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ZOMBIE FIRMS AND THE TAKE-UP OF SUPPORT MEASURES DURING COVID-19

by Marco Pelosi[*], Giacomo Rodano[*] and Enrico Sette[*]

Abstract

In this paper, we analyse the incidence of zombie firms, how they have been affected by the pandemic, and their take-up of economic support measures. While balance sheet data for 2020 are not available yet, we find that in 2019, they represented 3 to 5 per cent of all corporations. In 2020, they were more likely to experience liquidity deficits and spikes in their default probability, as well as to exit the market. Importantly, we also find that they were less likely to take up the economic support measures. Overall, as fewer firms exited the market in 2020 than in 2019, the pandemic is likely to have boosted the zombie share. However, compared with other firms, zombies have exited the market more and had a lower take-up of support measures. Thus, the Government's policies are unlikely to have amplified such a trend.

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1 Introduction[1]

The Covid-19 pandemic has called for unprecedented governments' interventions to support firms. The rationale for these policy measures was to avoid that the strong negative liquidity shock, caused by the pandemic and the associated containment measures, forced otherwise solvent firms to shut down or go bankrupt. While necessary, economic support measures heavily affect public finances. Thus, it is crucial to design policies that use government funds as efficiently as possible.

However, given the emergency, economic measures have been enacted very quickly and most of them did not explicitly intend to separate viable from non-viable firms. A key concern is that these measures might have also benefited non-viable firms (also known as *zombie firms*). To the extent that these firms would have probably ceased to exist even without the pandemic, keeping them artificially alive decreases the effectiveness of governments' support measures and alter the process of firm selection. Unfortunately it is impossible to directly measure the actual extent of "zombification" from post-Covid balance sheet data, because they are not yet available.

Therefore, to help assessing the empirical relevance of this concern and to inform the policy debate, we provide evidence on the incidence of zombie firms in the Italian economy before the Covid pandemic, on how they have been affected by the Covid economic shock, and on their take-up of economic support measures implemented by the government in 2020.

As a preliminary step, we assess the quality of different ways of identifying non-viable firms in the data. We focus on two main definitions of zombie firms: the first is based on the extent to which firm profits cover interest expenses (Banerjee and Hofmann, 2018; McGowan et al., 2017; Andrews and Petroulakis, 2019) and the second leans on receiving subsidized credit (Caballero et al., 2008; Acharya et al., 2019). In particular, we compare several key firm characteristics between healthy and non-healthy firms according to the proxies for zombies associated to the different definitions.

We find that the definition based on profitability is better at classifying as zombies firms with lower productivity, low liquidity and capitalisation, and higher default probability (Z-Score) than the one based on subsidised credit. Moreover, the profitability-based definition has the additional desirable property of identifying borrowers whose loans are more likely to be non performing (NPL). However, even our preferred definition has some drawbacks. Transition matrices to and from zombie status show that: i) about a third of zombie firms persist in their status over a three-years horizon; ii) the share of recovering firms is significant, as on average about one third return to healthy status. This suggests a word of caution in concluding that our proxies always identify non-viable firms.

Next, using our preferred definition, we present evidence about the incidence of zombie firms

at the onset of the Covid crisis (as of 2019), as well as on how financial constraints for zombie firms have tightened, relative to healthy ones, following the Covid-19 shock. At the end of 2019, they represented between 3 and 5 per cent of all corporations (between 4 and 10 as shares of assets, between 1 and 4 for value added, between 2 and 4 for employment and between 1 and 8 per cent as share of investments[2]). Furthermore their incidence was higher in industries that experienced a larger drop in revenues in 2020. Using simulations on the effects of the Covid shock on firms' balance sheet (see De Socio et al., 2020), we also find that: i) zombie firms were more likely to experience liquidity deficits following the Covid shock; ii) their probability of default rose disproportionately more between February and December 2020.

Taken together, these results suggest that the Covid-19 shock induced a much higher increase in the default risk of zombie firms, compared to their healthy counterparts. This suggests that the former are less likely to survive the pandemic. Indeed, we find that zombies have relatively higher bankruptcy and exit rates during 2020[3]. However, we find that on average fewer firms exited the market in 2020 than in 2019 and that the reduction in the number of exiting firms does not seem weaker in those sectors more affected by the Covid shock. Our interpretation is that the economic measures implemented during 2020 have been successful in supporting the firms and avoiding excessive exits.

To the extent that support policies went disproportionately in favour of the most affected sectors, where the incidence of zombie firms was already higher in 2019, they may have ended up benefiting many of such firms with risk of contributing to the "zombification" of the economy. Therefore, in the last part of the paper, we describe the take-up of key support measures by zombie and healthy firms. Controlling for industry and province fixed effects, that proxy for the intensity of the Covid shock, we find that, compared to their healthy counterparts : i) zombie firms were between 16 and 21 per cent less likely to obtain a grant ("*contributo a fondo perduto*"); ii) they were between 4 and 7 per cent less likely to put their debt into moratorium; iii) they were between 14 and 22 per cent less likely to obtain loans guaranteed by the government granted through the "*fondo centrale di garanzia*". Moreover, non-viable firms received smaller loans, as the size of their guaranteed lines were between 44 and 49 per cent smaller compared to those granted to healthy firms. Such size effect is probably due to the fact that loans smaller than 30,000 euros were eligible for a 100 per cent guarantee, which were more likely to be granted to low quality borrowers. Indeed, we find that zombie firms were 12 per cent more likely to get fully-guaranteed loans, compared to healthy firms.

In a further test we study the take-up of support measures by firms that in 2019 were more likely to become zombie in the future (weak firms) because profits did not cover interest expense in that year, but were not yet zombies. Similarly to zombie firms, weak firms were less likely to

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[2]Firm investments are computed as the year-on-year difference in total fixed assets

[3]This is only partially due to the ban on the possibility of opening new bankruptcy procedures that was active until June 2020. In the last quarter of 2020, when the ban had been lifted, the number of bankruptcy opened was about 10% less than in the same quarter of 2019 (see also Giacomelli et al., 2021).

obtain grants and guaranteed loans than healthy firms, even though the difference between weak and healthy firms was smaller than that between zombie and healthy ones. On the other hand, they were more likely to apply for a debt moratorium.

Overall our findings show that, notwithstanding a significant recession, fewer firms exited the market in 2020 than in 2019. Therefore the Pandemic is likely to have boosted the share of zombie firms[4]. However, we also find that, relative to other firms, zombies have exited the market more and had a lower take-up of support measures. Thus we can conclude that the Government's policies are unlikely to have amplified such trend. This is in line with recent findings for France (Cros et al., 2021; Coeure, 2021) and for the US (Favara et al., 2021).

The Covid-19 shock may permanently alter consumer preferences and technology adoption (e.g. work from home). As a consequence, firms that were profitable and productive in the pre-Covid world may not be so in the new equilibrium (and possibly firms that were "zombies", or more generally weak, before Covid may instead have strengthened thanks to new demand for their products). Identifying these firms is very difficult with the currently available data. Therefore, the results in this note should be understood as relative to firms that were already weak (zombies) before Covid.

The paper is structured as follows: Section 2 discusses how to identify zombie firms and provides evidence of the ability of different measures to identify low productivity, low profitability and high risk firms; Section 3 presents the distribution of zombie firms in Italy across industries classified according to their exposure to the drop in revenues induces by the Covid shock; Section 4 shows evidence on the take-up of support measures by zombies and healthy firms.

2 Identifying Zombie Firms

As a starting point for our analysis, we briefly discuss the conceptual framework to identify zombie firms and present the main proxies used in the literature. Then, we assess their ability in identifying non-viable firms by comparing several firms characteristics for zombie and healthy firms when different proxies are used[5].

We find that proxies of "zombieness" based on comparing firms profits to interest expenses appear to be better able to classify low productivity, higher default risk firms than zombies than measures based on the presence of subsidized credit. According to the former proxies we estimate the number of zombie firms at end 2019 in Italy to hover around 3-5 per cent of all corporations (between 4-10 per cent as share of assets, 1-4 per cent as share of value added, 2-4 per cent as share

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[4]Historical data based on our preferred measure of zombie firms, indicate that on average only about 3% of healthy firms become zombie within a 3 year horizon. Even assuming that this share tripled as a consequence of the pandemic, that share would still represent an average of 3% of all firms that become zombie per year, not an extremely large number.

[5]We rely on firm balance sheet data for the universe of incorporated firms from CERVED between 1997 and 2019. We exclude firms in the agriculture and mining sectors (NACE codes between 1 and 9), those in the public sector and in recreational activities (NACE codes between 83 and 99) and those in the financial and insurance sectors (NACE codes between 64 and 66).

of employment, 1-8 per cent as share of investments).

Defining zombie firms seems rather simple in theory. They are non-viable, but still active, firms that should stop operating, thus allowing the reallocation of the resources they employ to more productive uses. Yet, it is ultimately very difficult to identify non-viable firms in practice.

Existing definitions fall into two broad categories. According to the first one, zombie firms do not generate enough margins after paying productions factors. Typically, firms in this category are identified by comparing measures of operating profits (EBIT or EBITDA) with interest expenses: a firm is classified as a zombie if its profits are lower than interest expenses for a certain number of consecutive years. Intuitively, this means that value added after paying labor and replacing existing capital is not sufficient to remunerate providers of external finance.

The definitions in the second category are related to zombie lending. In this case, non-viable firms are those that receive subsidised credit, identified by comparing the interest rate a firm pays on its loan with a "prime" rate, the interest rate charged to low risk borrowers. The underlying idea is that (mostly) low capital banks lend at prices that do not reflect some borrowers' true riskiness. While sub-optimal, zombie lending keeps these firms alive and delay their default, which further erodes banks' net worth[6]. This class of measures does not make a specific reference to firm profitability.

Among the proxies associated to the first category we use the one proposed and used in policy papers by BIS (Banerjee and Hofmann, 2018), OECD (McGowan et al., 2017), and ECB (Andrews and Petroulakis, 2019; ECB Expert Group on productivity, innovation and technological progress, March 2021)[7]. According to this definition, a firm is classified as zombie if its EBIT is either lower than interest expenses or negative for at least three consecutive years, and is at least ten years old. In line with Rodano and Sette (2019), we also report results with a proxy that replaces EBIT with EBITDA.

For the second category, we consider a definition close to the one used in Caballero et al. (2008) and Acharya et al. (2019). This is constructed as follows: we first compute the "prime" rate as the average interest rate on outstanding loans for the safest firms, identified as firms in the two safest categories of the Z-score from Cerved, a nine-class variable with higher score meaning a higher probability of default[8]; then, we take firms with Z-scores in all the other categories, and define as zombie a firm that is charged a rate below the prime rate[9].

To understand to what extent the different proxies for zombie firms are able to identify non-viable firms, we compare several key firm characteristics across zombie and healthy firms, adopt-

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[6]Low capital banks have an especially strong incentives to hide losses to postpone costly recapitalisations. See Schivardi et al. (2020) for a more extensive explanation of banks' incentives to engage in zombie lending

[7]A very similar measure is used in De Jonghe et al. (2020) and is similar in spirit to Schivardi et al. (2020)

[8]Information on the interest rates are from the Taxia database, a subset of the Central Credit Register. See Rodano et al. (2018) for further details on the Z-score and its relevance for bank lending

[9]Similarly to Acharya et al (2019), in our definition, firms in the top two notches of the Z-score are automatically considered as healthy firms as the prime rate is considered as the average rate charged to this set of firms. We experiment with different ways to compute the interest rates, considering only homogeneous loan types (e.g. term loans, credit lines, loans backed by receivables) and maturities, but the overall results are not affected

ing the different definitions. In particular, we select measures of economic performance (labour productivity, TFP, profitability), of economic relevance (size), and of risk (Z-score, low net worth, liquidity).

Table 1 shows, with data as of 2019, that the proxies of zombie firms based on profitability (columns 1 to 4) identify firms with worse economic performance, measured either as labour productivity or as TFP. These proxies also identify riskier firms (as measured by the Z-score), and those more likely to have equity below the legal limit ("undercapitalised"). According to these metrics, zombie firms also had fewer employees than healthy firms. Finally, they held less liquidity, a key factor to survive the Covid shock (Gourinchas et al., 2020).

Interestingly, the proxy based on subsidised credit performs very poorly in classifying as zombies low productivity and high-risk firms. Columns 5 and 6 of Table 1 show that firms classified as zombies under this criterion had somewhat higher productivity than the healthy ones. Moreover, they had higher ROA and were larger. Instead, the Z-score was very close. Finally, they were slightly more likely to be undercapitalised and held somewhat less liquidity, but the differences were not very pronounced and much smaller in magnitude than those found when using the profitability proxies[10].

As a further step to assess the ability of the different proxies of zombie firms to identify weak firms, we test whether such proxies can identify firms that had bad or Non-Performing Loans (NPLs). Table 2 presents results of OLS regressions (linear probability models) of dummy variables equal to one if the firm had a bad loan (columns 1 to 3) or a NPL (columns 4 to 6) on the three proxies used so far. Regressions include two-digit industry and year fixed effects. Both regressions point to a strong positive correlation between the zombie status based on the interest coverage ratio and measures of default on outstanding loans. The opposite occurs for the proxy based on subsidised credit. This may be partly expected, to the extent that subsidised credit aims at avoiding firms' default.

An additional desirable feature of proxies of zombie firms is the ability to identify firms that after becoming zombies remained persistently bad and ultimately exited the market. Otherwise, it could be possible that the classifications used to identify these firms are just capturing business cycle fluctuations. To assess the ability of the different proxies to identify firms that eventually exit the market, we compute transition matrices that show, for each firm that in a given year is either healthy or zombie, its status over a three years horizon, where the status can be healthy, zombie or out of the market[11].

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[10]We also look at the same statistics at different points in time. The first is 1998, right before the launch of the Euro. We then consider 2007, the last year before the Global Financial Crisis. The third is 2014, the last year after the Recession triggered by the Eurozone sovereign debt crisis. The descriptive statistics are shown in Appendix Table A1 and are very similar to those in Table 1 for 2019 and very stable over time. The proxies of zombie firms based on the interest coverage ratio perform better at identifying lower productivity, returns, and liquidity, undercapitalised, and high-risk firms. An interesting insight from the evolution of the characteristics of zombie and healthy firms is that the differences in terms of ROA, Z-score and liquidity seem to have widened after the Eurozone sovereign crisis.

[11]We define a firm as out of the market if it has started a bankruptcy procedure, it is signalled as in liquidation, it has been cancelled from the Firm Register, or it has exited from the database (i.e. it has stopped posting balance sheets).

Figure 1 shows that, between 2006 and 2016, zombie firms were about equally likely to recover, to remain a zombie, or exit the market. These figures indicate that, while a large share of non-viable firms left the market after 3 years, a substantial fraction of them returned healthy. This suggests a word of caution in concluding that zombie firms really are non-viable firms. Those firms that the most commonly adopted proxies classify as non-healthy might actually be firms that were only in temporary difficulties. Many of them recovered after a relatively short period of time. Thus, even proxies that seems to be reasonably good in identifying low productivity and high risk firms as zombies, carry a substantial risk of misclassification of firms in temporary difficulty. To the extent that a good definition should forecast a higher market exit, the proxy based on subsidised performs poorly also in this regard. Consistently with the previous evidence on productivity, a firm classified as zombie because it receives subsidised credit had a very low probability of exiting the market (14.5 per cent) against a high probability (almost 49 per cent) of becoming healthy within three years.

Taken together, these results suggest that proxies based profitability perform better than those based on subsidised credit in identifying low productivity and high default risk firms as zombies. A possible explanation (which may be further explored in future work) is that firms that get subsidised credit are still good enough to obtain credit. In datasets that include large and creditworthy firms, such as those on syndicated loans used by e.g. Acharya et al. (2019), proxies of zombie firms based on getting subsidised loans may be better able to identify relatively weak firms. When the analysis is instead based on the universe of corporations, these proxies may lose large part of their ability to identify weak firms, because these may not have access to bank credit to start with.

In the rest of the paper, we focus on our two preferred proxies, both based on profitability: the first is based on EBIT and the second on EBITDA.

3   Zombie Firms and Covid-19

One of the main policy concern related to the Covid-19 pandemic, is that the economic shock might trigger a disorderly and excessive increase in the number of firms exiting the market. Even if it might be efficient that many of these firms cease operating, a sharp rise in exits might exacerbate the recession and create negative externalities on other firms, also because of congestion effects in courts. However, a possible side effect is that the economic policy measures to support firms, might contribute to the "zombification" of the economy.

To help assessing the empirical relevance of these concerns, in this section we first present evidence about the incidence of zombie firms over time and across geographical areas and industries up to the onset of the Covid crisis (December 2019). Then, we explore to what extent financial constraints for zombie firms have tightened, relative to healthy ones, following the Covid-19 shock.

Finally, while balance sheet data for 2020 are not available yet, we use information on the exit and bankruptcy of firms during the year as a first attempt to evaluate the effects of the Covid shock on firms performance. We find that zombie firms were more likely to experience liquidity deficits and spikes in their default probability, as well as to exit the market in 2020.

As of 2019, the incidence of zombie firms was at the lowest level in the full 24 years included in our sample (Figure 2): the share of zombie firms stood at around 3-5 per cent of active firms Panel 2a), at around 4-10 per cent of total assets (Panel 2b), and below 5 per cent of value added Panel (2c). Moreover, they employed 2-4 of active workers and their investment share is about 1-8 per cent. Their incidence is somewhat cyclical and it decreased steadily after 2014, the end of the recession that followed the Eurozone sovereign debt crisis. Moreover, these patterns are homogeneous across all areas of the country.

Based on balance sheet data as of December 2019, Figure 4 and Table 3 show the distribution of zombie firms across geographical areas and sectors at the onset of the Covid-19 shock. Their geographical distribution is potentially important as the incidence of the pandemic has been characterized by outbreaks localized at the province or regional level, and the system to activate more stringent containment measures works mostly on a regional basis. Figure 4 displays wide variation across regions[12], which is somewhat difficult to interpret. For example, the share of non-healthy firms was low in Veneto and Campania, which are regions with different sectoral specialization, economic performance, and institutional quality.

Table 3 presents the distribution by 2-digit Nace industry, documenting significant cross-sectoral differences in the incidence of non-viable firms, ranging from about 2 per cent in some sectors to above 10 per cent in others. Importantly, the share of zombie firms (in terms of number of firms) was higher in industries that experienced a larger drop in revenues in 2020[13], as shown in Figure 3. As these firms have a higher exit rate than healthy firms, their high incidence in sectors more affected by Covid suggests that we could observe an even sharper rise of firm exits in these industries than what the drop in revenues would imply.

We now explore to what extent financial conditions of zombie firms are likely to have deteriorated, relative to those of healthy firms, during 2020, because of the Covid-19 shock.

To obtain our first measure of firms' financial conditions, we exploit the methodology in De Socio et al. (2020)[14] to obtain an indicator of liquidity deficit for individual firms in the counterfactual scenario where there is the Covid-19 shock but no economic support measures[15]. Table 4 shows the results of regressions of these indicators of liquidity deficit on the measures for zombie firms,

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[12]Darker colors indicate a larger share of zombie firms in the region.

[13]The growth rate of revenues from 2019 to 2020 across industries is computed from data on electronic invoices from the Italian Ministry of the Economy.

[14]In De Socio et al. (2020), liquidity deficit is computed as initial liquidity minus the monthly cash flow obtained subtracting material costs, wages, interest expenses. Firm sales are proxied with those of the 2-digit Ateco industry of the firm. The evolution of the outflows (inputs expenses, wages, etc.) depends on elasticities to sales estimated on the basis of historical data. The methodology is based on Schivardi and Romano (2020) and it is also similar in spirit to Gourinchas et al. (2020) who used the condition of liquidity deficit as a proxy for firm exit. This exercise is updated with the most recent information on firm balance sheets, sectoral revenues dynamics, and loan status and usage from the Credit Register.

[15]Results are qualitatively and quantitatively similar if we consider also the effect of economic support measures.

controlling for 2-digit Nace industry and province fixed effects. As shown in columns 1 and 2, where we report the estimates for the full sample, we find that zombie firms were between 35 and 45 per centage points more likely than healthy firms to suffer from liquidity deficit after the Covid-19 shock. [16] In columns 3 and 4 we repeat the exercise, but we exclude firms that would have experienced a liquidity deficit even in the absence of the Covid-19 shock[17]. Even in this restricted sample, zombie firms were 3 per centage points more likely than healthy ones to experience a liquidity deficit, although the differences in the probability are smaller in magnitude[18].

As a second measure of how firms' financial conditions changed with the Covid-19 shock, we analyse whether the probability of default over one year horizon (PDs) of zombie firms increased more strongly than for healthy firms between 2019 and 2020. In particular we use the change in the PDs computed by the Bank of Italy for the In-House Credit Assessment System (ICAS) [19]. The PD for December 2020 is estimated using the same methodology as in De Socio et al. (2020), where the scenario takes into account not only the effects of the Covid-19 shock, but also those of the economic support measures.

For two thirds of the firms in the sample the PD increased, and the average change is 53 basis points. Table 5 shows that PDs of zombie firms increased more than those of healthy firms (controlling as usual for firm size, industry and province, which capture the impact of the Covid-19 shock). The effect is sizeable, as the PDs of non-healthy firms increased by between 83 and 110 basis points more than for healthy firms[20].

This evidence suggests that the exit rate in the sectors most affected by the pandemic should be especially large. Not only did these sectors experience a particularly pronounced drop in activity, but they were also populated by a larger share of zombie firms, whose PDs and more general financial conditions deteriorated more strongly than those of other firms.

Indeed, using data on exit and bankruptcy of firms up to April 2021, Table 6 shows that, consistently with the evidence from the transition matrices (Figure 1), even after the Covid-19 shock, zombie firms were significantly more likely to exit the market or declare bankruptcy. The effect is quite sizeable. In this period, the bankruptcy and exit rates of these firms were more than double in size than that of the average firm in the sample.[21]

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[16]About 20.3 per cent of firms were in liquidity deficit (among those in the sample for which we could compute the measure and that are still operating in 2019, which include slightly less than 510,000 firms).

[17]This exercise allows us to focus more strictly on the effects of the Covid-19 shock. Non reported results (available upon request) show that zombie firms were more likely than healthy firms to experience liquidity deficit even without Covid-19.

[18]About 7.3 per cent of firms were in liquidity deficit among those that would not have experienced a liquidity deficit even without the Covid-19 shock.

[19]ICAS is the Bank of Italy internal method of evaluating credit risk of loans used as guarantees in monetary policy operations. The PDs measure the probability a firm defaults within a year.

[20]The results are similar if we use the PDs of banks' internal rating models observed in Anacredit. A shown in Table A2 in the appendix, both the mean and the median PD were more likely to increase for zombie firms than for healthy firms. Economically, these effects are strong. PDs for non-viable firms increased by more than 100 basis points than for healthy firms, against a mean and median PDs in the sample equal to about 7 per cent.

[21]The average exit rate over one year horizon in 2020 is about 2.7%, and that of zombie firms is about 4 per centage points higher than that of healthy firms. Similarly, the bankruptcy rate of the average firm is about 0.11%, while that of zombie firms is 0.4 per centage points higher than that of healthy firms. The exit rate rates in 2020 were about one 15% lower than in 2019 both for healthy and zombie firms; similarly bankruptcy rates were about one third lower in 2020 than

However, as depicted in Figure 5, on average less firms exited the market in 2020 than in 2019. [22] Furthermore, the reduction in the number of exiting firms does not seem weaker in those sectors more affected by the Covid-19 shock[23]. One possible explanation is that the economic measure might have been successful in supporting firms, avoiding exits, and smoothing out differences in the strength of economic shocks across sectors. To the extent that support policies went disproportionately in favour of the most affected sectors, where the incidence of zombie firms was already higher in 2019, they may have ended up benefiting many zombie firms with risk of contributing to the "zombification" of the economy. We address these matters explicitly in the next section.

4   Zombies and the Take-up of Support Measures

In this final section, we document to what extent zombie firms took up the Covid-related support measures. In particular, we study the take up of grants ("*contributi a fondo perduto*"), of debt moratorium, and of government guaranteed loans of the "*Fondo Centrale di Garanzia*" (FCG)[24]. We find that zombie firms did not benefit as much as other firms from policies in place, probably because eligibility criteria leaned more towards relatively healthier enterprises.

This evidence is crucial for the debate about the allocation of the support measures, and the extent to which they reached firms that were more likely to be ex ante not viable. While the post-Covid world is likely to be very different form the pre-Covid one, it is reasonable to think that firms characterized by lower productivity and profitability, and higher probability of default before the Covid-shock — the firms we identify as zombies — are likely to be non-viable even after the shock. This is corroborated by the findings that these firms were more likely to be experiencing a liquidity deficit and that their probability of default increased much more strongly than those of healthy firms in 2020. Furthermore, understanding to what extent the policy measures are supporting non-viable firms can inform the decisions about the phasing out of economic support measures. In particular, the higher is the take up of actual support measures among zombie firms, the higher is the risk of "zombification" and the more important is to better target the new measures and the phasing out of the current ones by including mechanisms that induce non-viable firms not to take them up.

The first measure we analyse is grants ("*contributi a fondo perduto*"). Grants were given to firms

in 2019 % for both kind of firms.

[22]This result is only partially due to the ban on new bankruptcy procedures which was in place until June 2020: while the reduction in bankruptcies and exits with respect 2019 is stronger in the second quarter of 2020, even in the last quarter of 2020 the number of bankruptcies starter was more than 10% lower than in the same quarter of 2020.

[23]The correlation coefficient between the growth rates of exits and sales across productive sectors is actually negative, although not statistically significant. The results are qualitatively similar if we use the growth rate of bankruptcies by sector instead of the growth rate of exits.

[24]We take information on the take-up of economic support measures, for the period from March to December 2020, from several sources: government grants are from *Tesoreria telematica* while Government guaranteed loans and loan moratoria are from Anacredit. We do not have firm-level information about the take-up of furlough schemes (*Cassa Integrazione Guadagni*) which is therefore excluded from our analysis.

based on their size (only SMEs) and on the drop in revenues from April 2019 to April 2020. Table 7 shows that zombie firms were less likely than healthy firms to obtain the grants[25]. The effect is economically large. These firms were between 16 and 21 per cent less likely than healthy firms to obtain a grant, when on average 46.2 per cent of firms in the sample obtained a grant. This result holds controlling for industry fixed effects (that capture the size of the shock, together with other structural characteristics of the industry), province fixed effects (that can also proxy for local factors affecting firms' activity during Covid, including the local incidence of the contagion, the ability of workers to commute, etc), and firm size (measured as the logarithm of total assets). The lower take-up of grants by zombie firms may reflect the condition that firms could apply for grants if they experienced a drop in revenues in April 2020 relative to April 2019 larger than 33 per cent. To the extent that these firms already had low revenues in 2019, this condition contributed to exclude them from the measure. It is also possible that some of these firms decided not to apply, but we cannot distinguish this possibility with our data.

Next, we study the take-up of the debt moratorium. For this analysis, we select only eligible firms, excluding firms that already had a non-performing loan as of February 2020, and including only SMEs (according to the "European Union definition)[26]. Table 8 shows that zombie firms were less likely to take the moratorium than healthy firms were. Yet, the economic significance is somewhat lower. While on average 35.9 per cent of firms obtained the moratorium, zombies were between 4 and 7 per cent less likely to get it. Again, this result holds controlling for industry and province fixed effects.

Then, we explore the government guaranteed loans from the "*Fondo Centrale di Garanzia*" (FCG). These were available for firms with less than 500 employees. Table 9 shows the results of regressions of different indicators of the take up of guaranteed loans on our zombie variables. As a first step we explore the intensive margin. Our data do not allow us to observe if the firm applied for the loan and was denied by the bank, or whether it just did not apply. Therefore, what we are estimating is a cumulate effect of lower demand and tighter supply for zombies. Yet, at least for small loans that could be fully guaranteed (and for which banks screening was likely to be limited), we conjecture that our results are mostly driven by demand. In columns 1 and 2 the dependent variable is an indicator variable equal to 1 for firms that obtained a loan from the FCG. The estimates show that zombie firms were less likely to obtain a guaranteed loan. The effect is sizable, as zombie firms were between 14 and 22 per cent less likely to obtain a guaranteed loan, against an unconditional average of 61.5 per cent. We also look at the size of the loan, conditional on obtaining one. Estimates in columns 3 and 4, where the dependent variable is the amount (in log) of guaranteed loans, show that non-healthy firms obtained smaller loans. Their guaranteed loans were about between 44 and 49 per cent smaller than healthy firms' (the average loan amounted to about 465,000 euros, the median loan to 103,000).

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[25]The sample only includes SMEs, as non-SMEs were not eligible to apply for the measure
[26]We run a robustness check on the full sample of firms and results are very similar

Interestingly, columns 5 and 6, where the main dependent variable is an indicator variable equal to 1 if the loan was 100 per cent guaranteed, show that upon obtaining a loan, zombie firms were more likely to obtain a loan with a full guarantee. For these loans, there was no screening by the guarantee fund, and clearly banks had lower incentives to screen borrowers as the guarantee fully covers the loans. The effect is non-negligible, as zombie firms were 12 per cent more likely than healthy firms to obtain fully guaranteed loans, while roughly 31 per cent of firms obtain fully guaranteed loans. This result partly reflects the smaller size of the former, but it is also likely to reflect the incentives of banks to grant loans that are fully guaranteed to firms that are more likely to enter into NPL status.

Finally, we explore to what extent the zombie measure captures a permanent as opposed to transitory status of weakness of the firms. In particular, we test whether the take up of the different measures differs for firms in temporary difficulties and zombie. To do this, we run the same exercise by adding to the zombie dummy an indicator variable equal to one if a firm has the interest coverage ratio below unity in 2019 (and is not a zombie). This measure identifies firms that do not have the interest coverage ratio below unity for three consecutive years or that are less than ten years old. We label these firms as "weak firms".

Results are in Table 10. Weak firms take up rate of grants was also smaller than healthy firms but smaller in magnitude to that of zombie firms (Columns 1 and 2). As in the case of zombie firms, this can be explained by the fact that even weak firms had lower revenues in 2019 and were less likely to be eligible for grants. Interestingly, weak firms were more likely than healthy firms to obtain the debt moratorium, while zombie firms were less likely. Finally, similar to zombie firms, weak firms were less likely than healthy firms to get a guaranteed loan. Moreover, they received guaranteed loans of smaller size (conditionally on being granted one), and were more likely to obtain fully guaranteed one. However, the magnitude of the differences with respect to healthy firms is smaller for weak firms than for zombie ones. Overall, these results suggest that the moratorium have been taken-up by firms in temporary difficulty that did not become a zombie (yet), while zombie firms did not even apply. As for guaranteed loans, this evidence hints banks were likely to turn down firms with weak balance sheet conditions (thus potentially affecting their demand and selection in smaller and fully guaranteed loans) to a lesser extent than zombie firms.

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Figures

Figure 1: Transition in Three Years from Healthy and Zombie Status
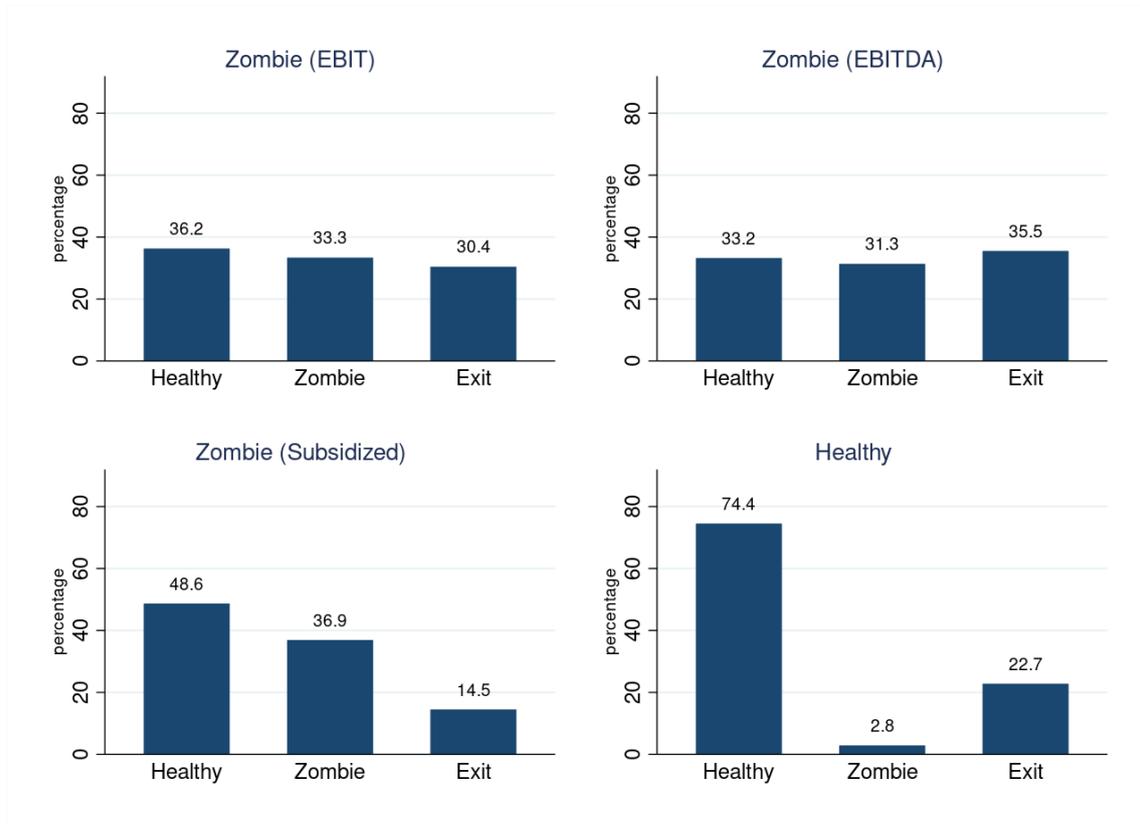
Notes: this graph reports the status in three years for healthy and zombie firms in a reference year. Reference years are 2006-2016. For healthy firms the EBITDA definition is used.

Figure 2: Zombie firms (% total outstanding balances)

(a) Share of active firms

(b) Share of assets

(c) Share of value added

(d) As a Share of Active Firms by Geographical Area (EBIT-based Definition)
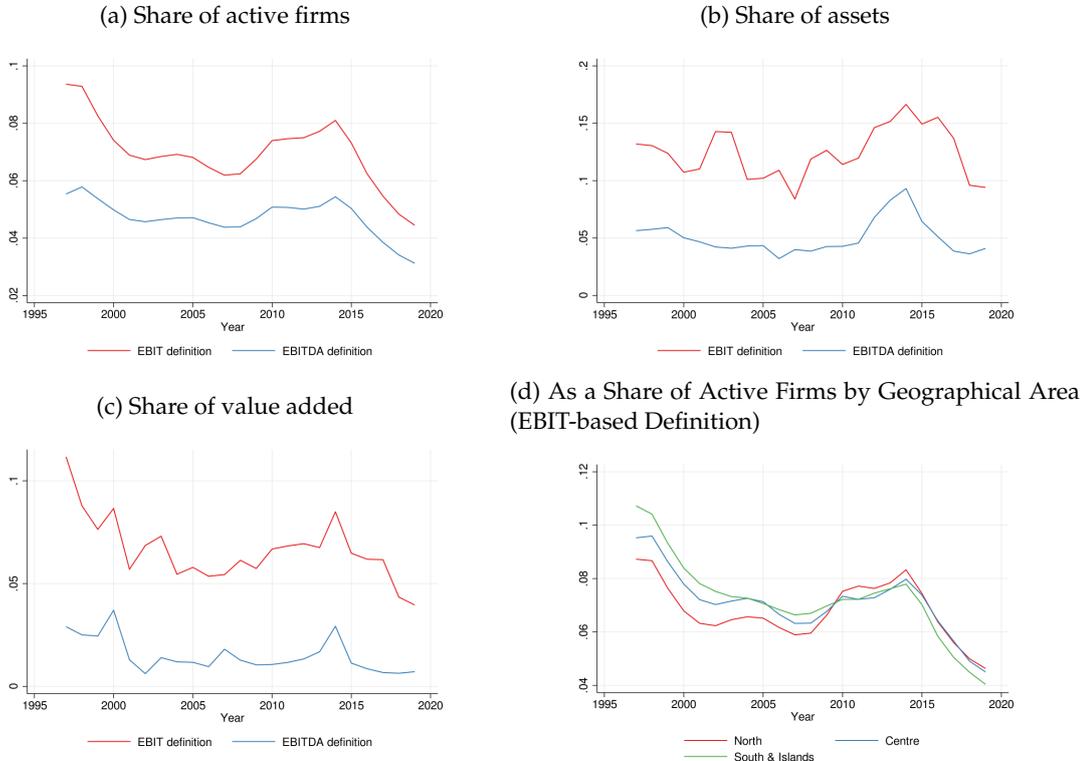
Source: CERVED.

Figure 3: Correlation Between Share of Zombie Firms and Revenues Growth in 2020 (Growth Rates)

(a) EBIT-based Measure

(b) EBITDA-based Measure
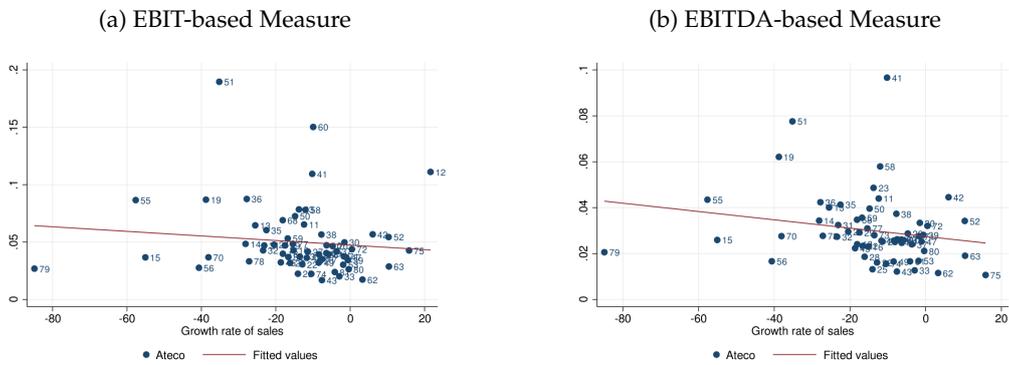
Source: Cerved and Agenzia delle Entrate. The share of zombie firms is measured as of 2019. The growth rate of sales is measured in 2020.

Figure 4: Share of Zombie Firms Across Regions as of 2019 (EBIT-based Measure)

Zombie Share
(4.985,6.86]
(4.62,4.985]
(4.34,4.62]
[2.81,4.34]
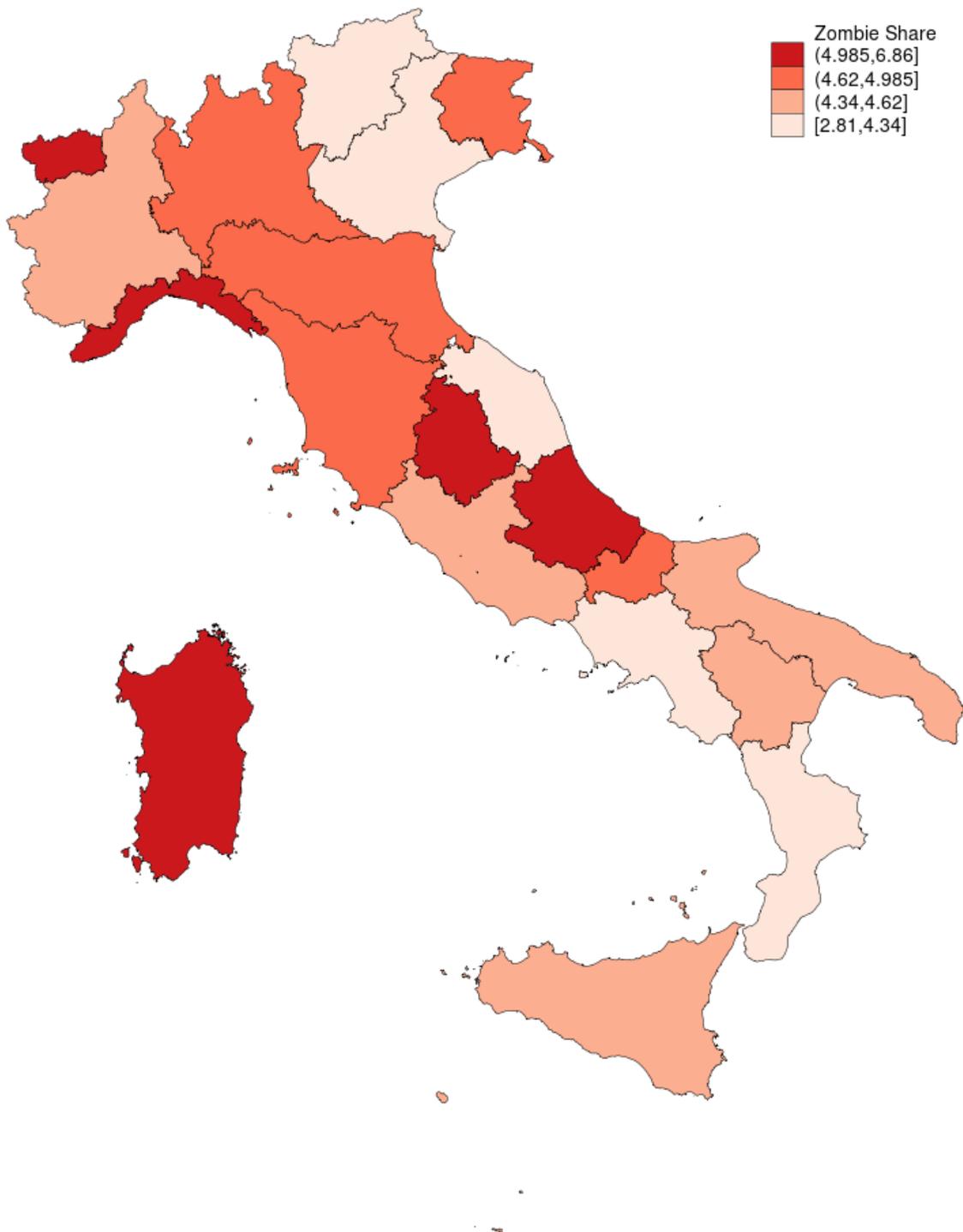
Notes: data are from CERVED, 2019.

Figure 5: Correlation between the Growth rate of Exiting firms and Revenues Growth in 2020 (by sector)
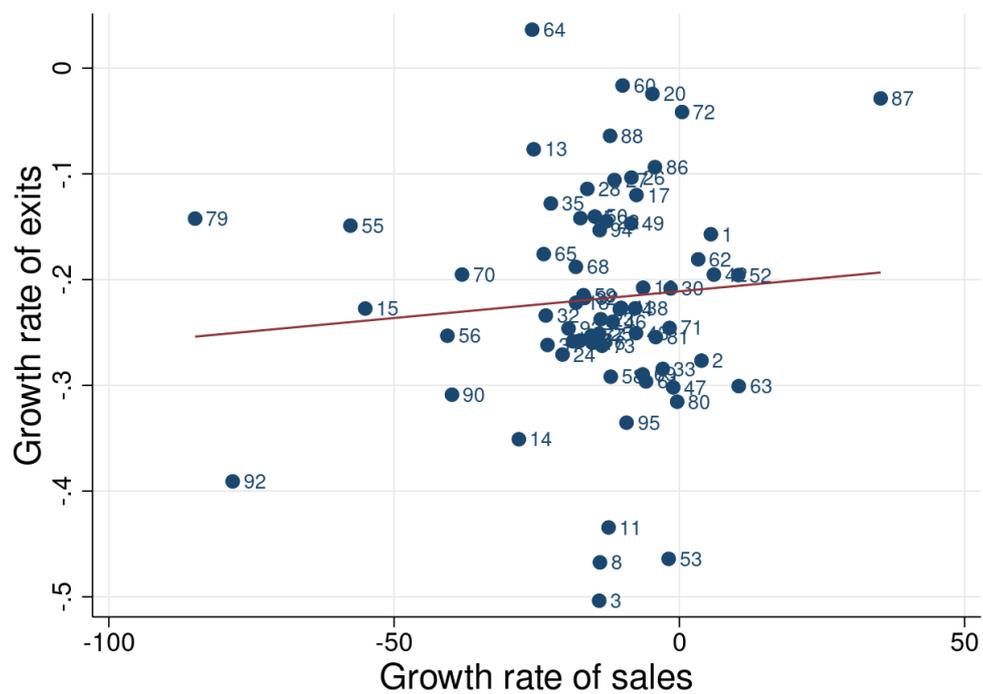
Source: *Agenzia delle Entrate* and *Infocamere*. Growth rate of sales is from *Agenzia delle Entrate* and is measured as the growth rate of total revenues of the sector between 2019 and 2020. Growth rate of exits is from *Infocamere* and is measured as the growth rate of the number of firms exiting from a given sector between 2019 and 2020. A firm exits the market in a given year when the first of 3 events happens in that year: i) the firm starts a bankruptcy procedure; ii) the firm starts a liquidation procedure; iii) the firm is cancelled from the Firm Registry.

Tables

Table 1: Characteristics of Zombie and Healthy Firms as of 2019

	Zombie EBITDA		Zombie EBIT		Zombie Subsidized	
	No	Yes	No	Yes	No	Yes
Labour Productivity (Revenues)	135.76	93.5	136	107.23	177.57	239.78
Labour Productivity (Value Added)	41.5	16.5	41.56	26	48.33	55.5
Employees	2.25	0	2.25	0	7	11.67
ROA	2.02	-4.76	2.11	-3.89	1.26	1.16
Z-Score	3	6	3	5	4	4
Undercapitalised	0.07	0.27	0.07	0.23	0.04	0.04
Liquidity/Assets	10.2	2.9	10.36	2.86	4.21	3.52

Notes: all balance sheet data are from Cerved, while the number of employees comes from social security data *INPS*. The table shows median values for all the variables except for the Z-score and the dummy for undercapitalized firms for which it shows the mean. Data for the Zombie EBIT and Zombie EBITDA proxies are from 2019, while for Zombie Subsidized are from 2018.

Table 2: Correlation Between Zombie Status and Presence of NPLs or Bad Loans

	Bad Loans dummy			NPL dummy		
	(1)	(2)	(3)	(4)	(5)	(6)
Zombie EBIT	0.0823***			0.162***		
	(0.000538)			(0.000755)		
Zombie EBITDA		0.116***			0.217***	
		(0.000833)			(0.00110)	
Zombie Subsidised			-0.00130***			-0.0267***
			(0.000124)			(0.000351)
Firm Size	-0.00921***	-0.00854***	0.000491***	-0.00314***	-0.00180***	0.00831***
	(0.0000620)	(0.0000614)	(0.0000382)	(0.0000927)	(0.0000925)	(0.000116)
N	5410610	5410610	3257184	5410610	5410610	3257184
R-squared	0.0319	0.0334	0.00382	0.0427	0.0427	0.0219

Notes: OLS regressions. All regressions include 2-digit industry, year and province fixed effects. In columns 1-3 dependent variable is a dummy equal to 1 if the firm had some share of bad loans in total used credit of at least 5%. In columns 4-6 the dependent variable is a dummy equal to 1 if the firm had some share of NPL or bad loans in total used credit of at least 5%. Data are from Cerved and from the Italian Credit Register. The sample period is between 2005 and 2019. Before 2005 the Credit register did not include information on NPLs, only on bad loans.

Table 3: Zombie Share by 2-digit Industry in 2019

Nace 2- Digit	Share Zombie EBIT (%)	Share Zombie EBITDA (%)	Sales Growth in 2020 (%)
Accounting, Law, Consulting	3.47	2.51	-17.67
Advertising	3.45	2.52	-13.56
Agriculture	11.66	7.47	5.17
Architecture&Engineering	3.48	2.51	-1.72
Arts, Museums, etc	3.10	2.13	-46.11
Automotive	4.27	2.59	-17.53
Automotive Wholesale trade	3.02	2.05	-18.65
Chemicals	4.22	2.49	-4.72
Coke, Petroleum	8.23	5.70	-38.78
Computer repair	2.18	1.55	-9.26
Construction	6.71	5.77	-6.50
Electric Gas Utilitie	5.74	3.97	-22.53
Electrical products	3.75	2.09	-11.39
Electronics	3.61	2.31	-8.40
Food, Drinks, Tobacco	4.51	2.37	-6.91
Furniture	4.18	2.70	-23.25
HR	3.00	2.43	-27.17
HoReCa	4.30	2.31	-46.86
Iron&Steel	4.29	2.52	-20.47
Leasing&Rental	4.32	2.76	-15.41
Logistics	5.02	3.13	8.89
Machinery	2.81	1.54	-16.13
Metal products	2.04	1.15	-14.05
Minerals non metal	7.33	4.42	-13.78
Mining	12.92	8.75	-18.84
Other business support serv	2.93	1.93	-12.10
Other personal services	2.51	1.54	92.43
Other professional activities	2.10	1.43	-9.68
Other transport	4.23	2.73	-1.54
Paper	3.39	2.49	-7.52
Pharma	3.14	2.52	-8.13
Press	7.42	5.46	-12.03
Printing	3.73	2.22	-18.10
R&D	4.29	3.12	0.47
Real Estate	6.33	3.03	-18.14
Repair&Installation	1.86	1.10	-2.91
Retail trade	3.43	2.33	-1.08
Rubber	2.74	1.35	-12.86
Software	2.07	1.34	5.14
Sport	6.01	3.50	-19.42
TV and Cinema	6.59	4.37	-12.53
Telecom	3.13	1.96	-5.84
Textile	4.12	2.65	-38.57
Transport	3.30	1.65	-9.45
Travel Agents	2.50	1.96	-84.89
Waste	4.74	3.11	-6.99
Water utilities	8.36	3.75	-27.81
Wholesale trade	3.33	2.30	-11.67
Wood	3.96	2.02	-15.26

Notes: data are from CERVED, 2019.

Table 4: Correlation Between Zombie Status and Liquidity Deficit

	Liquidity Deficit (Full Sample)		Liquidity Deficit (Selected Sample)	
	(1)	(2)	(3)	(4)
Zombie EBIT	0.349***		0.0301***	
	(0.00365)		(0.00315)	
Zombie EBITDA		0.447***		0.0295***
		(0.00462)		(0.00459)
Firm Size	0.00551***	0.00706***	0.00609***	0.00620***
	(0.000330)	(0.000331)	(0.000216)	(0.000216)
N	621600	621600	531886	531886
R-squared	0.0894	0.0882	0.148	0.148

Standard errors in parentheses

$* \ p < .10, \ ** \ p < .05, \ *** \ p < .01$

Table 5: Zombie firms and change in ICAS PDs

	Delta PD	
	(1)	(2)
Zombie EBIT	0.00831***	
	(0.000365)	
Zombie EBITDA		0.0110***
		(0.000588)
Firm Size	-0.0000985***	-0.0000519
	(0.0000322)	(0.0000323)
N	245266	245266
R-squared	0.0556	0.0548

Notes: OLS regressions. All regressions include 2-digit industry and province fixed effects. Zombie firms are measured as of 2019. The change in the PD between 2019 and 2020 has been computed by the Bank of Italy' ICAS model as in De Socio et al. (2020). Those estimates have been updated using firm balance sheet data as of 2019 and the realized evolution of 2-digit Nace industry sales in 2020.

Table 6: Correlation Between Zombie Status and Bankruptcy and Exit

	(1)	(2)	(3)	(4)
	Bankruptcy	Bankruptcy	Exit	Exit
Zombie EBIT	0.00424***		0.0390***	
	(0.000431)		(0.00142)	
Zombie EBITDA		0.00418***		0.0446***
		(0.000519)		(0.00183)
Firm Size	0.000223***	0.000243***	-0.0110***	-0.0108***
	(0.0000253)	(0.0000256)	(0.000154)	(0.000153)
N	672399	672399	672399	672399
R-squared	0.00148	0.00127	0.0187	0.0185

Notes: OLS regressions. Standard errors in parentheses. The sample consists of all firms active (not yet exited from the market) in 2019. All regressions include 2-digit industry, year and province fixed effects. In columns 1-2 dependent variable is a dummy equal to 1 if the firm has declared bankruptcy in 2020. In columns 3-4 the dependent variable a dummy equal to 1 if the firm has exited the market in 2020. All data are from Cerved and Firm Registry (*Infocamere*). A firm exits the market when the first of 3 events happens in that year: i) the firm starts a bankruptcy procedure; ii) the firm starts a liquidation procedure; iii) the firm is cancelled from the Firm Registry.

Table 7: Take-up of Grants by Zombie Status

	Grant	
	(1)	(2)
Zombie EBIT	-0.159***	
	(0.00269)	
Zombie EBITDA		-0.211***
		(0.00308)
Firm Size	-0.0211***	-0.0219***
	(0.000337)	(0.000337)
N	672426	672426
R-squared	0.0906	0.0915

Notes: OLS regressions. All regressions include 2-digit industry and province fixed effects. Zombie firms are measured as of 2019. The sample include SMEs as these are eligible to apply for the grants. The grants have been taken by 46.2 per cent of the SMEs in our sample. Information on the grants take-up is from Servizio Tesoreria dello Stato (cfr. Appunto per il Direttorio "L'erogazione dei contributi a fondo perduto alle imprese", by Alessio D'Ignazio, Andrea Linarello, Ilaria Salvati e Piercarlo Venditti.

Table 8: Take-up of Loan Moratoria by Zombie Status

	Loan Moratoria	
	(1)	(2)
Zombie EBIT	-0.0364***	
	(0.00490)	
Zombie EBITDA		-0.0651***
		(0.00667)
Firm Size	0.0446***	0.0444***
	(0.000633)	(0.000632)
N	384924	384924
R-squared	0.0486	0.0488

Notes: OLS regressions. All regressions include 2-digit industry and province fixed effects. Zombie firms are measured as of 2019. The sample includes SMEs and firms without NPLs as of January 2020 (data from the Italian Credit Register) as these were eligible for the moratorium. Data on moratoria status are from Anacredit as of December 2020. Loan moratoria have been taken by 35.9 per cent of the SMEs (without NPLs) in our sample.

Table 9: Take-up of Guaranteed Loans by Zombie Status

	D(Loan from FCG)=1		Log(Loan)		D(Loan Guar100%)=1	
	(1)	(2)	(3)	(4)	(5)	(6)
Zombie EBIT	-0.142***		-0.586***		0.121***	
	(0.00483)		(0.0181)		(0.00633)	
Zombie EBITDA		-0.218***		-0.664***		0.118***
		(0.00636)		(0.0268)		(0.00999)
Firm Size	-0.0115***	-0.0122***	0.846***	0.843***	-0.150***	-0.149***
	(0.000615)	(0.000614)	(0.00183)	(0.00183)	(0.000635)	(0.000635)
N	672426	672426	307472	307472	307472	307472
R-squared	0.0819	0.0821	0.572	0.571	0.339	0.338

Notes: OLS regressions. All regressions include 2-digit industry and province fixed effects. Zombie firms are measured as of 2019. The sample includes firms with less than 500 employees as of January 2020 (data from the INPS), as these were eligible for the guaranteed loans. Data on guaranteed loans are from the Fondo Centrale di Garanzia – Amministrazione Trasparente and are publicly available on internet. Loans from the FCG have been taken by 61.5 percent of eligible firms without NPLs in our sample. Loans with 100% guarantee have been taken by 31.3 per cent of eligible firms without NPLS that obtained a loan from the FCG. The average loan granted amounts to 464,817 euros, the median loan amounts to 102,838 euros.

Table 10: Non-zombie Firms with Interest Coverage Ratio Less than One in 2019

	Grants		Loan Moratoria		D(Loan from FCG)=1		Log(Loan)		D(Loan Guar100%)=1	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Weak EBIT	-0.114***		0.0439***		-0.0824***		-0.252***		0.0518***	
	(0.00150)		(0.00248)		(0.00244)		(0.00757)		(0.00293)	
Zombie EBIT	-0.183***		-0.0297***		-0.155***		-0.622***		0.128***	
	(0.00271)		(0.00492)		(0.00484)		(0.0181)		(0.00634)	
Weak EBITDA		-0.146***		0.0267***		-0.124***		-0.278***		0.0542***
		(0.00164)		(0.00292)		(0.00288)		(0.00937)		(0.00366)
Zombie EBITDA		-0.238***		-0.0623***		-0.233***		-0.689***		0.123***
		(0.00311)		(0.00668)		(0.00637)		(0.0268)		(0.01000)
Firm Size	-0.0257***	-0.0282***	0.0455***	0.0450***	-0.0134***	-0.0152***	0.841***	0.837***	-0.149***	-0.148***
	(0.000338)	(0.000340)	(0.000634)	(0.000635)	(0.000614)	(0.000613)	(0.00184)	(0.00185)	(0.000636)	(0.000638)
N	672426	672426	317029	317029	325676	325676	200316	200316	200316	200316
R-squared	0.0983	0.102	0.0484	0.0478	0.0608	0.0638	0.547	0.545	0.225	0.223

Notes: OLS regressions. All regressions include 2-digit industry and province fixed effects. Weak firms are measured as of 2019. The sample used in the regressions in column 3 to 4 includes SMEs without NPLs as of January 2020 (data from the Italian Credit Register and INPS), as these were eligible for the guaranteed loans. Data on the moratoria are from Anacredit. The sample used in the regressions in column 5 to 10 includes firms with less than 500 employees and without NPLs as of January 2020 (data from the Italian Credit Register), as these were eligible for the guaranteed loans. Data on guaranteed loans are from the Fondo Centrale di Garanzia – Amministrazione Trasparente and are publicly available on internet. Loans from the FCG have been taken by 61.5 percent of eligible firms without NPLs in our sample. Loans with 100% guarantee have been taken by 31.3 per cent of eligible firms without NPLS that obtained a loan from the FCG. The average loan granted amounts to 464,817 euros, the median loan amounts to 102,838 euros.

Appendix A Variables Definitions

In this section we define the variables used throughout the analysis.

- Zombie EBIT: firms older than ten years, with either EBIT lower than interest expenses or negative EBIT for three consecutive years

- Zombie EBITDA: firms older than ten years, with either EBITDA lower than interest expenses or negative EBIT for three consecutive years

- Zombie subsidised: firms in one of the 7 riskiest Z-score classes that pay an interest rate lower than the "prime" rate, defined as the average rate paid by firms in the two safest Z-score classes

- Firm size: natural logarithm of total assets

- Labour productivity (revenues): ratio of revenues and number of employees

- Labour productivity (value added): ratio of value added and number of employees

- ROA: ratio of net income and total assets

- Z-Score: a class variable ranging from 1 to 9. Low ratings are assigned to safe borrowers

- Undercapitalised: a dummy that equals one if a firm displays a level of equity below the legal limit

- PD (ICAS): one-year default probability. This is estimated by the Bank of Italy for Italian banks without an internal model of default probability

Appendix B   Additional Tables

Table A1: Characteristics of Zombie and Healthy Firms Over Time

Panel A – 1998	Zombie EBITDA		Zombie EBIT		Zombie Subsidized	
	No	Yes	No	Yes	No	Yes
Labour Productivity (Revenues)	145.25	103.95	145.96	122.48	167.44	210.77
Labour Productivity (Value Added)	34.91	22.66	34.95	30.15	38.37	43.77
Employees	2	0	2	0.42	6.92	12.83
ROA	0.31	-4.35	0.37	-3.1	0.25	0.42
Z-Score	5	6	5	6	5	5
Undercapitalised	0.12	0.35	0.12	0.27	0.09	0.05
Liquidity/Assets	5.38	4.23	5.56	3.3	2.37	1.81

Panel B – 2007	Zombie EBITDA		Zombie EBIT		Zombie Subsidized	
	No	Yes	No	Yes	No	Yes
Labour Productivity (Revenues)	144.99	93.89	145.63	106.67	173.32	206.39
Labour Productivity (Value Added)	41.08	19.5	41.21	28.79	45.42	49.69
TFP (Revenues)	10.45	7.01	10.47	8.37	11.13	12.1
Employees	2	0	2	0	6	8.08
ROA (%)	0.69	-5.71	0.74	-4.59	0.52	0.6
Z-Score	5	6	5	6	5	5
Undercapitalised	0.12	0.42	0.12	0.35	0.08	0.06
Liquidity/Assets (%)	6.57	5.56	6.67	4.25	2.92	2.39

Panel C – 2014	Zombie EBITDA		Zombie EBIT		Zombie Subsidized	
	No	Yes	No	Yes	No	Yes
Labour Productivity (Revenues)	157.59	103.8	158.06	120.07	188.57	228.99
Labour Productivity (Value Added)	41.3	21.29	41.4	30.64	45.77	50.55
TFP (Revenues)	2.17	0	2.08	1	6	8
ROA	0.74	-5.17	0.8	-3.96	0.52	0.58
Z-Score	5	6	5	6	5	5
Undercapitalised	0.1	0.3	0.1	0.25	0.08	0.06
Liquidity/Assets	6.36	3.85	6.47	3.2	2.9	2.35

Notes: data are from CERVED, 1997, 2004, 2014.

Table A2: Zombie Firms and Change in PDs from Internal Rating Models

	Delta Mean PD		Delta Median PD	
	(1)	(2)	(3)	(4)
Zombie EBIT	0.00999***		0.0111***	
	(0.00149)		(0.00157)	
Zombie EBITDA		0.0135***		0.0142***
		(0.00238)		(0.00252)
Firm Size	-0.000159	-0.000106	0.000119	0.000178
	(0.000126)	(0.000126)	(0.000132)	(0.000132)
N	221218	221218	220529	220529
R-squared	0.00351	0.00347	0.00356	0.00347

Notes: OLS regressions. All regressions include 2-digit industry and province fixed effects. Zombie firms are measured as of 2019. The PDs from banks' internal ratings models are from Anacredit and are aggregated at the firm-level. The changes in the PDs are measured between December 2020 and February 2020.