this work, a set of papers explicitly analyze financial issues in the pandemic. Baker et al. (2020) employ text-based methods to discuss financial implications of the Covid-19. Moreover, Jorda et al. (2020) take advantage of 12 historical pandemics and study rates of return on assets and macroeconomic after-effects. Finally, Schivardi and Romano (2020) focus on the population of Italian balance sheets to estimate firms' liquidity needs under alternative scenarios.

study the transmission channel focusing on vertical specialization and inventory adjustments.<sup>3</sup> Finally, Békés et al. (2011), Brancati et al. (2017), and Accetturo and Giunta (2018) explore heterogeneities across the firms’ position in a value chain. To the best of our knowledge, this is the first paper rigorously exploring the pandemic shock for internationalized companies and documenting firm-level evidence on supply-chains.

The reminder of the paper is as follows: Section 2 presents our dataset and the ad hoc survey conceived to study the effect of the epidemic. Section 3 outlines the empirical methodology, while Section 4 discusses the main results. Finally, Section 5 deals with a discussion on the economic significance of our results (implied aggregate effects) and Section 6 concludes the paper.

## 2 Data and descriptive statistics

### 2.1 Sources of data

This paper takes advantage of panel data on the behavior and performance of Italian firms around the burst of the epidemic. We complement the large amount of information available in the 2019-wave of the MET survey with an *ad hoc* survey specifically designed to monitor the effects of the Covid-19 pandemic on the same set of companies.

MET is an Italian Research Center carrying on one of the most comprehensive surveys administered in a single European country. The original sample is fully representative at the firm size, geographic region, and industry levels and comprises seven waves – 2008, 2009, 2011, 2013, 2015, 2017, and 2019 – with roughly 24,000 observations in each cross section.<sup>4</sup> Unlike other recurring surveys, MET provides information on every size class including micro-sized companies with less than ten employees. Because of their prominent role in the overall population of firms (more than 90% in Italy) and since they are more fragile and exposed to economic shocks, the inclusion of very small companies is a critical issue in assessing the effect of this pandemic. The original questionnaire encompasses an extensive array of measures related to firms’ structure, behavior, and performance, including internationalization strategies, introduction of innovations, and R&D activities.

Coherently with the timing of the previous waves, the administration of the 2019-survey ended in

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<sup>3</sup>For further readings on the effect of the 2007-2008 crisis on suppliers, see also Accetturo and Giunta (2018); Altomonte et al. (2012); Agostino et al. (2015, 2020).

<sup>4</sup>The survey is fully representative for the manufacturing sectors (60% of the sample) and the production-service industry (40%), with a total coverage of 38 NACE Rev.2 3 digit sectors. Production services sectors are: distributive trades, transportation and storage services, information and communication services, administrative and support service activities.

late-January of the following year, right before the outbreak of the pandemic in Italy (late February 2020). This characteristic makes the 2019-MET survey the only available data, to the best of our knowledge, providing a comprehensive snapshot of firms' conditions in entering the Covid crisis.

We complement the information in the original questionnaire with a swift integration survey to the entire sample of respondents of the 2019-wave, so to have full information on the pre-Covid condition of each company.<sup>5</sup> Because we wanted to avoid excessive variation in the information set of the respondents, we restricted the timing of the survey in a 2-week window between March 24 and April 7, 2020. The administration started 13 days after the initial lockdown and the special measures imposed by the Italian government (March 8 and 11), so to leave firms enough time to update their beliefs and to evaluate adjustments in the production process and strategies.<sup>6</sup> At the same time, not much additional information was revealed within this short-time window, guaranteeing that heterogeneous responses are neither due to changes in the measures imposed by the government, nor to updated beliefs on the severity of the Covid-19 pandemic (we further address this issue in Section 4). The response rate was impressive given the time constraint (roughly 33%), and the survey ended with 7,800 final interviews. Importantly, the distribution of respondents across macro-sectors, geographical macro-regions, and size-classes is in line with the original survey, reassuring about potential selection issues. Moreover, unreported regressions on the entire set of firms in the 2019-wave of the MET survey, show no correlation between firms' likelihood of being interviewed in the Covid-survey and the set of characteristics employed in our analysis, not even dummies for macro-geographical location that capture the severity of the pandemic (see the Online Appendix for details).<sup>7</sup> This allays concerns about the potential attrition in the Covid survey compared to the representative sample of the 2019-wave.

Finally, we match both surveys with the last available official balance-sheet data (as of 2018) from CRIF-Cribis D&B. As a result of this alignment and of the censoring procedures aimed at removing outliers,<sup>8</sup> the estimating sample reduced by roughly 35% with a final size of about 5,000 observations.

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<sup>5</sup>The administration was performed according to the highest standards of CAWI techniques (Computer Assisted Web Interviewing).

<sup>6</sup>An update of the first decree of the Italian government was provided in March 22, two days before the beginning of the administration period. We will account for this additional heterogeneity in Section 3 when discussing the introduction of 6-Digit fixed effects as a robustness check.

<sup>7</sup><https://sites.google.com/site/emanuelebrancati/research/separate-online-appendix>.

<sup>8</sup>Some observations are dropped to reduce the influence of outliers (balance-sheet variables are censored at the 1%) or because of unreasonable values due to measurement errors (negative or nil assets, negative or nil sales).

## 2.2 Content of the Covid-19 MET survey

The Covid questionnaire is made of three main sections: i) a set of forward-looking questions on firms' future sales and R&D plans that replicates the exact same wording of the 2019-MET survey, ii) a block of questions directly asking, on several outcomes, the revision in firms' expectations due to the Covid-19 outbreak, and iii) a mixed field asking for broader issues related to the pandemic.

Since the first block guarantees a perfect comparability between the two surveys, we exploit variations in a firm's answers to measure the effects of its idiosyncratic shock in the crisis. In each point in time, firms are asked to report their forward-looking expectations about sales growth on a 12-months horizon by choosing among five options: very negative (sales growth below -15%), negative (in the interval -15%/-5%), constant (-5%/+5%), positive (5%/15%), or very positive (>15%). The difference between post- and pre-Covid answers  $-\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$  in our notation— gives rise to an ordinal measure ranging in the discrete interval  $[-4; +4]$ , which we employ as a dependent variable. Notice that, ideally, the “true” effect of the pandemic should be retrieved by comparing current expectations with the counterfactual (current) expectation in absence of the shock, which is clearly impossible. However, the difference with our proxy boils down to changes in fundamentals or expectations that are unrelated to the spread of Covid-19. In other words, whether or not our analysis is an actual counterfactual exercise translates into asking if there is substantial information that is not accounted for. In this regard, the short time window between the two surveys makes this difference potentially negligible. This is especially true conditioning the effect on a rich set of controls (see Section 3) absorbing most of the variation in firms' prospects between the first survey and the beginning of the pandemic (roughly one month).

In the same vein, the change in *planned* investments in Research and Development for the next 12 months (a dummy variable in both surveys) allows to construct an ordinal variable identifying the disruption of scheduled R&D plans (value of -1), firms that were unaffected by the pandemic (0), and the (few) companies that reacted to the shock by planning new R&D investments (+1).

Because we also wanted to explore the effect on other outcome variables, the second part of the Covid survey formulates questions so to rule out the need of pre-Covid observations. In particular, we were interested in the revision in firms' expectations on sales growth for the following three and 12 months, as well as on employment and expenditure in tangible or intangible investments, all on a 12-months horizon. The wording of the questions was designed so to capture the innovation in expectations compared to the previous administration. Specifically, for each of the aforementioned



variables ( $O$ ) we asked: “Compared to the pre-Covid situation, what is the effect of the pandemic on the future evolution of  $O$  for your firm?”. In other words, the phrasing was structured so that the change in expectation of firm  $i$ , in time  $t$ , on the outcome  $O$ , at the horizon  $\tau$ , was directly captured by the reported answer  $\Delta\mathbb{E}_{i,t}^R(O_{i,t+\tau})$ , which we allowed to be continuous.

We employ these measures as additional dependent variables. Yet, we are aware of some potential difficulties in interpreting  $\Delta\mathbb{E}_{i,t}^R(O_{i,t+\tau})$  as an update in firms’ beliefs, at least on its own. This is because of the possible misinterpretation of the question –whereby companies reported the current level of expectation rather than the change between pre and post Covid-19– or the “recall bias” associated to backward-looking scenarios. We correct for these issues thanks to the availability of pre-Covid information on future sales (although ordinal). This will clearly do the case for  $\Delta\mathbb{E}_{i,t}^R(\text{Sales})$ , but it will likely be important also for employment and investment dynamics that strongly correlate with it.

Finally, a third set of questions is broadly investigating additional issues on Covid-19. To the purpose of this analysis, we exploit managers’ self-assessment about the perceived danger of the pandemic. We provided five options: i) not dangerous at all (never chosen by anyone), ii) dangerous but inflated by social media, iii) very dangerous but of short duration, iv) very dangerous with effects that will last for up to 12 months, and v) very dangerous with long-run effects that will last for more than 18 months. We employ this measure to correct for a firm’s specific perception of danger that may in turn affect its expected outcome. Notice that, because this answer also reflects the perceived duration of the crisis, it is also likely to capture firms’ heterogeneous expectations on the possible extensions of lockdown policies.

### 2.3 Descriptive evidence

Table 1 presents the descriptive statistics of our dataset. As of April 2020, roughly 49% of the companies forecast a severe reduction in sales on a 1-year horizon (more than 15% drop), while only 18% declares a stable trend compared to the previous year. Importantly, the same expectations formed before the beginning of the pandemic portray a significantly different picture, with more than 80% of firms predicting stable or positive patterns. Noticeably, this difference is mainly driven by the updated beliefs of companies with brighter prospects before the epidemic (in the Online Appendix). Regarding the magnitude of the effect, cross-sectional data on  $\Delta\mathbb{E}_{i,t}^R(O_{i,t+\tau})$  highlight a 24%-reduction in expected sales on a 3-months horizon, followed by a very small recovery at 12 months (-19%). This

is paired with a significant contraction in tangible or intangible investments (-15% and -13%), and milder effects on employment (-9%). Concerning planned R&D projects, 10% of the sample cancelled on preexisting plans, but the disruption turns to be substantial (44%) when conditioning to the set of firms with scheduled R&D investments in January 2020. As for the heterogeneity of the effect, Figure 1 clearly shows that the shock was particularly severe for internationalized companies and firms that introduced product innovations in the recent past. Not only they display a distribution of post-Covid expected future sales that is significantly left-shifted compared to domestic companies and non innovators, but they also entered the pandemic with brighter expectations on future sales dynamic.<sup>9</sup> The next section outlines the empirical methodology aimed at digging deeper into this differential effect.

Table 1: Descriptive statistics.

Variable	Mean	Variable	Mean
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Very Negative}$	0.489	Product Innovation	0.392
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Negative}$	0.310	Process Innovation	0.321
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Constant}$	0.178	Leverage	0.691
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Positive}$	0.017	Tangible Assets	0.211
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Very Positive}$	0.007	Rollover Risk	0.824
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Very Negative}$	0.059	Size	14.73
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Negative}$	0.143	Age	3.010
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Constant}$	0.626	Group	0.124
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Positive}$	0.143	Headquarter	0.024
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Very Positive}$	0.059	Family Firm	0.706
Cancelled R&D plans	0.103	Investment	0.628
New R&D plans	0.057	% Graduated Empl.	0.112
$\Delta \mathbb{E}_{i,t}^R(\text{Sales3M})$	-0.240	Labor Productivity	8.814
$\Delta \mathbb{E}_{i,t}^R(\text{Sales1Y})$	-0.193	Vertical Integration	0.049
$\Delta \mathbb{E}_{i,t}^R(\text{Empl1Y})$	-0.088	Complex Intern.	0.258
$\Delta \mathbb{E}_{i,t}^R(\text{Tang1Y})$	-0.146	Export EU	0.299
$\Delta \mathbb{E}_{i,t}^R(\text{Intang1Y})$	-0.131	Export Extra-EU	0.188
Internationalization	0.444	Import EU	0.207
R&D	0.241	Import Extra-EU	0.061
		GVC	0.237

Notes: Descriptive statistics for the main variables employed.

### 3 Empirical methodology

The empirical analysis exploits the characteristics of our dataset to construct an econometric exercise around the outbreak of the Covid-19 pandemic and explore heterogeneities in the magnitude of the shock along firms' strategic choices. Our main dependent variable is the revision in expectations on future sales at a 1-year horizon, as captured by the difference between pre- and post-Covid measures

<sup>9</sup>As for the other dimensions of interest, descriptive distributions do not highlight any striking difference across subgroups.

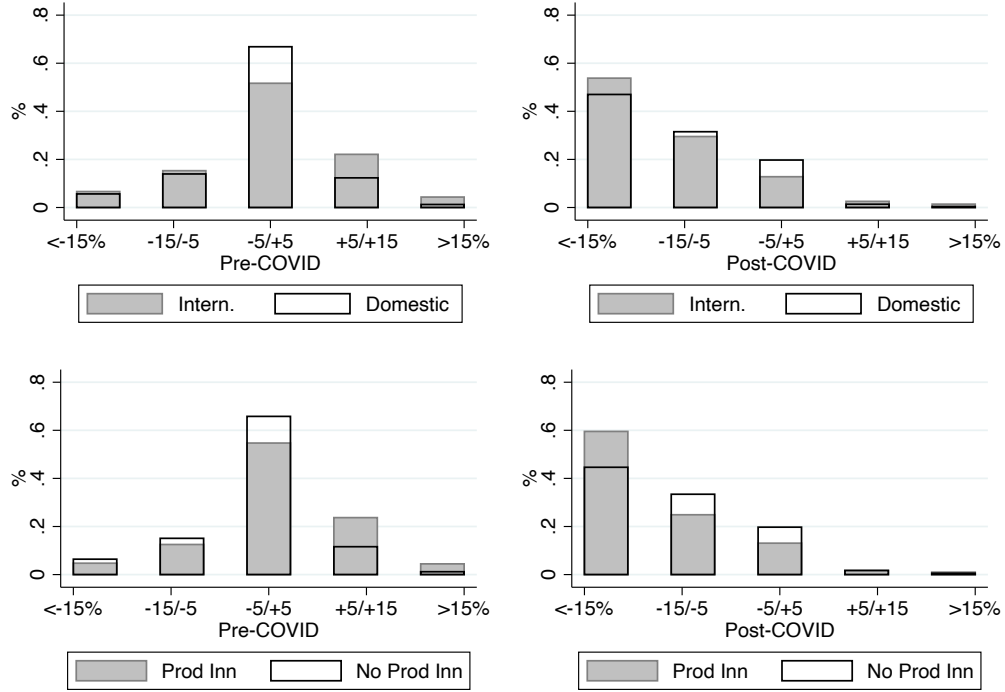


Figure 1: Expectation revisions by firms' internationalization and innovativeness.

*Notes:* Pre- and Post-Covid expectations on sales growth at a 1-year horizon. The top graphs distinguish between internationalized and domestic companies (in grey and white, respectively) while the bottom graphs provide a breakdown by firms' innovativeness (companies that introduced product innovations or not, in grey and white, respectively). Left graphs display firms' forecast as of January 2020, while the right graphs report the updated expectations in March.

defined in Section 2.2. Alternatively, we employ directly the current level of expectations while controlling for lagged expected values.

We regress the cross-sectional revision in beliefs on firms' internationalization, innovativeness, and R&D activity, all reported in January 2020, together with a rich set of controls capturing firms' structure and conditions in entering the pandemic. The baseline specification reads as follows:

$$Y_{i,t} = \alpha + \beta \mathbb{E}_{i,t-1}(\text{Sales1Y}) + \gamma^\top X_{i,t-1} + \delta^\top Z_{i,t-1} + \lambda_S + \lambda_P + \varepsilon_{i,t} \quad (1)$$

where  $Y_{i,t}$  is the revision in a firm's expectations and  $X_{i,t-1}$  is a vector of dummies identifying companies involved in relevant international connections (import, export, or more complex forms of internationalization), that introduced product or process innovations, or invested in R&D activities (labelled Internationalization, Product Inn, Process Inn, and R&D, respectively). Notice that because

both the timing and the magnitude of the Covid-19 shock, not to mention its very existence, were totally unexpected when the firm chose its strategies, these measures are all predetermined variables and thus can be regarded as orthogonal to the effects of the epidemic.  $\mathbb{E}_{i,t-1}(\text{Sales1Y})$  is the expectation on future sales reported in the 2019-wave and allows for path dependency in firms’ expectation revisions.<sup>10</sup> The inclusion of lagged expectations aims at purging the model from past trends in firms’ beliefs that may be correlated with  $X_{i,t-1}$  (realized past sales growth is added as an additional control in  $Z_{i,t-1}$  for a similar purpose). We also include an extensive set of fixed effects for firms’ belonging sector (2-Digit, 90 controls) and geographical province (107), respectively  $\lambda_S$  and  $\lambda_P$ . The latter is meant to account for the heterogeneous diffusion of the pandemic across the Italian territory. Not controlling for  $\lambda_P$  would have induced a significant bias in our estimates as the health crisis reached its peak in Northern regions that also display a higher concentration of more dynamic and better-performing companies. On the other hand, granular controls for the belonging sector aim at capturing differences between those industries restricted by the shutdown and the “essential” sectors that, staying in business, displayed better performances. Because the Italian Government regulated economic activity with a progressive closure of the economic sectors (the main decree in March 11, then revised in March 22), we also run robustness tests on 6-Digit sectors to perfectly account for this heterogeneity.<sup>11</sup> Notice that granular controls for sector specific components also allow to capture most of the variation in firms’ capability of teleworking, which is clearly an essential component in the magnitude of the shock (see for instance Dingel and Neiman, 2020). Finally,  $Z_{i,t-1}$  is a broad array of firm-specific characteristics from the 2019-MET survey or balance-sheet data. This set includes: size, age, realized past sales growth, share of graduated employees (further capturing ICT skills and teleworking capability), labor productivity, degree of vertical integration, a set of financial ratios (leverage, tangible assets, and rollover risk) and dummies for investment, corporate group belonging, or family managed firms (see the Appendix for exact definitions).

One potential issue of our analysis has to do with the reliability of expectations and, especially, with the possible correlation of forecast errors with  $X_{i,t-1}$ . Although we do not need to rely on assumptions about the accuracy of firms’ beliefs to exploit their revisions as a proxy for the idiosyncratic shock, unreported regressions based on previous waves of the survey show a strong predicting power of

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<sup>10</sup>Because our model is estimated cross-sectionally, this is conceptually different from dynamic panel data techniques whereby the demeaning process of the firm fixed effects generates in-built endogeneity in the lagged dependent variable (Arellano and Bond, 1991).

<sup>11</sup>It is indeed extremely likely that part of the heterogeneity is due to a different exposure to the lockdown at the time of the survey (i.e., some firms shut down for three weeks while other companies were just been affected by the second decree).

expectations on future realized sales, suggesting that firms’ beliefs anticipate indeed a significant component of future fundamentals (see the Online Appendix). Most importantly, the residual of this regression is found to be orthogonal to the entire set of variables employed in the analysis, reassuring about possible in-built correlations.<sup>12</sup>

The last issue that is worth discussing is related to firms’ information set and beliefs. In particular, it is possible that expectations on future outcomes reflect differential priors on the extension of lockdown policies (see for instance, Briscese et al., 2020). Notice that, to the extent that firms’ perception is correlated with the health crisis, we already control for most of it with the inclusion of 107 provincial effects capturing the local severity of the pandemic (such as provincial number of deaths, positive cases, hospitalized patients, etc.). However, we perform a number of robustness tests to further assuage this concern. First of all, we explicitly control for the manager’s expectation on the length and severity of the crisis, which is likely incorporating beliefs on the duration of the lockdown. Moreover, we account for a heterogenous information set of the respondents along the survey administration period by including a full set of controls for the exact day of the manager’s answer (i.e., 14 time dummies, one for each day). This captures common changes in the expected length of the crisis and any effect related to announcements or planned interventions by the Italian government (as well as ECB policies). We even allow time effects to depend on broader geographical and industrial characteristics (four macro areas and 12 sectors) so to deal with time-varying correlated shocks. Finally, we interact province dummies with a binary variable for essential sectors that were not directly affected by the lockdown (identified at the 6-Digit level) to further account for firms’ unobserved heterogeneity.

Equation 1 is estimated cross-sectionally via OLS or ordered logistic models with standard errors clustered at the province level that allow for correlation along the differential exposure to the epidemic.<sup>13</sup> However, in order to not rely on any parallel-line assumption (i.e., symmetry in the effect across each category of the dependent variable) we also test the robustness of our results to multinomial logistic models.<sup>14</sup> Estimates are also qualitatively similar if we employ sampling weights or rely, instead, on unweighted data. Additional analyses are all variations upon our baseline specifica-

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<sup>12</sup>Notice that the correlation of  $X_{i,t-1}$  with the residual of these regressions (i.e., the forecast error) would have generated doubts about the identification of the effect in Equation 1. For instance, if firms updated their beliefs based on past forecast errors (as in a Bayesian learning type of model, Brancati and Macchiavelli, 2019), a positive correlation of firms’ innovativeness and internationalization with the forecast error would have induced an in-built correlation in Equation 1 that prevented to interpret  $\delta < 0$  as an evidence of a stronger shock. The insignificance of the coefficients in Table A3 of the Online Appendix reassures about this possibility.

<sup>13</sup>We also experiment with several alternative clustering of the standard errors with no significant change in our results (see Section 4.1).

<sup>14</sup>Results are also robust if we employ logit models on a dummy measure taking unitary values only for “large revisions” in expectations (i.e., lower than -15%).

tion. When analyzing changes in future R&D plans, we employ multinomial logistic models on the differenced variable outlined in Section 2.2. For the effect on sales growth (three and 12 months), employment, and investment in tangible or intangible assets we simply estimate OLS models imposing  $Y_{i,t} = \Delta \mathbb{E}_{i,t}^R(O_{i,t+\tau})$  and keeping  $\mathbb{E}_{i,t-1}(\text{Sales1Y})$  in the set of controls.

## 4 Results

This section presents the results of the paper. First, we discuss the effect of firm strategies on the change in expected sales, employment, and investment. We then turn our attention to longer-run components by analyzing the impact on the disruption in future R&D plans. Finally, we provide evidence on the economic significance of this heterogeneity by estimating the relative aggregate contribution of firms' strategies on the expected change in sales and employment.

### 4.1 Main results

The baseline results on expected future sales are presented in Table 2. Our findings highlight significant heterogeneities in the magnitude of the shock that followed the pandemic outbreak. Both OLS and ordered logistic models point at a severe effect for internationalized companies and firms that introduced product innovations in the recent past. Although it is hard to quantify the overall impact with discrete measures, marginal effects imply, respectively, a 10% and 8% increase in the probability of a severe drop in future sales (more than -15%), paired with a reduced likelihood of having stable or positive prospects (see the Online Appendix for details). Conversely, process innovations seem to bring an average positive effect, possibly linked to a productivity channel, albeit it is not statistically significant in this set of regressions. On the bright side, firms involved in R&D activities are somewhat sheltered against shocks on expected future sales (7%-lower probability of very negative revision in expectations), probably because of a higher flexibility in the re-organization of production stages or their superior ICT skills alleviating the effect of the lockdown. These results are largely consistent if we employ multinomial logistic models that avoid assumptions on the symmetry in the effect of  $X_{i,t-1}$  across the categories of the dependent variable.

Turning to the other coefficients, we document a certain degree of persistence in the level of expectations, paired with a stronger worsening for companies that entered the pandemic with better prospects (columns 2 and 4). Moreover, the shock is found to have detrimental effect especially on

weaker companies, smaller and *a priori* financially fragile (highly leveraged, with few tangible assets to pledge as collateral, or highly exposed to rollover risk). On the other hand, younger firms fared better this first stage of the crisis.

We perform a number of robustness checks to test the validity of our results. First of all, we control for direct measures from the Covid-survey about the manager’s perception of danger, which allegedly capture also its expectations on possible extensions of lockdown policies (see Section 2.2). While this is significantly impacting firms’ answers (with expected negative signs), our baseline results are virtually unchanged. We also interact 107 Province dummies with a binary measure for the essential sectors that kept producing during the lockdown (identified at the 6-Digit level on the basis of the Italian government’s decree in March 22), together with controls for the exact day in which the company answered the survey (i.e., 14 dummies accounting for possible changes in the information set during the administration period).<sup>15</sup> In all cases our findings prove to be extremely robust, independently of the chosen clustering of the standard errors –at the province level, 6-Digit sector level (766), or at the intersection of 2-Digit sector and geographic region (772) (see the Online Appendix for some details). After outlined the main results on panel data, Table 3 turns to alternative measures of revision based on the Covid-survey. First of all, notice that the effect of past expectations turns very positive and significant, which is the opposite of what we found in our baseline specification of Table 2.<sup>16</sup> This suggests that the set of measures based on the Covid-survey alone ( $\Delta \mathbb{E}_{i,t}^R(O_{i,t+\tau})$ ) are likely underestimating the actual magnitude of the shock. Whether this is due to recall bias or to misinterpretation of some companies (reporting the level of current expectations –as in columns 1 and 3 of Table 2– rather the revision that followed the pandemic –columns 2 and 4) is unclear. Nevertheless, this evidence further stresses the relevance of our empirical analysis relying on a short-window identification. The possibility of controlling for past levels of expectations is a unique feature of our dataset and is critical to correct for these issues.

As for the effect on sales, they broadly confirm our baseline results. The shock was particularly severe for internationalized companies and firms that introduced product innovations, characterized by 5.8%- and 3.8%-lower expected sales in the very short run (three months). The effect is slightly reduced on a one-year horizon (-5.1% and -2.7%) but still extremely significant. As we elaborate

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<sup>15</sup>We even account for correlated time-varying shocks by further interacting time effects with broader geographical and industrial components (four macro areas and 12 macro sectors).

<sup>16</sup>For expositional purposes we replaced dummy variables for the five classes of expectations (outlined in Section 2.2) with a continuous measure taking values -15, -10, 0, 10, +15 (i.e. imputing the threshold for open intervals and averages for closed sets). Our results do not depend on this choice.

Table 2: Revision in expected future sales.

Model:	OLS		Ordered Logistic	
Dependent Variable:	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (1)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (2)	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (3)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (4)
Internationalization	-1.150*** [0.409]	-0.168*** [0.0557]	-0.525*** [0.156]	-0.467*** [0.151]
R&D	0.971* [0.510]	0.138** [0.0684]	0.349** [0.176]	0.359** [0.182]
Product Innovation	-1.158*** [0.439]	-0.168*** [0.0548]	-0.405*** [0.155]	-0.440*** [0.162]
Process Innovation	0.0991 [0.512]	0.0200 [0.0655]	0.0382 [0.179]	0.00830 [0.185]
$\mathbb{E}_{i,t-1}(\text{Sales1Y})$ : Very Negative	-3.591*** [0.753]	1.425*** [0.109]	-2.455*** [0.477]	3.822*** [0.301]
$\mathbb{E}_{i,t-1}(\text{Sales1Y})$ : Negative	-1.985*** [0.451]	0.696*** [0.0595]	-0.986*** [0.189]	1.653*** [0.178]
$\mathbb{E}_{i,t-1}(\text{Sales1Y})$ : Positive	1.125* [0.615]	-0.865*** [0.0757]	0.340* [0.195]	-2.351*** [0.253]
$\mathbb{E}_{i,t-1}(\text{Sales1Y})$ : Very Positive	4.005*** [1.352]	-1.526*** [0.164]	0.974** [0.383]	-4.450*** [0.527]
Leverage	-0.023** [0.0102]	-0.003** [0.0013]	-0.0101** [0.0049]	-0.008** [0.003]
Tangible Assets	2.529** [1.257]	0.362** [0.154]	0.794** [0.404]	0.952** [0.425]
Rollover risk	-1.998* [1.032]	-0.307** [0.137]	-0.644* [0.353]	-0.817** [0.398]
Size	1.153*** [0.162]	0.146*** [0.0190]	0.385*** [0.0502]	0.394*** [0.0533]
Age	-0.811*** [0.288]	-0.103*** [0.0338]	-0.270*** [0.0903]	-0.273*** [0.0943]
Province FE	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes
N obs.	5071	5071	5071	5071
R2 (Pseudo R2)	0.217	0.427	0.129	0.207

*Notes:* OLS and Ordered Logistic *estimates*. This table reports the effect on the change in firms' expected future sales. In columns 1 and 3, the dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). In columns 2 and 4, the dependent variable is the difference between post- and pre-Covid expectations ( $\Delta\mathbb{E}_{i,t}(\text{Sales1Y}) \in [-4, +4]$ ). Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

more in the conclusions, these results are likely underlying concerns about the future of world trade and the increasing uncertainty about returns from innovative products. Concerning firms' degree of innovativeness, Table 4 also distinguishes goods or production processes that are new both to the firm and the market (i.e., truly innovative or *radical*) or new only to the firm (i.e., *marginal* or imitative innovations already preexistent in the market). As it turns out, the negative effect of product innovation is entirely driven by truly innovative goods, while imitative innovations are not associated with any particular disadvantage. Differently from the analysis in Table 2, R&D seems to play a minor role in here. However, unreported results point at a very positive and significant effect for



Table 3: Expected future sales, employment, and investment.

Dependent Variable:	(1)	(2)	(3)	(4)	(5)
	$\Delta \mathbb{E}_{i,t}^R(\text{Sales3M})$	$\Delta \mathbb{E}_{i,t}^R(\text{Sales12M})$	$\Delta \mathbb{E}_{i,t}^R(\text{Empl12M})$	$\Delta \mathbb{E}_{i,t}^R(\text{Tang12M})$	$\Delta \mathbb{E}_{i,t}^R(\text{Intang12M})$
Internationalization	-5.839*** [1.798]	-5.055*** [1.614]	-3.082* [1.662]	-5.550*** [2.082]	-3.839* [2.082]
R&D	0.924 [1.345]	0.269 [1.291]	1.760 [1.847]	-1.338 [2.664]	0.635 [1.770]
Product Innovation	-3.809*** [1.370]	-2.728** [1.273]	-1.085 [1.834]	-0.628 [1.977]	-1.288 [2.296]
Process Innovation	1.507 [1.705]	0.858 [1.220]	0.982 [1.538]	-0.126 [2.242]	3.505 [2.199]
$\mathbb{E}_{i,t-1}(\text{Sales1Y})$	3.214*** [1.035]	4.028*** [0.841]	4.000*** [0.804]	5.839*** [1.256]	3.995*** [1.201]
Province FE	yes	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes	yes
N obs.	5071	5104	5070	5067	5066
R2	0.344	0.352	0.366	0.314	0.280

*Notes:* OLS estimates. The dependent variables (listed in the top row) are continuous measures from the Covid-19 survey. The questionnaire was formulated so to directly capture revisions in expectations due to the pandemic. Specifically, we asked about the effect, compared to the pre-Covid situation, on the future evolution of: sales growth in the following three and 12 months (columns 1 and 2, respectively), employment (column 3), investment expenditure in tangibles (column 4), and investment expenditure in intangibles (column 5). We control for past expectations on future sales to correct for misreporting. Additional controls (not reported) follow the specifications in Table 2. Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

the intensive margins, suggesting that the premium may be limited to non-occasional forms of R&D (allegedly captured by R&D intensity, as shown in the Online Appendix). Turning to the effects on the other measures, we document a negative effect of internationalization that is quite generalized: -3% on employment, -5.6% and -3.8% on investment in tangible and intangible assets.<sup>17</sup>

## 4.2 Additional international heterogeneity and Global Value Chains

Table 5 explores additional sources of heterogeneity along the mode of internationalization of the company. First of all, we allow the shock to depend on the complexity of firms' foreign activity by enriching our model with a binary variable identifying R&D-oriented international cooperation, Foreign Direct Investments (FDIs), and delocalization strategies. As for simple commercial relationships, we provide a breakdown by export and import activities along the macro area of destination/origin market. Panel A shows disproportionate effects for deeply internationalized companies, with a coefficient that is 5-percentage points lower than for basic forms of internationalization. Interestingly, the effect of commercial foreign relationships is mainly due to import from extra-EU countries, emphasizing the difficulties of Italian companies in purchasing production inputs from distant markets (mainly Asia and North America). This joint evidence provides some preliminary insights on the propagation of

<sup>17</sup>Unreported regressions also highlight a positive effect of R&D on employment that is, again, strictly increasing with firms' intensive margins.

Table 4: Heterogeneity by degree of innovativeness: radical vs. marginal innovations.

Dependent Variable:	(1) $\Delta E_{i,t}^R(\text{Sales3M})$	(2) $\Delta E_{i,t}^R(\text{Sales12M})$	(3) $\Delta E_{i,t}^R(\text{Empl12M})$	(4) $\Delta E_{i,t}^R(\text{Tang12M})$	(5) $\Delta E_{i,t}^R(\text{Intang12M})$
Panel A					
Radical Innovation	-5.250*** [1.889]	-4.298*** [1.396]	0.169 [1.633]	-3.390 [2.432]	-2.212 [2.349]
Marginal Innovation	-0.715 [1.828]	0.767 [1.335]	-0.0223 [1.745]	2.493 [2.497]	1.153 [2.632]
Province FE	yes	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes	yes
R-squared	0.192	0.190	0.212	0.107	0.168
N obs.	5071	5104	5070	5067	5066
Panel B					
Radical Product Inn.	-4.382** [2.208]	-4.351** [1.829]	2.170 [2.273]	-1.532 [2.551]	-1.446 [2.823]
Marginal Product Inn.	-1.534 [1.925]	-0.913 [1.403]	-3.970 [3.049]	0.0786 [2.855]	-2.502 [3.320]
Radical Process Inn.	-0.246 [2.511]	-0.683 [1.501]	-1.557 [2.743]	-4.237 [3.214]	-0.626 [2.192]
Marginal Process Inn.	1.395 [2.293]	1.567 [1.544]	5.257* [2.752]	5.111* [2.677]	6.059** [2.329]
Province FE	yes	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes	yes
R-squared	0.194	0.193	0.218	0.109	0.172
N obs.	5071	5104	5070	5067	5066

*Notes:* OLS estimates. The dependent variables (listed in the top row) are continuous measures from the Covid-19 survey. The questionnaire was formulated so to directly capture revisions in expectations due to the pandemic. Specifically, we asked about the effect, compared to the pre-Covid situation, on the future evolution of: sales growth in the following three and 12 months (columns 1 and 2, respectively), employment (column 3), investment expenditure in tangibles (column 4), and investment expenditure in intangibles (column 5). We control for past expectations on future sales to correct for misreporting. Panel A presents the *additional* impact of radical and marginal innovations (on the top of the average effect of product and process innovations). Radical innovations are truly innovative products or processes that are new both to the firm *and* to the market. Marginal innovations are imitative innovations that are new only to the firm (i.e., already existent in the market). Both measures (dummy variables) are reported in the 2019-wave of the MET survey. Panel B disentangles the average effect by splitting the coefficient between radical and marginal product or process innovations (thus absorbing the average impact of product and process innovations). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

the shock along supply chains.

In order to dig deeper into this issue, Panel B explicitly accounts for the involvement in Global Value Chains (GVCs). Coherently with Brancati et al. (2017), we take advantage of the rich information of our dataset to construct a synthetic proxy that better captures firms' participation in supply chains. In particular, we combine survey data on export, import, type of the main good produced, and involvement in global networks to construct an indicator variable (GVC) taking unitary value if the firm is either: i) exporter of semi-finished goods and components, ii) fully internationalized (i.e., simultaneously importing *and* exporting), or iii) partially internationalized (i.e., importing *or* exporting) but declares to be involved in "relevant and long-lasting commercial relationships with foreign companies" (i.e., belongs to a global network).<sup>18</sup> Panel B of Table 5 presents some evidence of a

<sup>18</sup>The last piece of information is directly inferred from a question in the MET survey leaving to the firm the evaluation of whether the international linkage is non-occasional and represents an important activity for its own business.

possible “supply chain contagion” (see Baldwin and Freeman, 2020). On the top of the baseline effect of internationalization, firms participating in GVCs are characterized by a 2.9% additional decrease in expected sales at the 3-months horizon, reduced at 2.1% at 12 months. This effect is paired with a 5% reduction in planned investment in both tangible and intangible assets that will likely have additional adverse effects in the long run.<sup>19</sup>

Table 5: Other forms of internationalization and GVC participation.

Dependent Variable:	(1) $\Delta \mathbb{E}_{i,t}^R(\text{Sales3M})$	(2) $\Delta \mathbb{E}_{i,t}^R(\text{Sales12M})$	(3) $\Delta \mathbb{E}_{i,t}^R(\text{Emp112M})$	(4) $\Delta \mathbb{E}_{i,t}^R(\text{Tang12M})$	(5) $\Delta \mathbb{E}_{i,t}^R(\text{Intang12M})$
Panel A					
Complex Intern.	-5.066** [2.270]	-5.464*** [2.067]	-2.533 [2.022]	-5.210** [2.147]	-2.976 [2.372]
Export EU	0.748 [2.346]	2.426 [1.547]	0.883 [1.441]	-0.146 [3.060]	-1.915 [2.810]
Export Extra-EU	-1.900 [1.572]	-0.390 [1.440]	-0.442 [1.376]	-2.377 [3.382]	-0.475 [3.011]
Import EU	2.118 [2.157]	1.480 [1.958]	-1.995 [1.843]	1.405 [3.197]	1.304 [2.514]
Import Extra-EU	-6.925** [3.011]	-5.005** [2.216]	1.334 [1.833]	2.824 [5.851]	-3.770 [6.289]
Panel B					
GVC	-2.905** [1.132]	-2.087* [1.085]	1.286 [1.145]	-4.915** [2.453]	-4.791*** [1.482]

*Notes:* OLS estimates. The dependent variables (listed in the top row) are defined as in Table 3. In this table, we enrich the baseline specification of Table 3 with a dummy for complex forms of internationalization in (FDIs, delocalization of production, or R&D-oriented international cooperation) and split simple forms of internationalization into export/import by geographical destination/origin markets in panel A (EU countries vs. extra-EU), or augment the model with a direct firm-level proxy for GVC participation in Panel B (as in Brancati et al., 2017). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

### 4.3 Effects on future R&D plans

One important issue is related to what revisions in firms’ expectations really capture. Although we showed that past beliefs are correlated with realized future outcomes, we do not regard sales prospects to fully reflect actual future performances. This is because the forecast error in this early stage of the crisis is probably going to be large and the direction of its bias is a priori ambiguous. Despite we only interpret expectation revisions as measures for the effects of the shock, they can still drive managers’ actual choices and can have, through this channel, significant impact on long-run growth. This can turn out to be true independently of the actual accuracy of the expectations.

In this regard, Table 6 presents some evidence exploiting panel information on future R&D plans. The pandemic brought about a strong contraction of scheduled investments in R&D (44% of cancelled

<sup>19</sup>Notice that this effect is not linked to firms’ lower degree of vertical integration which we control for in our regression.

preexisting plans documented in Section 2.2), but this effect is significantly more severe for some companies. As a result of the larger shock in Table 2, internationalized firms and product innovators display a significantly-higher probability of cancelling on R&D plans that were already programmed in January 2020 (-2.3% and -2.6%, respectively). Differently from before, R&D has a strong and negative impact. While this is not surprising because of the persistence of this kind of investments, it is definitely worrisome for its magnitude (11% probability of abortion). Notice that the disruption of R&D projects will clearly have long-run effects on productivity and aggregate growth.

Table 6: Change in R&D future plans.

Change in future R&D plan:	(-1) Cancelled	(0) Unaffected	(+1) New Plans
Internationalization	0.0228** [0.0108]	-0.0267** [0.0132]	0.00389 [0.00657]
R&D	0.111*** [0.0129]	-0.0590*** [0.0189]	-0.0521*** [0.0103]
Product Innovation	0.0258*** [0.00962]	-0.0354*** [0.0112]	0.00958 [0.00695]
Process Innovation	0.0130 [0.0108]	-0.0149 [0.0129]	0.00191 [0.00728]
Province FE		yes	
Industry (2 Digit) FE		yes	
N obs.		5070	
Pseudo R2		0.107	

*Notes:* Multinomial Logistic marginal effects. The dependent variable is the variation in firms' future R&D plans between January and March 2020. This measure is based on the same question posed in the 2019-wave and Covid-19 MET surveys, asking for the existence of planned investment in R&D for the next year (dummy measure). The difference between planned R&D expenditure in the Covid-19 survey and the same measure in January 2020 identifies a measure taking values: -1 in case of cancellation of planned R&D investments, 0 in case of no change (confirming previous strategies), and +1 in case of new planned R&D investment as a result of the Covid-19 pandemic. Additional controls (not reported) follow the specifications in Table 2. Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

## 5 Economic significance

Although our analysis is mainly based on firm-level data, the representativeness of the MET survey allows for deriving some general conclusions at the macro level and evaluating the relative weight of each strategy for the aggregate shock. Again, it is worth reminding that the purpose of this exercise is not to provide an estimate of the overall effect of the Covid-19 epidemic on aggregate outcomes, but rather to shed light on the economic significance of the heterogeneities emphasized in the previous sections. Indeed, the disproportionate effects for internationalized and innovative companies have unclear relevance for the entire industrial system. On the one hand, such companies represent only a fraction of the overall economy, especially in a context dominated by SMEs like Italy. On the other, any effect on more dynamic firms tend to have higher weight on aggregate sales and employment

dynamics because of their average larger scale.<sup>20</sup> This exercise has the objective to provide some back-of-the-envelope calculations on the relevance of each strategy for the aggregate shock.

In order to do so, we first retrieve the implied cumulative shock that serves as a benchmark for disentangling the contribution of firms’ strategic behaviors.<sup>21</sup> Aggregate effects differ from simple averages because of the heterogeneous weight of each firm in the industrial system or differences between the estimating sample and the population under consideration. The first component is simply taken into account by multiplying the change in expected future outcome ( $\mathbb{E}_{i,t}^R(O_{i,t+\tau})$ ) for its level at the beginning of the period ( $O_{i,t}$ ), as reported in the last balance sheets available. We correct for the second issue by employing sampling weights ( $w_i$ ) calibrated to reproduce known population aggregates.<sup>22</sup> More formally, the implied aggregate effect the Covid shock ( $g$ ) on  $O_{i,t+\tau}$  is computed as:

$$g = \frac{\sum_{i=1}^N w_i O_{i,t} \Delta \mathbb{E}_{i,t}^R(O_{i,t+\tau})}{\sum_{i=1}^N w_i O_{i,t}}. \quad (2)$$

The first row of Table 7 presents our implied benchmark for sales and employment (for which we have quantitative data on pre-Covid levels). Compared to the simple averages presented in Table 1, the effects are slightly reduced in aggregate terms. This is mainly due to the better prospects of larger firms. Nevertheless, the pandemic brought about a sharp reduction in aggregate future sales, with a 21%-expected drop on a 3-months horizon and still pessimistic dynamic at 12 months (-16%). Notice that these numbers are even more alarming in the light of the possible attenuation bias documented in Table 3. As for aggregate employment, we document a higher-degree of persistence with a drop of *only* 6.5%. However, this effect has to be taken with a grain of salt, as in this early stage of the crisis, characterized by widespread uncertainty, most companies are postponing firing decisions while exploiting vacation leaves and wage-guarantee funds (mainly *Cassa Integrazione Guadagni*).

In order to discuss the economic significance of the heterogeneity documented so far, we perform a *ceteris paribus* analysis to estimate the contribution of internationalization, innovativeness, and R&D activity on the implied aggregate effect of Equation 2. To do so, we first retrieve the estimates in Table 3 on the change in expected sales and employment for each strategy  $X$  ( $\hat{\delta}_x$  of columns 1, 2,

<sup>20</sup>Notice that the size of the company is also per se associated with better prospects, but the analysis rules out such effects by focusing on the net partial impact of dynamic strategies.

<sup>21</sup>Notice that while cross-sectional regressions implicitly difference out some macro variation of interest, such an exercise does not (and thus embed general equilibrium price effects and other common components).

<sup>22</sup>Sampling weights are calibrated by expert statisticians (the MET scientific committee is made, among others, of two former presidents of the Italian National Institute of Statistics, ISTAT) to reproduce the number of companies in the specific stratum (intersection of 20 regions, 2-digit sectors, and four size classes) and replicate some known aggregates at a national level (the overall number of companies in the economy, total value added, employment, and total sales).

and 3). Then, we compute the implied (counterfactual) aggregate growth in absence of  $X$  ( $\hat{g}_{|X=0}$ ) by sequentially silencing its effect in the economy (i.e., imposing, in turn, that either Internationalization, R&D, Product, or Process innovations is equal to zero for the entire sample). This translates into calculating:

$$\hat{g}_{|X=0} = \frac{\sum_{i=1}^N w_i O_{i,t} \left( \Delta \mathbb{E}_{i,t}^R(O_{i,t+\tau}) - \hat{\delta}_x X_{i,t-1} \right)}{\sum_{i=1}^N w_i O_{i,t}}.$$

We finally take the difference between the benchmark and counterfactual growth rate to recover the implied aggregate shock related to strategy  $X$ :

$$g - \hat{g}_{|X=0} = \frac{\sum_{i=1}^N w_i O_{i,t} \hat{\delta}_x X_{i,t-1}}{\sum_{i=1}^N w_i O_{i,t}}. \quad (3)$$

Results are reported in the bottom panel of Table 7. Firms' degree of internationalization plays a key role in explaining the overall drop in aggregate sales both at a shorter and longer horizon (respectively, 25% and 17% of the shock), but product innovations are still responsible for more than 12% of the total reduction in expected sales growth, which is substantial considering the large set of conditional controls. On the other hand, firms with R&D investment and process innovations have an impact that is only mildly positive. As for employment, the overall effects are much smaller, but the contribution of R&D turns out to be substantial in relative terms. This evidence is likely to be related the high replacement cost of skilled workers for this kind of companies.

Overall this exercise confirms the economic relevance of the documented heterogeneity and further emphasizes the critical role played by firms' degree of internationalization, capable of explaining roughly one-fourth of the overall shock in the short run.

Table 7: Economic significance and implied aggregate effects

	Sales 3M	Sales 1Y	Empl1Y
$g$	-21.18%	-16.11%	-6.43%
$g - \hat{g}_{ Internationalization=0}$	-5.15%	-2.77%	-0.31%
$g - \hat{g}_{ R\&D=0}$	+0.52%	+0.38%	+1.41%
$g - \hat{g}_{ Product\ Inn=0}$	-2.55%	-2.07%	-0.42%
$g - \hat{g}_{ Process\ Inn=0}$	+0.54%	+0.65%	+0.69%

*Notes:* The first row reports the benchmark implied aggregate shock on sales at 3 months, 12 months, and employment. Aggregations follow the procedure outlined in Equation 2. The central panel presents the contribution of each strategy on the aggregate dynamic. Coherently with Equation 3, these measures are computed as the difference between the expected growth rate (in the first row) and the hypothetical growth rate obtained by silencing, in turn, Internationalization, R&D, Product, or Process innovations. To perform this counterfactual exercise we rely on the estimated coefficients in columns 1, 2, and 3 of Table 3.

## 6 Concluding remarks

The Covid-19 pandemic is the most serious challenge the world has faced in recent times. In this early stage of the crisis, prompt policy interventions are critical to help firms managing the turmoil and avoid severe distress for the key segments of the economy.

This paper contributes to the policy discussion by showing relevant heterogeneities in the shock experienced by Italian companies. We investigate this issue by exploiting unique panel data that allow for a short-window identification of the shock. Our results bear some relevant policy implications and point in two complementary directions.

The first one is linked to firms' immediate need for liquidity and support to the financial structure. Although this is not the primary focus of this paper, financial fragility explains a significant component of the shock and can drive firms' choices and growth strategies (this issue will be deeply explored in Balduzzi et al., 2020). Central banks were quick to react in this direction, but the way fiscal authorities manage this issue will be equally important.

The second dimension concerns the relevant heterogeneity in the magnitude of the shock. In this regard, we highlight greater fragilities associated to firms' international openness and involvement in cutting-edge innovations, those same dynamic strategies that represented a factor of success in the recent past and that drove the performance of Italian firms during the financial and sovereign debt crisis.

The first effect is found to be significantly stronger for more complex forms of internationalization and firms involved in Global Value Chains. This evidence is related to the large uncertainty about international economic relationships and is likely linked to many interconnected issues ranging from the degree of globalized production, to the diffusion of neo-protectionist policies, the rate of regionalization of the international commerce, and the very future of global networks (see Baldwin and Tomiura, 2020 for a review).

The second dimension concerns the larger shocks for companies introducing product innovations, especially if regarded truly innovative goods (radical innovations). Moreover, when asked about the main factors of difficulty induced by the COVID-crisis, these firms reported significant problems related to their future needs of differentiating production (in Online Appendix). This joint evidence is likely driven by the increased uncertainty about the possible returns from innovations (already uncertain in normal times). Moreover, the perceived demand shock for these subjects may further be worsened by the fear of a permanent change in consumption habits. Whether this is the case or not

it is obviously too soon to say.<sup>23</sup>

Taken together, our results point at a shock in the aftermath of the Covid-19 outbreak that is particularly severe for the most dynamic segment of the market. This issue should be central in a policy perspective as it may translate into undesirable effects of selection or induce change in firms' strategic choices that can further impact the competitiveness of the entire industrial system. On the top of a generalized policy intervention in support of the economy, tailoring policies so to target more exposed and competitive firms is of paramount importance in this early stage of the crisis. Nevertheless, while internationalized and innovative companies are enduring the largest shocks, they are also likely to be the ones that better adapt to the fast-evolving scenario. Based on past experience, this is likely to happen in the long run, but in the meantime economic policy can help alleviate their position to avoid the disruption of key investments that can further depress long-run growth.

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<sup>23</sup>In this regard, Knotek et al., 2020 document a postponement of planned larger purchases linked to customers' fear to lose their jobs.



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## Appendix: Variable Definition

Variable name	Definition
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Very Negative}$	Dummy =1 for firms forecasting, in March 2020, sales growth on a 1-year horizon below -15%.
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Negative}$	Dummy =1 for firms forecasting, in March 2020, sales growth on a 1-year horizon in the interval (-15%,-5%).
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Constant}$	Dummy =1 for firms forecasting, in March 2020, sales growth on a 1-year horizon in the interval [-5%,+5%].
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Positive}$	Dummy =1 for firms forecasting, in March 2020, sales growth on a 1-year horizon in the interval (+5%,+15%).
$\mathbb{E}_{i,t}(\text{Sales1Y}): \text{Very Positive}$	Dummy =1 for firms forecasting, in March 2020, sales growth on a 1-year horizon above +15%.
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Very Negative}$	Dummy =1 for firms forecasting, in January 2020, sales growth on a 1-year horizon below -15%.
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Negative}$	Dummy =1 for firms forecasting, in January 2020, sales growth on a 1-year horizon in the interval (-15%,-5%).
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Constant}$	Dummy =1 for firms forecasting, in January 2020, sales growth on a 1-year horizon in the interval [-5%,+5%].
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Positive}$	Dummy =1 for firms forecasting, in January 2020, sales growth on a 1-year horizon in the interval (+5%,+15%).
$\mathbb{E}_{i,t-1}(\text{Sales1Y}): \text{Very Positive}$	Dummy =1 for firms forecasting, in January 2020, sales growth on a 1-year horizon above +15%.
Cancelled R&D plans	Dummy =1 for firms that reported planned investment in R&D for the next year in January 2020, and declared no R&D plans (for the same horizon) in March.
Unaffected R&D plans	Dummy =1 for firms that reported consistent answers on R&D planned investment in the two surveys (dummies in January and March are either both equal to 1 or to 0).
New R&D plans	Dummy =1 for firms that reported no planned investment in R&D for the next year in January 2020, and introduced new R&D plans (for the same horizon) in March.
$\Delta \mathbb{E}_{i,t}^R(\text{Sales3M})$	Continuous measure for the change in expected future sales on a 3-months horizon (as reported in March 2020).
$\Delta \mathbb{E}_{i,t}^R(\text{Sales12M})$	Continuous measure for the change in expected future sales on a 12-months horizon (as reported in March 2020).
$\Delta \mathbb{E}_{i,t}^R(\text{Empl12M})$	Continuous measure for the change in expected future employment on a 12-months horizon (as reported in March 2020).
$\Delta \mathbb{E}_{i,t}^R(\text{Tang1Y})$	Continuous measure for the change in expected future investment in tangible assets on a 12-months horizon (as reported in March 2020).
$\Delta \mathbb{E}_{i,t}^R(\text{Intang1Y})$	Continuous measure for the change in expected future investment in intangible assets on a 12-months horizon (as reported in March 2020).
Internationalization	Dummy =1 for internationalized companies (import, export, or more complex forms of international relationship), as of January 2020.
Complex Intern.	Dummy =1 for complex forms of internationalization (R&D-oriented international cooperation, FDIs, delocalization strategies)
Export EU	Dummy =1 for companies exporting in the EU area.
Export Extra-EU	Dummy =1 for companies exporting in countries outside the EU area.
Import EU	Dummy =1 for companies importing from the EU area.
Import Extra-EU	Dummy =1 for companies importing from countries outside the EU area.
GVC	Dummy =1 for companies participating in a Global Value Chain according to the taxonomy in Section 4.2.
R&D	Dummy =1 for the existence of R&D projects, as of January 2020.
Product Innovation	Dummy =1 for the introduction of product innovations, as of January 2020.
Process Innovation	Dummy =1 for the introduction of process innovations, as of January 2020.
Leverage	Total debts to equity ratio.
Tangible Assets	Stock of fixed assets to total assets ratio
Rollover Risk	Short-term debt to long-term debt ratio.
Size	log of (total assets).
Age	log of (1 + age).
Group	Dummy =1 for firms belonging to corporate groups, as of January 2020.
Headquarter	Dummy =1 if the firm is the headquarter of to corporate group, as of January 2020.
Family Firm	Dummy =1 for family-owned firms, as of January 2020.
Investment	Dummy =1 for firms that undertook investments (independently of the type), as of January 2020.
% Graduated Empl.	Share of graduated employees (bachelor at minimum), as of January 2020.
Labor Productivity	Log value added per worker.
Vertical Integration	Value added to sales ratio.

# Online Appendix

## Additional Tables

Table A1: Descriptive statistics: composition of the Covid and MET-2019 surveys.

	COVID-survey (1)	Met-2019 (2)
Macro Industry		
Manufacturing	63.2%	66.7%
Services	36.8%	33.3%
Size Class		
1-9 Employees	51.1%	48.1%
10-49 Employees	33.0%	34.8%
50-249 Employees	12.8%	12.5%
250 and more Employees	3.20%	4.60%
Macro Region		
Nort-West	25.1%	24.8%
Nort-East	26.6%	24.8%
Center	24.1%	25.4%
South	24.2%	25.0%

*Notes:* sample composition of the Covid and MET-2019 surveys along macro-sector, size class, and macro-geographical region.

Table A2: Attrition.

Dependent variable	COVID survey interview (0-1)	
	(1)	(2)
Internationalization	-0.0240 [0.0640]	-0.0202 [0.0637]
R&D	0.0487 [0.0655]	0.0465 [0.0652]
Product Innovation	-0.00135 [0.0633]	0.00472 [0.0630]
Process Innovation	0.100 [0.0627]	0.100 [0.0625]
North		0.0649 [0.0699]
Center		0.0578 [0.0710]

*Notes:* Logit estimates for attrition. The estimating sample is the entire set of respondents in the 2019-wave of the MET survey (24,000 firms). The dependent variable is a dummy taking value 1 if the company was interviewed in the Covid survey and 0 otherwise. The coefficients show no correlation between the probability of being interviewed a second time after the Covid outbreak and firms' past strategies. Moreover, the insignificance of the North macro-regional dummy in column 2 suggests no correlation even with the severity of the pandemic.

Table A3: Validation on past waves: expected sales, realized sales, and firms' strategies.

Dependent variable:	Realized growth (cont) (1)	Realized growth (coded) (2)	Realized growth (cont) (3)	Realized growth (coded) (4)
$\mathbb{E}_{i,t}(\text{Sales1Y})$	1.225*** [0.440]	0.0925** [0.0411]	0.777*** [0.249]	0.136*** [0.0290]
Internationalization	1.362 [0.894]	-0.0720 [0.0795]	0.345 [0.495]	-0.0348 [0.0555]
R&D	0.294 [0.985]	0.0879 [0.0969]	0.545 [0.516]	0.0639 [0.0636]
Product Innovation	-0.691 [0.985]	-0.0349 [0.0965]	-0.172 [0.510]	-0.0741 [0.0602]
Process Innovation	1.061 [0.962]	-0.0462 [0.0968]	0.00136 [0.500]	-0.0191 [0.0610]
Sample (wave)	2017	2017	2015 & 2017	2015 & 2017
R squared	0.344	0.308	0.115	0.232
N	15229	15229	31455	31455

*Notes:* OLS estimates. The estimating sample is the 2017-wave of the MET survey (columns 1 and 2), or the pooled sample of the 2015 and 2017 waves (columns 3 and 4). The dependent variable is the (realized) growth rate of future sales (on a 1-year horizon), either continuous (columns 1 and 3) or discretized (columns 2 and 4, recoded accordingly to the definition of  $\mathbb{E}_{i,t}(\text{Sales1Y})$ ). Results show a correlation between expected and realized sales growth, and no correlation with firms' past strategies.

Table A4: Descriptive statistics: change in expected future sales.

	$E_{i,t}(\text{Sales1Y})$ : Very Negative	$E_{i,t}(\text{Sales1Y})$ : Negative	$E_{i,t}(\text{Sales1Y})$ : Constant	$E_{i,t}(\text{Sales1Y})$ : Positive	$E_{i,t}(\text{Sales1Y})$ : Very Positive
$E_{i,t-1}(\text{Sales1Y})$ : Very Negative	75.8%	14.9%	8.00%	0.00%	1.40%
$E_{i,t-1}(\text{Sales1Y})$ : Negative	61.9%	27.4%	9.40%	0.70%	0.60%
$E_{i,t-1}(\text{Sales1Y})$ : Constant	42.3%	34.7%	21.1%	1.30%	0.70%
$E_{i,t-1}(\text{Sales1Y})$ : Positive	36.2%	32.8%	24.3%	6.10%	0.60%
$E_{i,t-1}(\text{Sales1Y})$ : Very Positive	27.3%	30.3%	24.8%	12.2%	5.50%

*Notes:* summary statistics on the change in firms' expected future sales. On the rows we report firms' expectations on sales at the 1-year horizon formed in January 2020. Along the columns, the same expectation revised in March 2020. Both variables are ordinal measures taking five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%).

Table A5: Descriptive statistics: change in future R&D plans.

	R&Dplan $_{i,t=0}$	R&Dplan $_{i,t=1}$
R&Dplan $_{i,t-1}=0$	92.2%	7.80%
R&Dplan $_{i,t-1}=1$	44.2%	55.8%

*Notes:* summary statistics on the change in firms' R&D plans. On the rows we report the existence of planned R&D investment for the next year, as reported in January 2020. Along the columns, the same measure, as revised in March 2020. Both variables are binary measures.

Table A6: Change in expected future sales: marginal effects.

Post-COVID Expectations:	(1) Very Negative	(2) Negative	(3) Stable	(4) Positive	(5) Very Positive
Internationalized	0.102*** [0.0298]	-0.0239*** [0.00711]	-0.0663*** [0.0208]	-0.00840*** [0.00294]	-0.00320** [0.00130]
R&D	-0.0677** [0.0344]	0.0159* [0.00848]	0.0440* [0.0228]	0.00559* [0.00286]	0.00213* [0.00127]
Product Innovation	0.0785*** [0.0295]	-0.0185** [0.00783]	-0.0511*** [0.0191]	-0.00648** [0.00274]	-0.00247** [0.00117]
Process Innovation	-0.00742 [0.0348]	0.00174 [0.00812]	0.00483 [0.0228]	0.000612 [0.00285]	0.000233 [0.00109]
Province FE			yes		
Industry (2 Digit)			yes		
N obs.			5071		
R2 (Pseudo R2)			0.129		

*Notes:* Ordered Logistic *marginal effects* (Table 1, column 3). This table reports the marginal effect on the change in firms' expected future sales. The dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table A7: Change in expected future sales: Multinomial Logit.

Post-COVID Expectations:	(1) Very Negative	(2) Negative	(3) Stable	(4) Positive	(5) Very Positive
Internationalization	0.0929*** [0.0341]	-0.00679 [0.0358]	-0.110*** [0.0339]	0.0223*** [0.00517]	0.00191 [0.00181]
R&D	-0.0799* [0.0479]	0.0342 [0.0512]	0.0349 [0.0397]	0.0107** [0.00444]	0.0000831 [0.00324]
Product Innovation	0.104*** [0.0344]	-0.0598 [0.0472]	-0.0385 [0.0377]	-0.00905* [0.00467]	0.00302 [0.00274]
Process Innovation	-0.0258 [0.0352]	0.0171 [0.0294]	0.00543 [0.0340]	0.00375 [0.00612]	-0.000459 [0.00318]
Province FE			yes		
Industry (2 Digit)			yes		
N obs.			5071		
Pseudo R2			0.166		

*Notes:* Multinomial Logistic *marginal effects* (Table 1, column 3). This table reports the marginal effect on the change in firms' expected future sales. The dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table A8: Change in expected future sales: controlling for perception of risk.

Model:	OLS		Ordered Logistic	
Dependent Variable:	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (1)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (2)	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (3)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (4)
Perception: Dangerous but Inflated	2.520* [1.319]	0.360** [0.146]	0.930** [0.389]	1.003** [0.425]
Perception: Very Dangerous ( $\leq 12$ months)	-0.646 [0.650]	-0.122 [0.0798]	-0.295 [0.199]	-0.290 [0.228]
Perception: Very Dangerous ( $\leq 18$ months)	-2.007*** [0.756]	-0.356*** [0.0932]	-1.120*** [0.243]	-1.023*** [0.263]
Internationalized	-1.264*** [0.436]	-0.178*** [0.0589]	-0.606*** [0.178]	-0.538*** [0.171]
R&D	0.971* [0.540]	0.137* [0.0726]	0.381* [0.197]	0.373* [0.202]
Product Innovation	-1.169*** [0.445]	-0.173*** [0.0554]	-0.443*** [0.155]	-0.471*** [0.166]
Process Innovation	0.152 [0.513]	0.0262 [0.0655]	0.0612 [0.195]	0.0211 [0.198]
Province FE	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes
N obs.	4974	4974	4974	4974
R2 (Pseudo R2)	0.233	0.454	0.151	0.228

*Notes:* OLS and Ordered Logistic *estimates*. This table reports the effect on the change in firms' expected future sales. In columns 1 and 3, the dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). In columns 2 and 4, the dependent variable is the difference between post- and pre-Covid expectations ( $\Delta\mathbb{E}_{i,t}(\text{Sales1Y}) \in [-4, +4]$ ). We explicitly control for self-assessment about the manager's perception of danger related to the pandemic, as reported in the Covid-19 survey. The questionnaire allowed one answer among five options: i) not dangerous at all (never chosen and thus dropped), ii) dangerous but inflated by social media, iii) very dangerous but of short duration (chosen as a benchmark), iv) very dangerous with effects that will persist up to 12 months, and v) very dangerous with long run effects that will persist for more than 18 months. Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table A9: Change in expected future sales: controlling for 6-Digit sector fixed effects.

Model:	OLS		Ordered Logistic	
Dependent Variable:	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (1)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (2)	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (3)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (4)
Internationalization	-2.100*** [0.499]	-0.278*** [0.0674]	-0.748*** [0.186]	-0.702*** [0.186]
R&D	1.328** [0.519]	0.184** [0.0723]	0.379* [0.218]	0.364* [0.214]
Product Innovation	-1.097** [0.516]	-0.162** [0.0659]	-0.432** [0.194]	-0.439** [0.187]
Process Innovation	0.327	0.0353	0.147	0.139
Province FE	yes	yes	yes	yes
Industry (5 Digit) FE	yes	yes	yes	yes
N obs.	5071	5071	5071	5071
R2 (Pseudo R2)	0.345	0.521	0.155	0.229

*Notes:* OLS and Ordered Logistic *estimates*. This table reports the effect on the change in firms' expected future sales. In columns 1 and 3, the dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). In columns 2 and 4, the dependent variable is the difference between post- and pre-Covid expectations ( $\Delta\mathbb{E}_{i,t}(\text{Sales1Y}) \in [-4, +4]$ ). We control for 6-Digit sector fixed effects to further account for the difference between industries restricted by the shutdown and the "essential" ones that stayed in business. Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table A10: Change in expected future sales: controlling for the exact day of the firm's answer.

Model:	OLS		Ordered Logistic	
Dependent Variable:	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (1)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (2)	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (3)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (4)
Internationalization	-1.180*** [0.379]	-0.168*** [0.0534]	-0.555*** [0.159]	-0.494*** [0.151]
R&D	1.134** [0.516]	0.163** [0.0680]	0.440** [0.183]	0.439** [0.187]
Product Innovation	-1.187*** [0.439]	-0.175*** [0.0545]	-0.441*** [0.156]	-0.461*** [0.160]
Process Innovation	0.126 [0.522]	0.0245 [0.0664]	0.0417 [0.184]	-0.00270 [0.191]
Day of Survey FE	yes	yes	yes	yes
Province FE	yes	yes	yes	yes
Industry (5 Digit) FE	yes	yes	yes	yes
N obs.	5071	5071	5071	5071
R2 (Pseudo R2)	0.234	0.438	0.138	0.216

*Notes:* OLS and Ordered Logistic *estimates*. This table reports the effect on the change in firms' expected future sales. In columns 1 and 3, the dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). In columns 2 and 4, the dependent variable is the difference between post- and pre-Covid expectations ( $\Delta\mathbb{E}_{i,t}(\text{Sales1Y}) \in [-4, +4]$ ). In this table we enrich the specifications in Table 2 with 14 dummies, one for each day of the survey period (March 24–April 7). This perfectly controls for the possible changes in firms' information set between the beginning and the end of the administration. Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.



Table A11: Change in expected future sales: additional robustness.

Model: Dependent Variable:	OLS		OLS	
	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (1)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (2)	$\mathbb{E}_{i,t}(\text{Sales1Y})$ (3)	$\Delta\mathbb{E}_{i,t}(\text{Sales1Y})$ (4)
Internationalization	-1.122*** [0.387]	-0.152** [0.0585]	-1.130*** [0.393]	-0.165*** [0.0556]
R&D	1.112*** [0.410]	0.153*** [0.0563]	0.832* [0.437]	0.121* [0.0610]
Product Innovation	-1.102*** [0.418]	-0.159*** [0.0522]	-1.347*** [0.420]	-0.191*** [0.0527]
Process Innovation	0.410 [0.508]	0.0494 [0.0671]	0.170 [0.490]	0.0227 [0.0629]
Province FE	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes
Day of the answer $\times$ Region FE	yes	yes	no	no
Day of the answer $\times$ Sector FE	yes	yes	no	no
Essential $\times$ Province FE	no	no	yes	yes
N obs.	5071	5071	5071	5071
R2 (Pseudo R2)	0.347	0.519	0.247	0.448

*Notes:* OLS estimates. This table reports the effect on the change in firms' expected future sales. In columns 1 and 3, the dependent variable is an ordinal measure identifying a company's expectations on future sales as reported in the Covid-19 survey. The variable can take five values: Very Negative (sales growth below -15%), Negative (in the interval -15%/-5%), Constant (-5%/+5%), Positive (5%/15%), or Very Positive (>15%). The same question as reported in the 2019-wave of the MET survey (January 2020) is used as a control to capture variations in expectations due to the Covid-19 pandemic (Constant is the benchmark). In columns 2 and 4, the dependent variable is the difference between post- and pre-Covid expectations ( $\Delta\mathbb{E}_{i,t}(\text{Sales1Y}) \in [-4, +4]$ ). In columns 1 and 2, we enrich the specification of Table 2 with 14 dummies, one for each day of the survey period (March 24–April 7), interacted with four macro-areas (North-East, North-West, Center, and South) and with 12 macro-industrial sectors. In columns 3 and 4, we augment the model with the interaction between 107 provincial fixed effects and a dummy variable taking value of 1 for the essential sectors that were not directly hit by the lockdown (identified at the 6-Digit level). Additional controls (not reported) are: past sales growth (realized), dummies for corporate group belonging, whether the company is the headquarter of the group, or a family managed firm, the share of graduated employees, labor productivity and vertical integration (see the Variable Definition in Online Appendix). Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table A12: Heterogeneity by intensity of R&amp;D: intensive margins.

Dependent Variable:	(1)	(2)	(3)	(4)	(5)
	$\Delta\mathbb{E}_{i,t}^R(\text{Sales3M})$	$\Delta\mathbb{E}_{i,t}^R(\text{Sales12M})$	$\Delta\mathbb{E}_{i,t}^R(\text{Empl12M})$	$\Delta\mathbb{E}_{i,t}^R(\text{Tang12M})$	$\Delta\mathbb{E}_{i,t}^R(\text{Intang12M})$
R&D Expenditure (%)	0.190** [0.0798]	0.158*** [0.0574]	0.233*** [0.0789]	-0.0900 [0.104]	-0.0797 [0.0970]
Province FE	yes	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes	yes
R2	0.191	0.191	0.217	0.105	0.170
N	5071	5104	5070	5067	5066

*Notes:* OLS estimates. The dependent variables (listed in the top row) are continuous measures from the Covid-19 survey. The questionnaire was formulated so to directly capture revisions in expectations due to the pandemic. Specifically, we asked about the effect, compared to the pre-Covid situation, on the future evolution of: sales growth in the following three and 12 months (columns 1 and 2, respectively), employment (column 3), investment expenditure in tangibles (column 4), and investment expenditure in intangibles (column 5). We control for past expectations on future sales to correct for misreporting. On the top of the average effect of R&D, this table reports the *additional* impact of the intensive margin of investment in Research and Development. R&D Expenditure (%) is defined as the expenditure in R&D activities expressed as a share of total sales, as reported in the 2019-wave of the MET survey. Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.

Table A13: Main factors of difficulty in the post Covid-19.

Difficulties:	Purch. Inputs (1)	Old Suppliers (2)	Skilled Workers (3)	Access to credit (4)	Delvery serv. (5)	Reorganiz. (6)	Differentiation (7)
Internationalization	0.0241 [0.0228]	0.0401 [0.0317]	-0.00785 [0.0163]	-0.00110 [0.0357]	0.0561*** [0.0188]	-0.0276 [0.0324]	0.0300 [0.0343]
R&D	0.0340 [0.0241]	0.125*** [0.0406]	0.00356 [0.0110]	-0.0900* [0.0518]	0.00784 [0.0297]	-0.0193 [0.0453]	0.0408 [0.0510]
Product Innovation	0.00260 [0.0201]	-0.0828** [0.0363]	0.0283* [0.0148]	0.0572 [0.0447]	0.00873 [0.0311]	0.0209 [0.0459]	0.0958** [0.0393]
Process Innovation	0.0174 [0.0207]	-0.0312 [0.0251]	0.00547 [0.0136]	0.0340 [0.0603]	0.000519 [0.0226]	-0.0315 [0.0444]	0.0335 [0.0396]
Province FE	yes	yes	yes	yes	yes	yes	yes
Industry (2 Digit) FE	yes	yes	yes	yes	yes	yes	yes
Pseudo R-squared	0.209	0.148	0.185	0.127	0.222	0.128	0.116
N obs.	5071	5105	4833	5071	5022	5071	5071

*Notes: Logistic marginal effects.* The dependent variables (listed in the top row) are dummy variables identifying the possible main factor(s) of difficulty the firm faces in recovering the post-Covid shock. The questionnaire allowed for up to 3 answers among the following difficulties: i) in purchasing raw materials and semifinished products (column 1), ii) related to the relationship with long-lasting commercial partners (column 2), iii) related to the hiring of skilled workers (column 3), iv) in accessing financial resources (in column 4), v) regarding specialized services (transportation and logistic, in column 5), vi) related to the need of reorganization of work and production processes (column 6), vii) related to the need of product differentiation (column 7). Additional controls (not reported) follow the specifications in Table 2. Clustered standard errors in brackets. \*, \*\*, \*\*\* indicate statistical significance at the 10%, 5%, and 1%, respectively.