Ca' Foscari
University
of Venice

Master's degree
in Economia e Finanza

Final Thesis

Public support and firm zombification during Covid-19: an empirical analysis on the effect of public interventions on bankruptcy dynamics in Italy

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Academic year
2020/2021

Abstract

The economic crisis following the Covid-19 pandemic impacted productivity and output performances of most countries, putting at risk the survival of many companies. Policy choices were implemented to "hibernate" the economy and avoid disruptive effects of firms bankruptcy on employment, consumption and supply chain dynamics. We investigate whether governments did too much, fueling the risk of firm zombification, or too little, letting productive companies die. To examine this issue we try to understand if public supports and policy choices distorted the usual determinants of bankruptcies. Referring to existing studies on the matter conducted using French data, we develop a linear probability model and a logit model for Italy on a sample of 262,509 Italian firms of the retail sector during the period 2014-2020. Using data of the Household budget survey (HBS), we measure the Covid-19 shock on consumption with the variation in the average monthly payments by Italian families between 2019 and 2020, using the ECOICOP classification. Results show that the determinants of bankruptcies work similarly in 2019 and in 2020, without relevant distortion in the bankruptcy dynamics. However, models including the shock show that the Covid shock measure is still a significant predictor of bankruptcy probability for 2020. For this reason, we conclude that policy support partially hibernated the economy given the minor relevance of the shock in the prediction of firm bankruptcy, as confirmed by analyses on the decomposition of R^2. However, government measures did not completely absorb the shock given its significance in the models.

Introduction

The Covid-19 pandemic spread worldwide in an unexpected and disruptive way, leading governments to adopt strong containment measures, such as lockdowns and travel bans, in order to stop human lives losses and avoid overload of the healthcare system.
These measures had a huge impact on the overall global economy in terms of consumption, employment, trade, production and supply chain dynamics. Because of this, one of the first most feared consequences of the pandemic was the widespread of a wave in bankruptcies and firm failures (Vereckey, 2020). This possibility would threaten economic performances in the long run: bankruptcies impact an economy reducing employment, production and the overall performance of a country. For this reason, a wide range of government measures was adopted to support businesses impacted by the crisis in order to "hibernate" the economy during the pandemic shock period. These interventions included suspension of tax payments, subsidized wage payments and a huge amount of liquidity supports through grants and loans.

Italy was one of the first countries to experience the pandemic and to adopt extraordinary measures to intervene. The amount of resources allocated was considerable over time, starting with 100 million euros in aids to support SMEs in April 2020[1] and continuing with other allocations targeted at specific categories. As of December 31st 2020, the total above the line measures implemented by the Italian government were estimated to be of around 112 billion euros, while the liquidity support as guarantees was of around 579 billion euros[2].
Thanks to these interventions, the fear of a spread in failures did not actually materialize in 2020. On the contrary, a drop of 15.39% was registered in the bankruptcy procedures between 2019 and 2020[3].

This caused a certain shift in worry. At first the excess of bankruptcies was highly feared, but when it did not materialize, the attention was moved to the risks of a distortion in

[1] Detailed information available at: https://ec.europa.eu/info/live-work-travel-eu/coronavirus-response/jobs-and-economy-during-coronavirus-pandemic/state-aid-cases/italy_en
[2] Data taken from the IMF, available at: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19 (visited February 10, 2022)
[3] Data from DG-Stat, available at: https://webstat.giustizia.it/SitePages/StatisticheGiudiziarie/civile/Procedimenti%20Civili%20-%20flussi.aspx (visited in May 2021)

market failures dynamics. The question immediately arose: data showed that bankruptcies actually decreased in number during 2020, but why was that so? Did governments do too much and kept unprofitable firms alive?

The risk of this possibility is well known in literature and is usually referred to as zombification. An economy is zombified when its market is characterized by a huge amount of unprofitable highly indebted firms that actually slowdown the entire economy. The long run consequences of a zombified economy are threatening and put at risk "creative destruction", which was defined by Schumpeter as the "process of industrial mutation that continuously revolutionizes the economic structure from within, incessantly destroying the old one, incessantly creating a new one" (Schumpeter, 1942). In the context of firm existence, it refers to the entering and exiting of companies depending on their productivity and innovation capacity.

Empirical evidences confirm Schumpeter intuition: the exiting of firms that are less productive is fundamental for the development of an economy. In particular, studies by Turner (2013) show that 40% of the hourly productivity growth between 1997 and 2007 in France comes from entry and exit of firms, while David et al. (2020) show that more than 60% of labour productivity in France in the period 2011-2017 can be attributed to creative destruction. The Italian situation is comparable: studies by Linarello et al. (2017) show that business demography (so the process of entry and exit of companies) improved the dynamics of aggregate labour productivity between 2005 and 2013. In fact, the authors find that firm demography has always a positive net contribution to aggregate productivity growth.

On the contrary, when unprofitable zombie firms do not exit the market the consequences are disruptive. Zombification creates market distortions and lowers productivity in the economy (Caballero et al., 2008). In addition, zombie firms tend to crowd out investment from other healthier firms (Banerjee et al., 2018).

In literature zombification is usually accessed setting a priori thresholds in most important leverage and balance sheet information. Most of zombification analyses are in fact focused on how to identify zombies using conditions on indebtment levels, productivity and access to credit. The result is usually an overview of the share of zombies in an

economy, which is further analysed to understand the impact of those companies on the potential and overall performance of a country.

In light of these considerations, it is clear that the selection process of firms in an economy is fundamental for the long run growth perspectives of a country.

Scholars were aware of the importance of this issue during the pandemic crisis and conducted preliminary analyses to understand the matter.
One of the first works is by Cros et al. (2021) and investigates the firm selection process in France relying on bankruptcy dynamics. The authors constructed some logistic regression models, analysing the determinants of bankruptcy before and after the Covid-19 shock, checking for relevant changes and investigating the impact of an additional determinant: the shock in turnover faced by companies during the pandemic. This approach allowed to preliminary compare the determinants of failure over time. In the end, the authors conclude that the sectoral heterogeneity of the Covid-19 shock was partially absorbed by government policies and that the economy was correctly hibernated.

The model used by the French authors, a logistic regression model, is one of the most famous models for bankruptcy analysis. These kinds of analysis are usually conducted in financial contexts to evaluate credits within banks. In fact, analysing bankruptcy determinants is very useful to identify the most relevant balance sheet information to judge and classify credits owned by banks. Other models available include the discriminant analysis and the linear probability model.

This work tries to combine existing literature and most common models for bankruptcy analysis to understand if at the outbreak of the pandemic government measures did too little, putting at risk the survival of profitable firms, or did too much, fuelling the threat of zombification.

Therefore, we constructed a rich dataset of 262,509 Italian firms of the retail sector using data from the Aida (Orbis) dataset. This is one of the largest samples among the ones used in bankruptcy analysis in Italy. To investigate the main determinants of firm failures in the years 2016-2020 we use firm level data of 2014-2018. Similarly to what Cros et al. (2021) do in their work, we construct models where the bankruptcy probability is

determined by firm characteristics of the two prior years.
With respect to the information available at the time the French authors conducted their research, our model is able to include a larger amount of failures for 2020, given that data was collected in May 2021, when legal events were all already registered in the Aida systems.
The Covid sectoral shock is measured in our model as the variation in household expenditure between 2019 and 2020. This measure appears to be less endogenous than the turnover shock measured by Cros et al. (2021), who relied on the variation in credit card transactions registered by companies between 2019 and 2020.

This work can be included in the vast literature analyzing bankruptcy determinants and failure dynamics. The methodologies chosen are in fact those typically used in most recent years to investigate the matter. Therefore, we construct both a linear probability model and a logistic regression model, recognized in literature as two very well fitting models in bankruptcy analysis.

This work is also a relevant contribution in the evaluation of public policy measures during Covid-19 and especially for the Italian case. It may also serve as an interesting point to compare policies in France and Italy, given the similar approaches taken in this work and in the one by Cros et al. (2021). In the context of the literature on zombification, the approach taken results to be slightly different from usual techniques to access the zombification level in an economy. However, one of the objectives of this analysis is to access not the level of zombification but its potential risk. In this sense, the aim is to detect the risk of zombification by means of significant changes in bankruptcy dynamics.
For instance, if the sign of a determinant such as bank debt would change from positive to negative, it would indicate that the access to credit (and consequent high firm indebtedness) would actually help a company avoid failure. Combining this result with information on productivity of the company, the issue of zombification may arise relatively easily. This of course would be a very exceptional result, but the underlying logic is quite similar. If usual determinants lose significance or change sign, it is a wake-up call for possible zombification and for further investigations on the matter.

The first chapter of this thesis is dedicated to a detailed discussion of the literature on firm zombification, in order to better understand to what extent this may be a threat for

economies, and which was the role of government decisions in fuelling it in previous crises. In the same chapter an overview of the Italian economy and of zombification in Italy is included.

The second chapter discusses the main government interventions put in place in Italy to face the pandemic. A specific paragraph is dedicated to supports directed toward the retail and tourism sectors, which are the main focus of this analysis.

The third chapter then presents data, the descriptive statistics and the main results from the linear probability models and the logistic regressions.

Conclusions are presented in the last chapter and try to summarize the main and most important results of this analysis, presenting limits and possible future research.

1. The Zombie Menace in Italy

1.1 Zombification

1.1.1 Zombie firms

Corporate zombification is an issue that gained a lot of interest in the past few decades, from its relevance in the Japanese banking crisis in 1990s to the current pandemic emergency. The process usually refers to the maintenance of highly indebted, unproductive businesses in the market through supports such as bank loans or even public subsidies. If this phenomenon is present in a market, it limits the "creative destruction" identified by Schumpeter in his work. The economist theorized that corporate success relies on innovation capacity, so that when a firm becomes obsolete, it would naturally exit the market in favour of more innovative ones (Schumpeter, 1942). In light of these considerations, any source of artificial support may keep alive firms that in other circumstances would be destined to bankruptcies or failure. In such case, the normal competitive process is altered and the whole system is penalized: "zombie" firms slow down innovation resulting in an overall lower level of efficiency and in many cases they may crowd out growth of more productive firms (Banerjee et al., 2018).

The definition of "zombie" firm is not sharp but depends on the different aspects considered. For example, in their analysis of firm zombification in Japan, Caballero et al. (2008) refer to zombie firms as companies that benefit from specific favourable financing terms, but at the same time are extremely fragile. In particular, the scholars identified zombie firms focusing only on their assessment to subsidized credit.

More recent studies, instead, try to analyse the issue of firm zombification identifying zombie firms through specific operating characteristics. Adalet McGowan et al. (2017a) propose some key aspects for zombie firm identification relying on persistency of financial weakness. After considering the use of negative profits and negative value added, they classify zombie firms with the interest coverage ratio, defined as the ratio between operating income and interest expenses. In particular, a company was labelled as "zombie" if it was aged 10 years or older and had an interest coverage ratio less than one for three consecutive years. Rodano and Sette (2019) try to investigate the validity of such classification, focusing on the choice of operating profits before or after amortization

and depreciation. More recent studies propose zombie companies classification based on persistent lack of profitability and low stock market valuation (Banerjee, 2020).

Even if the definition of zombie firms is not unambiguous, some key aspects are generally considered: firm operating characteristics, age and access to credit or public support.

Even though there is a debate on the choice of the most relevant firm operating characteristics for zombie classification, they are fundamental in identification of internal states of weakness. The measures that are usually considered more indicative come from firm financial statements and financial ratios. Some authors use negative equity (Mohrman and Stuerke, 2014) as a measure of firm zombification; other authors rely on profits and their comparison with interest subsidy, identifying zombies as firms with profits being smaller than the interest subsidy (Fukuda and Nakamura, 2011); also indebtedness is a fundamental aspect used, with authors like Hoshi (2006) focusing on total debt over assets ratio and labelling zombie firms as those making very low interest payments considering their debt levels.

Age is also a fundamental aspect because of the dynamics assumed in the life cycle of a company. In fact, newly established firms are usually assumed to be low profitable with growth potential higher than older companies. The issue then concerns how to avoid "zombie" classification of young start-ups likely profitable in the future. Some studies such as the one by Adalet McGowan et al. (2017a) choose to simply apply age restrictions, while others such as the one by Banerjee (2020) rely on potential future profitability as perceived by markets.

Access to credit and public support is the last fundamental aspect considered in "zombie" firm classification, but is exactly what keeps a zombie firm alive. Operating characteristics give the "interior" weakness of the company, but it is the access to external support that keeps it operative, with all the possible related issues. Therefore policy choices are key determinants of zombification, but they are not easy to be evaluated. In periods of crisis policy makers face a trade-off between letting companies fail and dealing with the issues linked to firm zombification caused by public support.

1.1.2 Live and let die

Bankruptcies and firm failures are a consequence of indebtedness and firm insolvency. Intuitively, when a company is unable to repay its debts, creditors can rely on legal remedies for debt collection. Every country has its own insolvency regime, created to deal with these situations and guarantee creditors' rights.

In Italy, bankruptcies are regulated through a specific legislation, the "Regio Decreto n°267" (March 16, 1942), which has been integrated and modified during the course of time with the recent drafting of the "Codice della crisi di impresa e dell'insolvenza" (contained in the D.L. n. 14/2019). It disciplines bankruptcies defining companies subject to them, conditions for bankruptcy filing and different possible states of a company. The discipline usually aims at satisfying creditors in terms of debt repayments but also tries to preserve the company existence and operativeness. The reason for this choice lies in the consequences of firm failure. From a Schumpeterian point of view, as we have seen, firm bankruptcies are potentially positive in an economy. They may in fact reflect a process of productive entrepreneurship, where outdated structures are disbanded and firm renewal and formation occurs (Schumpeter, 1911). However, this is true as long as one looks at a failure in terms of lack of innovative capacity or of efficiency. In such case, the exit of a company allows other more efficient ones to enter the market, coherently with the principle of creative destruction. However, firm failures, especially of innovative and profitable ones, might be a problem not just for companies, but also for stakeholders and, in the end, the entire society (Carter and Auken, 2006).

The first stakeholders involved in firm bankruptcies are trivially creditors. In particular, the issue mainly refers to bank credits and solvency of them. When a company enters the bankruptcy phase, assets are liquidated in order to repay creditors. However, the complexities linked to firm conditions and actual assets available for repayment are a fundamental determinant for the so called "Non performing exposure" defined for security of the banking system. In particular, the risk of a bankrupt company to be unable to repay its debts is concrete and is evaluated by banks granting credits. If a company goes bankrupt and is unable to repay its debts, the shock may therefore affect the banking system. Even if this issue has been partially relieved with the Basel III accords, which secure with particular requirements the impact of insolvencies for the banking system, the

issue of insolvency may still impact third parties and other types of private creditors.

A second fundamental issue concerns firm relevance and supply chain exposure. The structure of supply chains is based on relations: companies rely on suppliers for supply of intermediate goods or other services. When a company goes bankrupt and stops its activity, suppliers lose a source of work and the same holds true the other way: if a company loses a supplier, they have to find another one in the market. If this happens at a general level, it may lead to a sectoral crisis (Yang et al., 2015).

Another relevant issue regards employment costs. The activity closure of a company in fact leads employees to a state of unemployment. Some scholars have investigated this issue trying to quantify human costs of bankruptcy. In particular, the work by Graham et al. (2015b) analyses U.S. data to understand the dynamics of employment after a bankruptcy filing by employers of a company. Their result sustains the importance of this issue: after a bankruptcy filing, annual wages deteriorate by nearly 10% and such fall stays persistent after at least six years. Bankruptcies can therefore harm an economy not only through unemployment but also through persistent wage drops. This leads to consumption consequences. Despite systems of unemployment insurance, consumers expenditure decreases with unemployment, given also that spending is highly sensitive to income (Ganong et al., 2015; 2019). Persistent lower wages then cause decreases in income and potentially harm consumption and savings behaviours in the longer run (Saporta-Eksten, 2014). Furthermore, Graham et al. (2015a) also show that when the bankruptcy is filed by the employers, employees not only leave the firm, but often also change industry and local labour market.

The failure of a company also comes with production falls and resource reallocations that may influence macroeconomic variables such as TFP and GDP. Analyses by Neira (2019) investigate the issue of relevance of bankruptcy regimes for cross-country productivity differences. The author measured the goodness of bankruptcy regimes with the amount recoverable by the lender from a bankrupt borrower. Results show that to better bankruptcy regimes correspond better performances in terms of TFP. Intuitively, looking at the productivity of companies as part of the total factor productivity the result does not surprise much. The more companies go bankrupt in an inefficient way, so that resources are not reallocated because the credit recoverable is deteriorated, the more this impacts

the overall productivity (interpreted ultimately as TFP). However, it is important to point out that the persistence of such effects is not certainly determined. Fluctuations of TFP are linked to many other possible aspects such as financial frictions, recessions and business cycles (Chen et al., 2013). These may occur, as one may expect, at the time of bankruptcy.

In light of all the above considerations, it is possible to notice that insolvency regimes and public policies in times of crisis play a fundamental role in determining the aliveness of a company.

From what was discussed above, it may appear that letting firms die would cause more damage than benefits, but it is not necessarily the case. Even keeping firms alive at all costs may be a problem because aliveness of unprofitable firms, as we will see, may create "zombies", which harm an economy in many ways.

The effects of firm zombification have been discussed and analysed by many authors in the literature. The first works focus on the Japanese banking crisis and economic stagnation in the early 90s (Caballero et al., 2008), while later works try to analyse the phenomenon during other financial crises such as the 2008 financial crisis and the 2012 sovereign debt crisis (Acharya et al., 2019; Schivardi et al., 2017).

Empirical evidence from the work of Caballero et al. (2008) shows that zombie firms create relevant market distortions. Focusing on the issue of creative destruction, the scholars investigate the effects of zombification on job dynamics. Results show that the presence of zombie firms not only slows job destruction, but also depresses job creation. Similarly, Adalet McGowan et al. (2017a) find that zombie firms slow down employment growth, given that the high presence of this type of companies in the economy discourages non-zombie firms to grow, also in terms of hirings.

Productivity distortions are another issue investigated. Results from Caballero et al.'s model show that the presence of firm zombification lowers industry's average productivity from two points of view: on one hand, zombie firms continuing to operate directly impact productivity by being less productive than other companies, on the other hand, they indirectly impact production by deterring entry of more productive firms. This

issue is fundamental and alarming given that its consequences are believed to have an impact in the long run, with "longer-lived aggregate affects" (Caballero et al., 2008).

Investment distortions and crowding out constitute another issue of zombie firm presence. In the comparison with other healthy firms, empirical results from Caballero et al. (2008) show that zombie firms crowd out investment to other healthy firms, which would have registered higher investment growth with less zombies in the market. This abundance of zombie firms is defined as congestion and its effects are quite disruptive in terms of economic performance. As Adalet McGowan et al. (2017a) pointed out, zombie congestion may explain the rising of entry barriers and productivity dispersion registered in the last few decades. In particular, the authors claim that the higher the number of zombie firms existing in the market, the more difficult it is for new companies to enter. The most harmed companies are usually young and productive. In fact, congestion forces young firm to face higher productivity threshold and at the same time it limits upscaling at market entry.

Congestion effects also refer to the lock of resources in zombie firms. This leads to crowding out of growth and resources, given the high capital stock sunk in zombie firms (Banerjee et al., 2018). In fact, it has been showed that in a specific industry an increase in the capital stock sunk in zombie firms is associated with a decline in the ability of more productive firms to attract capital (Adalet McGowan et al., 2017a).

Another key concern about zombification is its possible persistence. Fukuda and Nakamura (2011) first access this issue introducing a "profitability criterion", used by the authors in order to control for possible recovery of zombie firms. This criterion was used to exclude firms with earnings before interest and taxes (EBIT) exceeding what was identified as the hypothetical risk-free interest payments from the sample of zombie firms. The authors considered this as a sign of recovery and used it to avoid classifying healthy recovering firms as zombies. However, their investigation did not focus specifically on zombie recovery. Later analyses by Hallak et al. (2018), instead, examine the behaviour of zombie firms over time, trying to understand the possibility that a firm classified as zombie would result healthy again in the following years. To do so, the authors define a "successful" zombie firm as one classified as zombie firm (in 2010 or 2013) but reporting a coverage ratio above one in the following two years. This measure captures the recovery of a company since it translates into making profits again after a period without. Using

different zombie firms definitions, results suggest that zombies rarely turn healthy again in the short run. On the contrary, most of them (almost 90%) remain zombies or exit the market in the two years following the zombie labelling. Other more recent studies analyse the same matter (Banerjee, 2021), coming to a quite different conclusion from a long run perspective. Looking at a sample of firms from mid 1980s, distinguishing between recovered, dead and active firms, the author finds that the majority of zombies recover. In particular, about 60% of the sample of 12.727 zombies recover, while a quarter dies and a stable amount remains active over time. Even if this result appears comforting in terms of the economic threat of zombification, the author points out that there is a considerable risk for recovered zombies to relapse into the zombie state. In particular, the probability for a recovered zombie to become a zombie again in the next period was of about 17% in 2017.

In conclusion, concerns around zombie firms are many and of great relevance. Overall, zombification may not only influence other firms' performance but also hold back the whole potential growth of a country (Caballero et al., 2008).

The fear of zombification usually arises during periods of particular crisis, where policies intervene in the market. Such policies may impact firm aliveness regardless of their productivity or profitability, creating the concrete threat of a sectoral zombification. Considering that the aim of this work is to understand possible distortive effects on the dynamics of bankruptcies created by public support during the pandemic crisis, it is useful to check during which crises zombification became an issue, what were the causes identified and which are the differences between this crisis and previous ones.

1.1.3 Zombification before Covid-19

As anticipated in previous paragraphs, the discussion on zombie firms first arose from the Japanese banking crisis of the 90s. During the 80s Japan was living a period of exceptional growth, with low unemployment rates and high standards of living. The origins of the crisis are complex, but many scholars believe that the start of it was the drafting of the Plaza Accord, an agreement intervening on currency markets to depreciate the dollar with respect to some of the major currencies at that time: the German mark, the French franc, the British sterling and the Japanese yen (Funabashi, 2018; Shen, 2016).

After the agreement, given the difference between the dollar and the yen, to avoid the risk of a crisis for Japanese exports, the Japanese government and central bank tried to boost domestic demand and chose an expansive monetary policy. This led to an over-lending to firms and families and real estate assets started to rise steeply, leading to a real estate bubble. Savings from Japanese households were then directed to the asset market, further fuelling the bubble. In addition, the period was also characterized by overconfidence and speculation on asset and stock markets, incentivized by the expansive monetary policy. All these characteristics slowly fostered the bubble, which finally burst in 1992.

When the stock crashed, banks were hit by equity and asset prices fall. To bail them out the Japanese government adopted capital infusions while the central bank introduced loans and cheap credit. This choice then led to a zombification of banks and, as Ken Okamura stated, "zombie banks make zombie firms" (Okamura, 2011).

In particular, most scholars identify the main cause of zombification during this period, called "Lost Decade", in misdirected lending by Japanese banks (Caballero et al., 2008). In fact, sustained by the government and the central bank, Japanese banks started to "evergreen" loans to insolvent firms and in the end support unprofitable zombie firms. Some scholars believed that this practice caused the stagnation levels of the following periods, limiting recovering (Schuman, 2008).

The origin of the crisis is therefore mainly financial, with a policy reaction which was insufficient in monetary terms. The Japanese government chose to keep insolvent banks alive and this lack of recapitalization led the country to a deflationary trap which is still in place, where zombie banks have huge NPL (non-performing loans) in their books due to the support to zombie firms.

The issue of firm zombification later regained popularity with respect to policy interventions during the 2008 financial crisis and the following European sovereign debt crisis. To understand in which terms these crises caused worries for the rise of zombies, it is important to first overview them.

The Global financial crisis originated in the US from a housing bubble which catalysed the financial crisis. After a positive period with increasing housing prices, in 2007 they started to drop and the problem of subprime mortgages emerged. These were financial instruments intricately repacked to be sold to other banks and investors. The result was that many banks owning such mortgages could not correctly estimate their value. In this way, the crisis passed to the banking system as banks were no longer willing to lend money to other banks, given the impossibility to evaluate quality of assets owned in their books.

As prices of assets dropped, with the housing crisis still in place, consumers in the US dropped their spending and consumption. This impacted, understandably, the production system and firms cut investments, given the fear of a long lasting crisis.
The crisis then spread globally through two channels characterizing the Us economy. First, international trade linkages between the US and the rest of the world spread the crisis to other countries, since the shock on US demand translated to a shock to imports from other countries. Secondly, the behaviour of American banks further weakened the stability of the world financial system. In particular, banks in the US started repatriating funds allocated abroad, creating relevant issues for banks in foreign countries.

When the crisis finally spread to Europe, it contributed to feelings of uncertainty which later led to the European sovereign debt crisis. In particular, public interventions were used to save European credit institutions weakened by the subprime crisis, but such government spending created high imbalances in national accounts which, in terms of investors' trust, were already fragile due to pre-existing structural problems within the European Union. In particular, many scholars believe that the imbalance between a unique monetary policy and national fiscal regimes created free riding opportunities, which were exploited by countries such as Greece (Anand et al., 2012). There was a dichotomy within the Union: "core" countries, such as Germany, had contained levels of public debt and a more solid economy, while "periphery" countries, called PIIGS (Portugal, Ireland, Italy, Greece, Spain) were characterized by high levels of public indebtedness, uncontrolled increase in deficit, low GDP growth rates and higher exposure due to bailing out of banks during the subprime crisis.

In the end, in 2009 the sovereign debt crisis exploded with the exposure of the disruption

in Greece's national accounts and spread later to other periphery countries.
The consequences were serious: investors' trust in bank solvency dropped and rating agencies started downgrading the creditworthiness of European countries. The crisis then passed to the real economy by means of lending contraction, with a significant decrease in firm lending. The real economy was strongly impacted, affecting firm employment growth, investments and sales growth (Acharya et al, 2018; 2019).

The situation called for a prompt and extraordinary policy intervention aimed at restoring the banking system but which later created suspects of firm zombification. In 2012, the ECB's president Mario Draghi assured investors that the European Central Bank was willing to do "whatever it takes" to preserve the Euro. To do so, the Outright Monetary Transactions (OMT) program was launched in order to significantly increase the value of sovereign bonds issued by countries at the European periphery.

The program consisted in allowing the European Central Bank to buy a theoretically unlimited amount of countries' government bonds in secondary markets. The announcement aimed at restoring trust and lowering spreads of sovereign bonds of weaker European countries. Many studies prove that this objective was reached, both in these terms and in terms of stabilization of the banking system (Krishnamurthy et al., 2018). However, as the ECB president himself commented in 2014, "[…] the positive developments in the financial sphere have not transferred fully into the economic sphere." (Draghi, 2014).

This notice rose interest in the matter and some scholars decided to investigate possible origins of this phenomenon (Gopinath et al., 2017; Schivardi et al., 2017; Acharya et al., 2019). Acharya et al. (2019), in particular, focus on the possibility that credit misallocation and firm zombification slowed the recovery in the real economy. Focusing on bank-firms relationship data, the authors find that indeed banks increased their loan supply, but it was mostly targeted to low-quality firms having pre-existing relationships with these banks. For this reason, employment and investment were not proportionally positively influenced: the zombie firms sustained by zombie lending mainly in the form of "evergreening" used the received funds just as cash reserve. In addition, the scholars showed that healthy firms suffered the presence of zombie firms in the industry, coherently with previous literature on zombification.

The authors point out that the OMT program announcement unintentionally created zombie lending incentives in banks not sufficiently recapitalized. In fact, these banks avoided losses on outstanding loans by continuing lending to impaired borrowers in order to avoid regulatory consequences and market pressure.

Zombification usually occurred in contexts of financial crises where monetary or government policy choices unintentionally incentivized credit misallocation and zombie lending. Moments of crisis requiring unconventional and extraordinary policy choices appear to be determinant for the rising of possible zombification threats. This applies also to the current pandemic crisis, even if its nature differs from preceding ones.

Previous crises arising worry for zombification are mainly financial, and later spread to the real economy. On the contrary, the Covid-19 economic crisis originated from an external shock, a pandemic, and later it impacted the real economy.

In these types of crises the primary objectives of policy choices are different. The aim of policies during financial crises were to save the existing financial and economic systems, to adjust the consequences of the bubbles and limit the impact on the real economy. In the case of a pandemic, even if in different terms by different countries, the aim is to control the spread of the virus, to avoid human capital losses and overload for the health system, all while trying to limit as much as possible the economic consequences and the threat of further recessions. However, fear of zombification arose for similar reasons, still linked to policy choices mainly of central country governments.

1.1.4 Zombification with Covid-19

The Covid-19 pandemic was an unexpected health emergency where a deadly virus spread uncontrollably from China to other countries in the world. Despite similar historical examples in the last decades (such as the SARS outbreak in 2003), no other recent epidemic affected so much the world and the economy.

Governments followed general indications by the World Health Organization[4], but the response was far from coordinated at a supranational level (Balmford et al., 2020). The stringency of containment measures varied across countries, based on policy choices and measured infection rates. For example, the stringency index, a measure developed based on policy response indicators such as workplace and school closures, travel bans and restrictions on internal movements, varied considerably between Italy and Sweden for all the duration of the pandemic until the present day, with Italian policies being stricter than Swedish ones (see Figure 1).

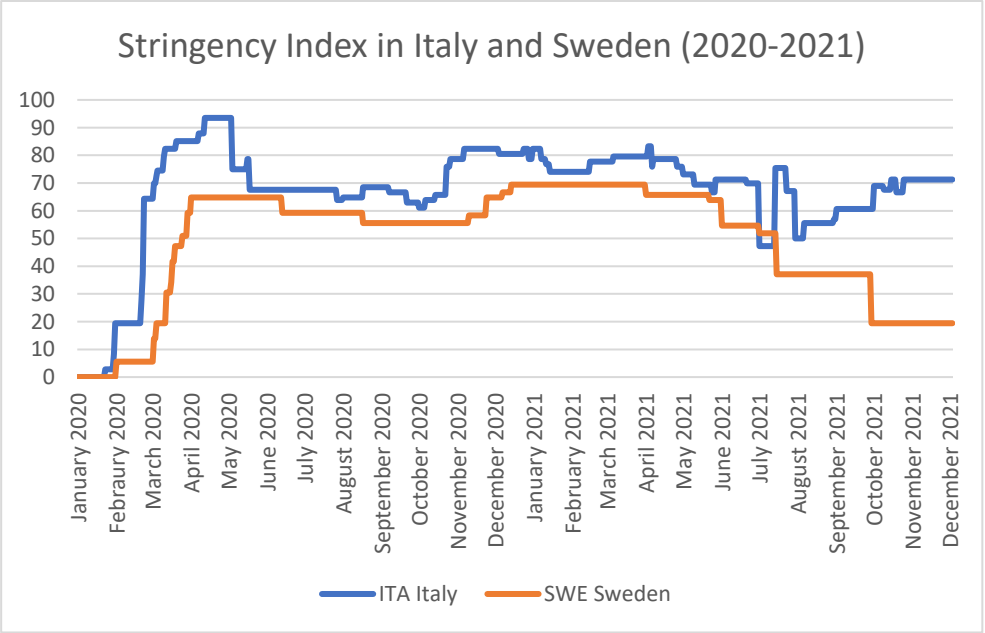


Figure 1: Stringency index in Italy and Sweden, comparison from January 1st 2020 to December 1st 2021; Data source: Hale, Thomas, Sam Webster, Anna Petherick, Toby Phillips, and Beatriz Kira (2020). Oxford COVID-19 Government Response Tracker, Blavatnik School of Government. Data use policy: Creative Commons Attribution CC BY standard.

Despite cross-country differences in policy choices, the main measures first put in place where the following: social distancing, school and workplace closures, stay-at home orders, event gatherings prohibitions and travel restrictions[5]. These choices immediately impacted a wide range of activities and, overall, the issue of possible recessionary consequences of such shock immediately arose (Horowitz, 2020; Elliott, 2020; El-Erian,

[4] Policy and general recommendations by WHO are available at: https://www.who.int/emergencies/diseases/novel-coronavirus-2019 (visited in November 2021)
[5] For a general indication of level and types of government measures, refer to the Covid-19 Government response tracker, available at: https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker (visited in November 2021)

2020). Some even believed that the recession resulting from the pandemic outbreak would be at least as bad as the Global Financial Crisis (Georgieva, 2020).

The economic disruption created by the Covid-19 pandemic was destined to have spill over implications in the economy because it created demand and supply shocks in various areas of human activity (El-Erian, 2020). First assessments to consumer behaviour highlighted an overall pessimism on the economic recovery and a tendency to choose savings behaviours in light of possible worsening of the situation (Catena et al., 2020). In hindsight, later analyses confirmed that the increase in savings reflected lower consumption and that a large part of them was held in liquid assets (Dossche et al., 2021).

In addition, fears that the pandemic itself and containment measures would impact the potential output rose quickly. Some simulations and interpretations tried to understand the issue, coming to the conclusion that both supply and demand dropped after the Covid-19 shock (Bodnár et al., 2020). The identified channels of impact on potential output were many. First of all, supply chain disruption was a concrete problem, given the strict containment measures in China, "the factory of the world" (Blanchard et al., 2020). Firms were believed to need new suppliers, identifying also new locations for production and travel routes. Furthermore, there was the concrete risk that the costs of new projects for firms would rise uncontrollably due to the financial distress caused by the crisis. In addition, a possible increase in corporate default rates was strongly feared also because of its possible consequences in terms of job disruption and productivity losses (Bodnár et al., 2020).
Conscious of these risks and depending on the level of stringency and on the estimated impact of containment measures on the economy, governments tried to avoid disruptive consequences and, above all, to preserve the productivity and economic sectors.

It was fundamental to be able to save activities from the shock: reductions in wage bills through short time work schemes were introduced in Europe in addition to direct transfers to firms in paying some fixed costs and incentives to bank lending to companies. The aim was to "freeze the economy during the crisis and put firms most at risk in hibernation" (Cros et al., 2021).
Even if the choice was theoretically and logically correct considering possible disruptive effects of extreme bankruptcies, it was difficult to determine which was the right amount

of support to avoid distortions in the market. Therefore the question rises spontaneously: did governments do too much or too little?

First assessments both at the European and national level find different answers. At first, some insights by the French bank Natixis, issued in the Financial Times, were quite alarming. Their analyses estimated a proportion of zombie companies on the rise, from 3.5% in the 1990s to nearly 11% in 2008 and 21% in 2019[6]. Therefore, public interventions were likely to worsen an already difficult situation.

Also other newspapers tried to give first insights on the matter. The Economist, for example, pointed out how Covid-19 would rise difficulties in killing off zombie firms, given the new unintended aids for them to keep being alive: easier access to credit and government support to freeze the economy (The Economist, 2020).

Analyses conducted by official authorities came to different less worrying conclusions. At the end of 2020 the European Central Bank published an article considering the issue of creation of zombie firms linked to pandemic relief measures. The analysis coherently focused on the lending matter, considering possible threats of misallocated credits for the overall economic situation and for the rise of firm zombification. The conclusions were positive but not absolute: the aim and the expected effect of relief measures was "vital help to the economy, not life support for zombies" (ECB, 2020). There was a general confidence that the risk management rules for bank lending posed by the ECB would avoid the increase in zombie firms, but the risk was not cleared.

For this reason, later analyses of the issue were conducted and published in May 2021 in the Financial Stability Review (Helmersson et al., 2021). The authors investigated corporate zombification conditions in Europe, further evaluating how concrete the risk of distortive effects of Covid-19 policies for firm aliveness was.

Results show that the risk of zombie support is concrete, but is not a huge threat. As the many possible zombie identification strategies proved, in policy response there was a general difficulty in determining which companies were valuable, so worthy of support,

[6] Data from Natixis' Universal Registration Document and Annual Financial Report, available at: https://www.natixis.com/upload/docs/application/pdf/2021-06/natixis_2020_urd_en.pdf

and which not. However, the authors point out that the policy response to the pandemic quite likely supported zombie firms but in the short term it also gave support to aggregate demand. This limited unemployment shocks and spillovers from insolvency.

Despite this, the issue is far from negligible. The ECB analysts point out that in the medium run threats are still present. In fact, zombie firms may access relatively cheap funding, exposing banks, sovereigns and investors.

Other analyses at the national level come to similar conclusions. In particular, the paper by Cros et al (2021) focuses on the French case, trying to understand if the measures put in place to face the Covid-19 crisis created distortions in the process of firm failure and bankruptcies filings in France. The analysis is interesting because it accesses zombification in a somehow unusual way. While other investigations try to choose and focus on zombie identification strategies, in this case the approach is accessing zombification in a deductive way. The zombification framework is not checked on a firm-level identification basis, posing logical but arbitrary conditions. On the contrary, it is accessed by looking at the bankruptcy system dynamics prior and posterior to the shock. Before Covid-19 the mechanism of firm bankruptcies is considered somehow the norm. The determinants for bankruptcy filing depend on firm characteristics that are chosen in a logical way, similarly to what would be done to "identify" zombie firms. In particular, the authors first choose labour productivity and then some measures of indebtedness: total debt over assets, bank debt over assets, supplier debt payable over assets, other debts over assets. In addition, age was considered as a possible determinant as well as the log of the number of employees. However, with the Covid-19 shock public supports may lead to different outcomes that may harm aggregate productivity from a Schumpeterian point of view. First, supports may protect low productivity firms, leading to the risk of firm zombification; second, high productivity firms may not be protected enough, and this would distort creative destruction.

To investigate this issue, the authors focused on the retail sector and developed a logit model measuring the shock by means of changes in the credit card transactions registered by the different companies. Then they checked the determinants of bankruptcy during time, constructing a dataset of nearly 400,000 companies. Logit results were interpreted in the light of bankruptcy distortion effects, which were associated to distortions in the

creative destruction dynamics.

If the Covid-19 shock was so disruptive that it negatively distorted the bankruptcy system, then it would become the main significant determinant of bankruptcies in 2020 and, in addition, it would significantly change the impact (coefficients) of other determinants. Giving a policy interpretation, this would mean that policy remedies were insufficient to avoid firm failures. Unintentionally, the government let companies die.

On the other hand, the failure system may be unaffected by the shock in terms of bankruptcy dynamics. This doesn't mean that the shock would be insignificant, just that adding the Covid-19 shock to the model for the 2020 bankruptcies would not significantly change the impact of other determinants.

The results of this first analysis for the French economy were reassuring. The bankruptcy dynamics appeared to be almost unchanged by the Covid-19 shock with the creative destruction mechanism only hibernated and not distorted. The authors' conclusion from a policy point of view seems comforting: policy remedies correctly supported the economy without distorting the market.

Looking at these results from a country closed to Italy, it may be natural to wish to investigate the issue also at the Italian national level. The economic characteristics of Italy differ from the French ones. In addition, policy choices during Covid-19 were different, as were insolvency regimes and pre-existing zombification conditions. For this reason, it is useful to have an outlook at the Italian case.

1.2 Italy

1.2.1 Economic structure

The Italian economy is one of the main European economies, with a nominal GDP of 1,790.942 billion euros in 2019 and a GDP per capita of 29,671.230 euros[7]. Its performances make it the eighth country in the world for GDP performance and the fourth in Europe, after Germany, UK and France.

The economy is oriented to international trade, being the tenth country by exports of goods and services, with exports accounting for 31.5% of the GDP[8].

In 2019 the sectoral composition of GDP in percentage showed a predominance of the service sector, which accounted for 66.3% of output in terms of value added. Manufacturing and industry accounted for almost 36% of total GDP, while agriculture for around 2%.

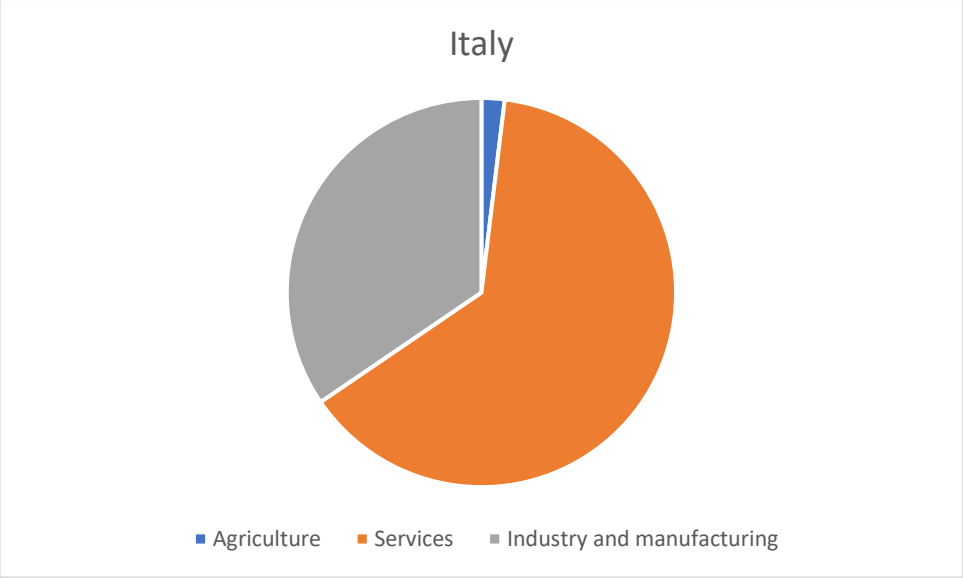


Figure 2: Structure of output in Italy; suddivision by Agriculture, Services, Industry and manufacturing sectors. Data source: World Development Indicators: Structure of output http://wdi.worldbank.org/table/4.2#

The primary sector is characterized by a great amount of family-operated farms, with land covering 12.7 million hectares, mainly located in Southern Italy (Istat, 2010). The

[7] Data on GDP from IMF, https://www.imf.org/en/Data (visited in November 2021)
[8] Data from World Bank, available at: data.worldbank.org (visited in November 2021)

relevance of the primary sector is limited in our investigation, but it is useful to keep in mind its importance. As per the 6th Istat Agriculture Census (2010), the overall value of agriculture production accounted for around 50 billion euros (Istat, 2014).

A key aspect that drives the relevance of the sector is the so called "made in Italy", considered the third most known brand worldwide[9]. The importance of the Italian reputation for what concerns agricultural and food products is a key driver in the sustainment of the whole sector, so that many agricultural products have quality assurance labels.

The "brand" recognition of Italian product quality also applies to other sectors, such as the secondary one. The secondary sector is characterized by a large number of small and medium-sized enterprises, with fewer number of large sized companies. SME (PMI in Italian) usually cluster in particular areas of the Italian territory, called *distretti industriali*, recognized and protected by the Italian government in a number of around 150 districts (Istat, 2015). These companies usually focus their production on leather, textile, clothing, chemical and heavy industries. In 2016, microbusinesses constituted 95.2% of active enterprises, employing 46.1% of overall workers. SMEs, instead, were 204 thousand, employing 33.2% of workers.

The amount of big enterprises is more limited: in 2016 they were 3.601. However, their relevance in the market is considerable, given that they employ 20.7% of workers (Istat, 2019). Bigger companies usually operate in the construction sector, with examples such as Salini Impregilo and Astaldi. Other industries of specialization include the motor sector, with famous productors such as Fiat, and the navy construction sector, with examples like Fincantieri. Also the luxury sector, recognized worldwide, includes bigger companies. Some examples are Luxottica, Safilo for the eyewear and Gucci, Prada for the fashion industry.

The tertiary sector is the one of main interests for this analysis. It usually includes all economic activities excluded from the first two sectors and refers to services. In Italy, the

[9] As by analyses by KPMG, results reported at: https://st.ilsole24ore.com/art/commenti-e-idee/2014-08-27/se-made-italy-fosse-brand-sarebbe-terzo-mondo-063909.shtml?uuid=ABdARknB

number of tertiary activities constituted 65.6% of the total in 2010, reaching a quota of 70.2% in 2018. The share of workers employed in the sector reached 64% in 2018, 5 percentage points more than in 2011 (Istat, 2020a). The activities included are both private and public. Among mostly public ones some mentions are healthcare, public health and education. Among private ones, instead, fundamental activities include telecommunications, mass media, IT, financial services such as banking and insurance, tourism and retail. The two latter are the main focus of our investigation.

Tourism is one of the main drivers of the Italian economy, accounting itself for around 5% of the country GDP and employing almost 6% of workers (Petrelli, 2018).
In 2018, Italy was the third most visited country in the world, with 94 million yearly visiting tourists, of which the majority were foreign (ONT, 2018). In addition, the country is the first by number of facilities and second only to France for number of beds (Petrelli, 2018).

The facilities present at a territorial level are usually family conducted and the relevance of chain hotels is almost nil. In particular, three-quarters of the overall value added in the industry are produced by micro and small businesses (Petrelli, 2018).

The sector is therefore very important for the Italian economic performance and we analyze it within a general focus on the retail sector, which is specialized in selling of goods and services directly to final consumers. Retail is usually divided among three major sectors by type of goods sold. The food sector includes all items necessary for nutrition and retailers operating in this branch usually own refrigeration facilities to store food and beverages. The sector of consumer durables includes appliances, furniture, dishes and other goods that are subject to slow deterioration. The third kind of goods are consumer goods, which include clothing and other goods subject to rapid deterioration.

Classifications exist also for the kind of channel through which retailers connect to the consumer. In particular, distributions may be in large scale, characterized by large spaces where a wide variety of products is sold. Business structures may differ, but there is usually a parent company managing other branches distributed in the territory in a direct way. Four types of shops are usually included in this category: food retail stores, supermarkets, hypermarkets and discounts.

There are also smaller firms which operate in smaller areas and are usually associated with local commerce, within a city or an urban center.

A third particular category is e-commerce: retail activities selling products on the Internet. There is usually no physical space where the retailer meets the consumer, but the exchange between product and monetary remuneration happens on digital platforms.

Before the outbreak of Covid-19, the retail sector in Italy was registering increases in the value of sales, within a general growing trend (see Figure 3). In particular, in 2019 the value of retail sales grew by 0.8% overall, even if growth dynamics were diversified among various distribution channels. While large-scale distribution registered an annual growth of 1.4%, sales of firms operating on small surfaces decreased for the third consecutive year (-0,7%). The e-commerce registered a significant increase by 18,4%, while discount stores registered an increase of 4.5% (Istat, 2020b).

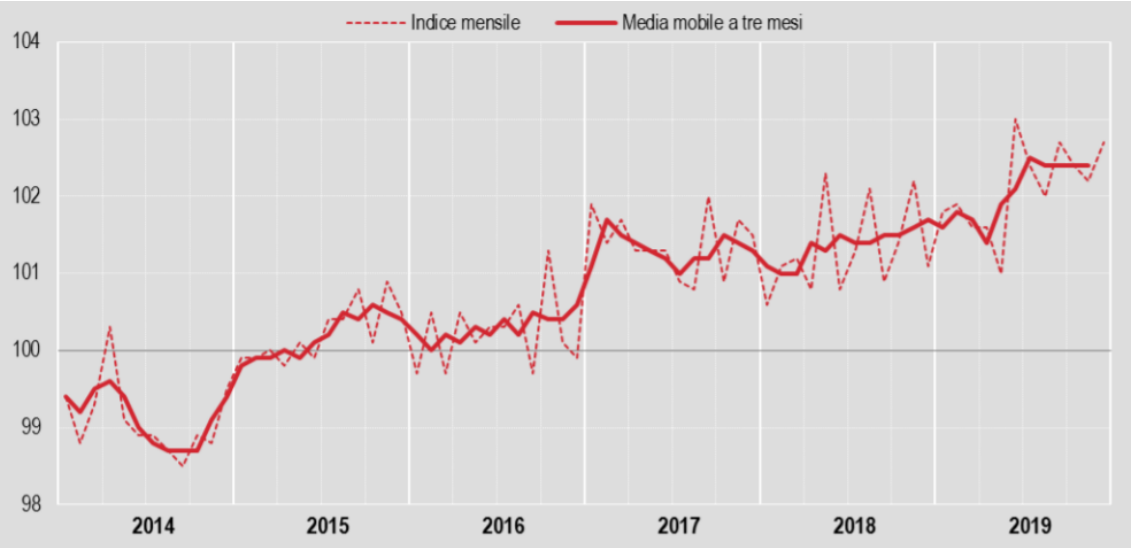


Figure 3: Retail trade, seasonally adjusted index and three-month moving average, January 2014 - December 2019, value data (base 2015=100); Istat, Retail - Commercio al dettaglio (December 2019), published in February 2020, https://www.istat.it/it/files//2020/02/Commercio-al-dettaglio-12-2019.pdf

Despite registering one of the highest GDP performances in Europe, Italy has seen its productivity slowing down in the past decades, following a decreasing trend, as Figure 4 displays.

Figure 4 GDP growth (annual %) in Italy. Data source: World development indicators, GDP growth (annual %), NY.GDP.MKTP.KD.ZG, World Bank

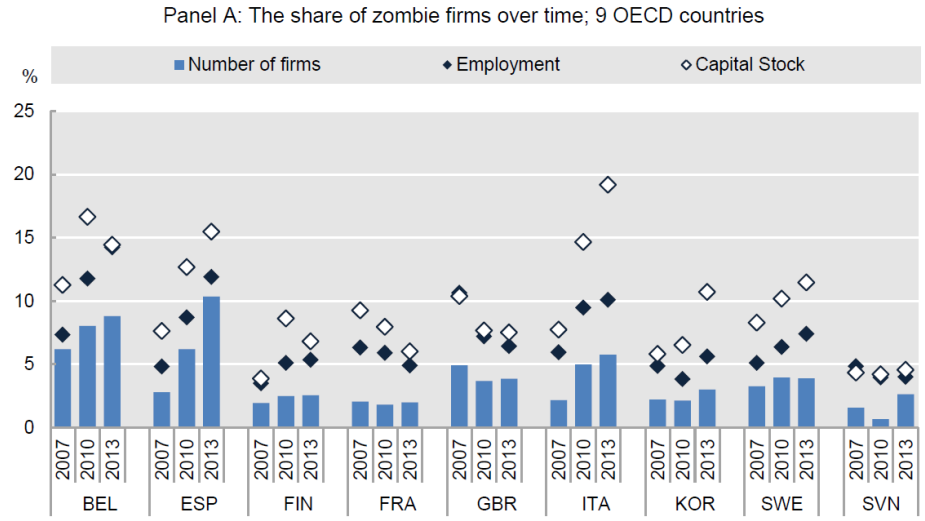
The reasons for this general consistent decrease over time may be different. However, some scholars proposed that one of the issues may concern firm zombification (Fabiani et al., 2016). For this reason and in light of the aim of our investigation, it is useful to check which was the zombies situation in Italy before the outbreak of the pandemic in 2020.

1.2.2 Zombification in Italy before Covid-19

Italy is one of the countries where concerns about zombification have been more relevant over time. As the previous section introduced, the slowdown of the economy and the persistent decrease in GDP growth rise concerns that among the factors trapping the economy firm zombification could be a relevant one.

First assessments to the phenomenon have been conducted by the OECD at a cross-country level. Results for Italy immediately appeared to be considerable in terms of

relevance of zombification in the country. Following Adalet McGowan et al.'s zombie classification, in Italy in 2013 the percentage of zombie firms was 6% of total and the share of employment and capital stock sunk in zombies was of 10% and 19% respectively (Adalet McGowan, 2017a). This is one of the highest results in the sample, as Figure 5 displays.



Note: Firms aged ≥10 years and with an interest coverage ratio<1 over three consecutive years. Capital stock and employment refer to the share of capital and labour sunk in zombie firms. The sample excludes firms that are larger than 100 times the 99th percentile of the size distribution in terms of capital stock or number of employees. Figure A1 shows zombie shares for two additional countries (Greece and Japan), which are not included in the following empirical analysis due to lack of productivity data.

Source: OECD calculations based on ORBIS.

Figure 5 Share of zombies firms over time in 9 OECD countries; elaborations by McGowan, Müge Adalet, Dan Andrews, and Valentine Millot. "The walking dead?: Zombie firms and productivity performance in OECD countries." (2017a).

The analysis by Adalet McGowan et al. (2017a) also points out other interesting aspects about zombification in the country. In fact, there is evidence that after the 2008 financial crisis the prevalence of zombie firms has considerably increased as well as the capital sunk in zombies. This has relevant consequences: if the share of zombies had stayed at the pre-crisis (2007) level, the employment and investment of a non-zombie firm in Italy would have been around 1.7% and 6% higher. The authors also point out that the rise in zombie congestion in the country could account for one quarter of the actual decline in aggregate business investment between 2008-2013.

Some analyses focusing on the Italian case (Rodano and Sette, 2019) notice that these results may be overestimated by the OECD zombie identification strategy. However, the

issue seems to be far from negligible.

More recent analyses by Pelosi, Rodano and Sette (2021) give an interesting outlook of zombie firms in Italy using firm-level data from 2019. In their investigation, the authors conduct an updated analysis on the geographical and sectoral distribution of zombie firms before the pandemic outbreak. Zombies are identified combining different classifications, in order to give a complete insight on the overall Italian situation. In particular, the first measure identifies zombies if their profits are lower than interest expenses for a certain number of years. For this reason, the chosen proxy relies on EBIT and EBITDA: a zombie is a ten year or older firm with EBIT (or EBITDA) lower than interest expenses or negative for at least three consecutive years. The second definition refers to zombie lending and focuses on credit access, but does not rely on operating characteristics, similarly to what Caballero et al. (2008) did in their first work on the matter. In particular, the authors choose a proxy of elaborated construction, based on the Z-score from Cerved, a variable with nine classes where a higher score means a higher probability of default. The authors 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. Then, the researchers take firms in all other Z-scores categories and define a zombie as a firm with a charged rate below the "prime" rate.

The better performing proxy between the two seems to be the first one, so the one relying on operating characteristics. For this reason, the EBIT/EBITDA measure is chosen to analyze other characteristics of zombie distribution.

In particular, for what concerns the geographical distribution of zombie firms, the results display a certain geographical variability, with regions in darker colors as those with the highest share (Figure 6).

It is hard to find any north-south pattern given that the variation across regions is quite high. However, it is an interesting point to take into consideration in the light of the Covid-19 outbreak, given that in Italy policy interventions in terms of mobility limits and activity closures intervened also at the regional level.
In addition, it is peculiar that the share of zombies is similar in very different areas of the country. As the authors themselves point out, Veneto and Campania are two regions with

low zombie firms share but differ for economic performance, sectoral specialization and institutional quality.

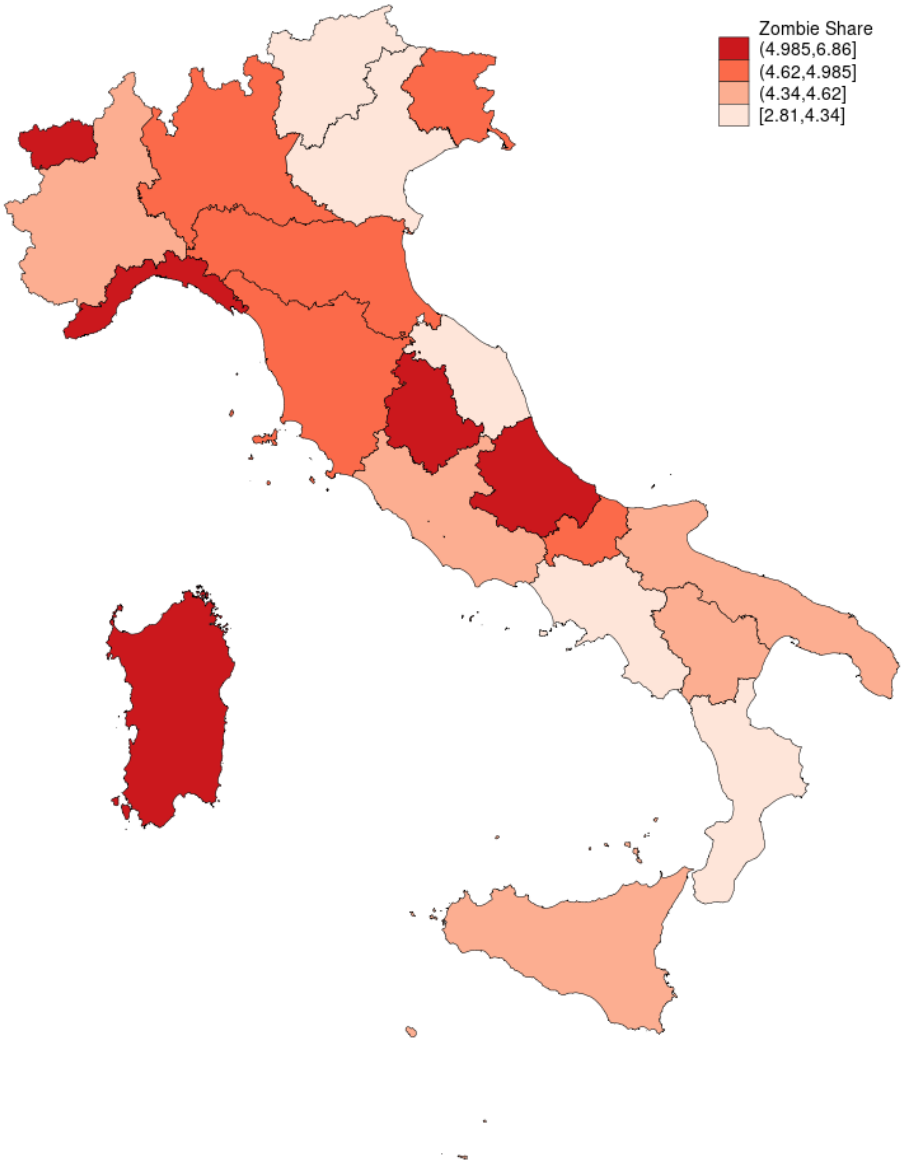


Figure 6: Share of Zombie Firms Across Regions as of 2019 (EBIT-based Measure), data from CERVED (2019); Pelosi, Marco, Giacomo Rodano, and Enrico Sette. *Zombie firms and the take-up of support measures during Covid-19*. No. 650. Bank of Italy, Economic Research and International Relations Area, 2021.

The distribution of zombie firms is also analysed at a sectoral level, with relevant results for our analysis. There is a significant cross-sectoral difference in incidence of zombie firms, with a share ranging from about 2% to 10% in different sectors. The most important aspect emerging from the authors' results is that the sectors most affected by the Covid-19 crisis in terms of drop in revenues already presented a higher share of zombie firms.

In particular, an example is TV and Cinema, with a zombie share between 4.37% and 6.59% and a drop in sales growth in 2020 of 12.53%.

Retail trade, the sector of highest interest for our analysis, registered a share of zombie firms between 2.33% and 3.43%, with a sales drop in 2020 of 1.08%.

Therefore, there is evidence of a significant presence of zombie firms in Italy before the outbreak of Covid-19. This further fuels the worries concerning a possible rise of zombification related to the pandemic crisis and the following government supports. Before presenting public interventions on the matter, it is important to have an insight on the impact of the pandemic on the Italian economy.

1.2.3 Covid-19 in Italy: impact on retail and tourism

Italy was one of the first countries to register cases of Covid-19 and to face the spread of the pandemic and the overload of the national health system. First cases of Covid-19 were registered in Italy at the end of January 2020, as "imported" cases from China. The government immediately isolated the two infected Chinese tourists and checked their linkages, imposing travel restrictions to China and declaring the emergency state. Despite this, the situation was believed to stay contained, as the Prime Minister declared. However, almost a month later, on the 21th of February, cases of infected people who never visited China were registered in Lombardy and later on in Veneto, with the first deaths the following day.

The government reacted trying to contain the spread of the virus with limitations in localized areas where outbreaks where identified after screening controls (D.L. n 6/2020). However, the infection continued to spread and on March 22nd (almost a month later) a national lockdown was declared, which was extended with varying containment measures until May 3rd 2020 (DPCM March 22nd 2020).

The possible economic impact of such a strong measure was immediately considered a matter of fundamental relevance for the Italian economy. In particular, the government measures imposed the closure of some activities, most if they required the interaction between people and which could create excessive gatherings. Many activities belonging

to the primary and secondary sectors were left active, while most of those in the tertiary sector were suspended (DPCM March 22nd 2020, Annex 1). Among all activities, the retail sector was most impacted by the restrictions because they affected the channels where human interactions were necessary. It is the case for example of clothing, hairdressing and other beauty person care activities. Despite possible adjustments to e-commerce solutions, the retail sector was further impacted by the shock in consumer's demand.

In particular, focusing on the goods side of the retail sector and specifically on food, beverages and tobacco, it is possible to observe that the impact of the pandemic and of pandemic measures was considerable. The index of deflated turnover, which shows volume activity of the retail trade sector each month, registered a considerable drop after the first cases of Covid-19 and reached a low peak in April 2020, when the lockdown was consolidated and believed to continue over time.

Figure 7 Index of deflated turnover[10], Retail trade, except of motor vehicles and motorcycles, Seasonally and calendar adjusted data, Index, 2015=100, dataset Eurostat: sts_trtu_m, https://appsso.eurostat.ec.europa.eu/nui/show.do

Differentiating by type of product sold, following the NACE codification, the contraction in the index of retail turnover shows different impacts for the various retail categories. In

[10] Explanation and calculations: https://www.allthatstats.com/

particular, *Retail of textiles, clothing, footwear and leather goods in specialized stores* registered the highest contraction in April 2020, while other retails registered lower drops, with *Dispensing chemist; retail sale of medical and orthopedic goods, cosmetic and toilet articles in specialized stores* registering the lowest fall.

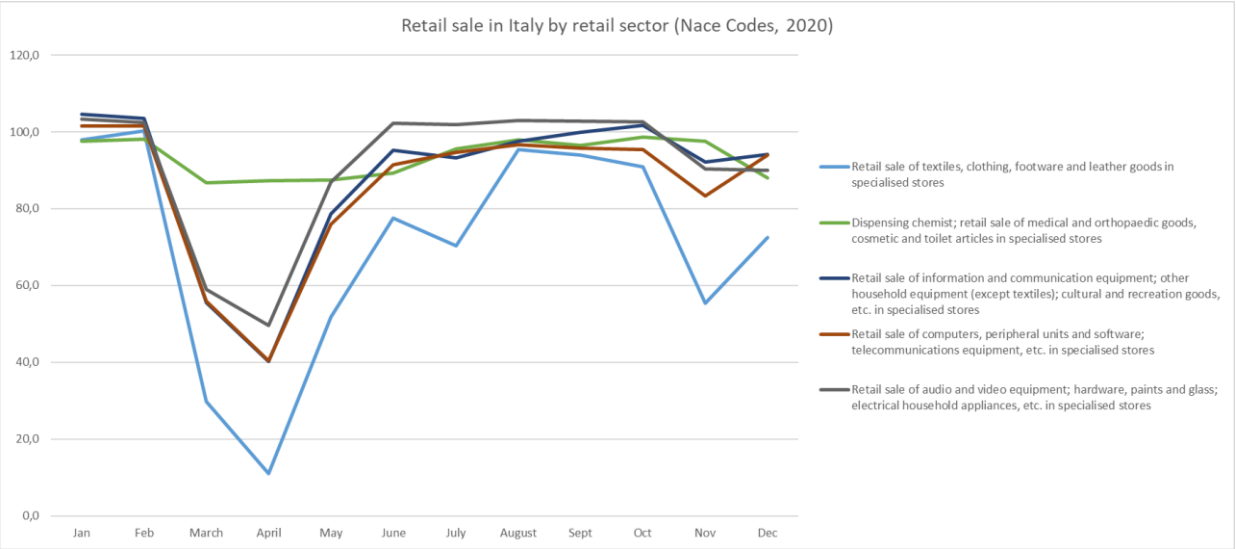


Figure 8 Index of deflated turnover[11], Retail trade by Nace Code, Seasonally and calendar adjusted data, Index, 2015=100.
Dataset Eurostat: sts_trtu_m, https://appsso.eurostat.ec.europa.eu/nui/show.do

For what concerns the service side, it is important for our analysis to focus on the impact of the pandemic on tourism. Similarly to what happened for retail, tourism was hit both by the pandemic and by measures adopted. As discussed in the previous paragraph, the Italian economy relies on the tourist sector and in particular on foreign tourists visiting the country. Therefore, movement and travel restrictions stopped flows within Italy and from other countries. In particular, according to the World Tourism Organization (UNWTO), in 2020 international arrivals in Italy decreased by 61% with respect to the previous year. In April 2020, at the outbreak of the pandemic, the lack of foreign visitors with respect to the previous year was of around 5 thousand people. This gap remained almost constant over time, with months such as May 2020 when the actual amount of visitors was around one sixth of the previous year's result[12]. This relevant drop in incoming tourists was particularly strong for extra-Eu travelers, with the number of

[11] Explanation and calculations: https://www.allthatstats.com.
[12] Data by UNWTO available at: https://www.unwto.org/international-tourism-and-covid-19

arrivals from Asia and the Americas falling by 81% and 87% (Della Corte et al., 2021). Analyses conducted by Istat and published in the *Conto satellite del turismo per l'Italia* point out how the tourism expenditure in the country registered a significant drop, with 54.6% less overnight stays by foreign visitors and 32.22% by residents. The domestic tourist consumption dropped of more than 63 billion euros and the value added fell by 31 billion, reaching levels well below those of 2010. These results account for more than one quarter of the overall drop in value added registered in Italy (Istat, Report 2021). As Demma (2021) points out, the tourist sector was one of the most impacted by the pandemic crisis, registering not only a significant contraction in turnover, but also a deterioration in employment.

Many scholars pointed out how an insufficient policy response to the crisis could disrupt the whole Italian economic system (Dupeyras et al., 2021). In the end, to avoid massive losses and disastrous effects, Italy chose to use almost all forms of public support, which will be examined in detail in the next chapter.

2. Institutional background: Italian public interventions in response to the pandemic

2.1 Interventions

2.1.1 Fiscal policy

Italy is part of the European Union, a political and economic union with an internal single market and a unique common currency. Within a monetary union, monetary and exchange rates policy choices are centralized so that shocks within a country can be controlled at the government level with the use of fiscal remedies. Government finances allow the use of two main instruments to intervene in the market: expenditure and taxation. To face this particular crisis governments could choose a wide spectrum of policy options, intervening in the market with public spending or adjusting taxation.

Italy itself reacted to the pandemic with a wide range of public supports and interventions, which were permitted and encouraged within the European Union. In particular, the European Commission introduced the so called "Temporary Framework" for allowing States to run significant fiscal deficits in order to put in place the necessary state aids to preserve the national and community economic structure. The framework, which was progressively updated following the pandemic evolution and is expected to expire on June 30th 2022, allows Member States to grant aids in derogation of article 107 of the Treaty on the Functioning of the European Union (TFEU). This article contains fundamental rules and limits to state aids to avoid distortions of competition in the European internal market.

The Temporary Framework, instead, allows extraordinary state aids to support undertakings during the pandemic. In particular, the European Commission justified such exceptional measures by considering how the pandemic was a "major shock" for the economy. Its impact was in fact believed to create a strong supply and demand shock, expected to create negative effects on investments and liquidity availability. Given the risks posed by Covid-19, the European Commission concluded that there was the urge to implement "well-targeted public supports", but also pointed out that "given the limited size of the EU budget, the main response will come from Member States' national budgets" (European Commission, C/2020/1863). However, the need for close

coordination between national aid measures was considered a key aspect to ensure homogeneity and avoid distortions in the internal market. For this reason, the European Commission posed some conditions on state aids. First, a specific duration limit was set, in consideration of the momentaneous shock due to the pandemic. Second, the Commission needed to evaluate aid programs before implementation as "necessary, appropriate and proportionate to remedy a serious disturbance in the economy of the Member State concerned" (European Commission, C/2020/1863). In addition, the European Commission itself suggested possible financial remedies in order to ensure liquidity to undertakings. Some examples are wage subsidies, tax advantages, direct grants or repayable advances. It also indicated specific conditions for the implementation of them: for instance, the first specified ceiling was of 800,000 euro per undertaking, considering gross accounting figures.

Provisions also focused on the possibility of aids in the form of guarantees and subsidised interest rates on loans, in order to ensure liquidity access to companies in cash shortage. The European Commission posed some conditions on guarantee premiums, differentiating them by type of recipient and credit risk margin, specifying in addition limits for loan amounts and maturity. Setting these condition was fundamental to uniform interventions across countries.

Considering the sectoral impact of the pandemic, the European Commission also highlighted how Member States were allowed to support particular sectors hit by the pandemic, such as culture, hospitality, tourism, transport and retail.
All state aids put in place needed to be monitored and reported to the Commission, which would approve them for their realization.

Italy presented state aids' schemes approved within the Temporary Framework using instruments such as grants, subsidized wage payments, direct tax cuts, reductions in social and other types of contributions, government loans guarantees and direct loans to companies.

In general, grants are remedies that consist in a contribution which does not need to be repaid and in Italian is often referred as *contributo a fondo perduto*. These instruments give almost immediate relief to moments of distress at the private or company level.

Subsidized wage payments, widely used also at an European level, consist in contributions by the State to employees' wages made directly or through employers.

Direct tax cuts and reductions in contributions fall within the taxation instrument. During the pandemic these remedies were limitedly used, while it was often chosen to freeze payments at the outbreak of the emergency. These solutions were used to relieve families and SMEs from tax duties in the most distressing moments of the crisis.

Government loans guarantees and direct loans to companies are very important interventions aimed at addressing the liquidity issue. In practice, the central government through agreements with credit agencies guarantees loans as a third party. Therefore it is the government who takes responsibility for the loan and its repayment in the event of a possible default. This is a key intervention in the light of "hibernation" of the economy to avoid the effects of the pandemic but it is a tricky measure looking at it mindful of the discussion on zombification. It is however important to point out that despite cross-country differences, these kind of fiscal remedies are strictly regulated at the European level (Falagiarda et al., 2020).

In Italy all these interventions were implemented starting from March 2020, as the pandemic was evolving, with many government decrees: the Decreto "Cura Italia" n. 18/2020, the Decreto "Liquidità" n. 23/2020, the Decreto "Giustizia" n 28/2020, the Decreto "Rilancio" n 34/2020, the Decreto "Semplificazioni" n 76/2020, the Decreto "Agosto" n 104/2020 and a package of four decrees called Decreti "Ristori".

The approach chosen for the discussion of policies focuses on areas of intervention, considering mainly policies addressing families and work, businesses and liquidity. In addition, particular attention is given to sectoral remedies, in light of the aim of this investigation.

2.1.2 Interventions to support families and work

The pandemic and the stringency measures affected the balance of households both in terms of family and work management. In terms of family, the measures put in place to avoid the spread of the virus in schools led parents to have to manage their children at home, without the usual support from the school system. Many interventions were introduced to mitigate these effects. Smart working was encouraged for parents with children under the age of 14 even without individual agreements. Parental leaves were reinforced, introducing the right for employees with children under the age of 12 to take a parental leave with a granted allowance of 50% of their salary, starting from a total of fifteen days with the "Cura Italia" decree to thirty days with the "Rilancio" decree. This provision amounted for a total of 660 million euros. Bonuses for babysitting services were introduced in the form of vouchers at the beginning of the pandemic for a total of almost 680 million euros. Supports for schools in order to strengthen infrastructures, educational activities and digital innovation led to a total expenditure of almost 1 billion euros with the "Agosto" decree. In addition, a total of 85 million euros was set aside for the "Fondo per l'innovazione digitale e la didattica laboratoriale" ("Fund for digital innovation and teaching workshops") and 400 million euros for the "Fondo per l'emergenza epidemiologica da Covid-19" ("Fund for the Covid-19 epidemiological emergency"), in the context of implementation of containment measures in schools.

Work was one of the main concerns for policy intervention because of its relevance both for income protection and business continuity.

One of the first instruments strengthened to protect work places was the "Cassa integrazione guadagni", an exceptional fund to supplement salaries in certain extraordinary situations. The instrument was already in place before the outbreak of the pandemic and consisted in a wage subsidy accessible by companies in momentaneous times of crisis, partially relieving them of the costs of temporarily unused labour. There are three types of "Cassa integrazione". First, the "Cassa integrazione guadagni ordinaria" (CIGO) is usually accessible for workers in companies that face seasonal or temporaneous averse events, such as meteorological ones. The "Cassa integrazione guadagni straordinaria" (CIGS), instead, can be requested in cases of restructuring, reorganization and reconversion of companies, for company crisis of particular social importance or in

case of bankruptcy procedures. The third kind of fund for salary support is the “Cassa integrazione in deroga”, which was particularly implemented during the pandemic. This fund can be obtained by companies that are unable to access other ordinary instruments (such as the already quoted CIGO and CIGS) or that have already used the ordinary fund till their limit. The functioning of these instruments is relatively simple: if a company had to suspend or reduce their activity because of the pandemic it could require the “Cassa integrazione” for its workers for “Covid-19” reason. This means that it would access the fund, without needing to fire workers or face the costs of labour in a context of significant contraction in activity. The access was first set for a duration of 9 weeks, but following government decrees extended it by 9 and 18 weeks.
Overall, the “Cura Italia” decree set aside an amount of 4 billion euros in national expenditure to implement these instruments.

In order to avoid delays in payments of the wage subsidy, the access to the “Cassa integrazione in deroga” was further simplified by the “Rilancio” decree, allowing companies with less than five employees to apply directly to the Italian National Institute of Social Security (INPS) in order to access the fund. In addition, an agreement between the Italian Banking Association, INPS and trade union organisations introduced the possibility for employees suspended from work because of Covid-19 to receive an extraordinary “Cassa integrazione” equal to 1,400 euros.

Another fundamental instrument introduced to support certain categories of workers are indemnities, which could not be combined with pensions or salaries. The indemnities covered different sectors and types of contracts. For instance, the “Cura Italia” decree put in place an indemnity of 600 euros for workers under freelance work contracts coordinated by an employer (namely “co.co.co.”), professionals not enrolled in official registers, traders, artisans, farmers and sharecroppers, seasonal workers, agricultural workers and entertainment industry workers. The indemnity was expected to be paid out in March and April 2020. For the month of May 2020 the “Rilancio” decree introduced an indemnity of 1000 euros for freelancers with a VAT number who registered “at least a 33% decrease in their income in March and April 2020 compared to the same period of 2019” (D.L. 34/2020). In the same month an indemnity based on loss in turnover was introduced for additional categories: artisans, traders and owner-farmers.

For categories excluded by the first indemnity of 600 euros contained in the "Cura Italia" decree, the same ordinance established a "Fondo per il reddito di ultima istanza" ("last resort income fund") to guarantee income support. The allocation was of 300 million euros for 2020.

For what concerns the matter of unemployment states and benefits, the Italian government decided to extend with the "Agosto" decree standard unemployment benefits (NASPI) and employment benefits for "co.co.co" (DISCOLL). These were existing unemployment monthly benefits for involuntary employment loss which were extended for two months to avoid their expire occurring between May 1st 2020 and June 30th 2020.

In order to avoid a strong contraction in employment, the "Cura Italia" decree also put in place the suspension of dismissal procedures, applied in combination with the strengthening of the already discussed "Cassa integrazione". Dismissals were first suspended for a period of 2 months. Then this period was extended for 18 weeks for companies covered by the "Cassa integrazione" fund and for 4 months for those covered by exemptions of fund contributions. The "Rilancio" decree further extended by 5 months the period of collective dismissals prohibition. It is however relevant to specify that these provisions did not apply for suspensions linked to the definite closure of a company.

Considering the threat of possible redundancies, in the "Rilancio" decree the Italian government established that local authorities could introduce extraordinary aid measures to support local economies, in line with the European Temporary Framework. The allowed interventions included contributions for support of wage costs of companies and self-employed workers, with a subsidy duration of 12 months that could not exceed 80% of worker's gross monthly salary.

2.1.3 Interventions to support businesses

At the outbreak of the pandemic the Italian government immediately took extraordinary measures to ensure the stability of companies during the emergency. The main concerns for policy makers were the liquidity issue, which will be discussed in detail in the next paragraph, and the weight of costs on the operativity of companies. In particular, to avoid taxes to burden excessively certain activities, tax cancellations of the IRAP (regional

income tax) were introduced for self-employed workers and businesses with revenues or fees of up to 250 million euros, with exclusion of public administrations, banks and insurance companies. To meet this purpose, a budget of nearly 4 billion euros was set aside.

The issue concerning the costs faced by companies to adapt workplaces to government sanitary dispositions was addressed with tax credits. Companies could benefit from a 60% tax credit for the 2020 expenses faced to comply to containment measures, with a maximum of 80,000 euros per beneficiary. An analogous 60% tax credit was introduced for sanitisation, up to 60,000 euros per beneficiary.

To avoid the impact of other ordinary fixed costs, a tax credit of 60% was introduced to help with the payment of monthly rents for the months of March, April and May 2020. The credit could be accessed by companies registering remuneration or revenues of up to 5 million euros in 2019 and with a 50% drop in turnover due to the Covid-19 emergency. In addition, 600 million euros were set aside to reduce the fixed amounts for energy bills for three-months starting from May 2020. The aim was to relieve SMEs requiring low voltages from electricity costs.

Refinancing measures were also put in place, mainly to improve existing remedies. Specifically, 64 million euros were used to refinance the "Nuova Sabatini", a measure with the aim of strengthening the productive and competitive system of SMEs through access to credit for purchase of tangible assets (machinery, equipment, plan) or intangible assets for productive use. Subsidies were granted for investments "equal to the interest calculated on a 5-year loan" (D.L. 18/2020).

Another relevant policy concerned investment boost. In fact, in order to "sustain large-scale production investments and national industrial policies 500 million euros were used to refinance development contracts" (D.L. 18/2020).

Besides that, 950 million euros were used to refinance the IPCEI fund, an instrument used for the implementation of relevant projects for the development of the European Union Industrial Strategy.

2.1.4 Interventions to support liquidity

With an economic contraction such as the one following the pandemic, governments feared that the effects on the real economy would be transferred to the credit sector, impacting negatively households, businesses and the financial system. The expected income reduction could significantly affect the access to credit and the ability to comply to previous financial commitments both at a household and business level.

In order to contain negative effects the Italian government developed different measures and dedicated a specific decree, the "Liquidità" decree, to the liquidity issue. The liquidity plan was worth 750 billion euros and was approved by the European Union under the Temporary Framework. Said decree addressed mainly three different recipients: businesses, households and local public administrations.

A first measure put in place to address the liquidity issue for businesses was a moratorium on loans, so that the payment of specific loan instalments was legally suspended and delayed by government authorization. In particular, SMEs, self-employed workers and professionals could access an exceptional moratorium on loans for an overall volume of 300 billion euros. This measure covered the entire 2020 year and established a partial free of charge guarantee from the "Fondo Centrale di Garanzia" for SMEs. This fund was first established in 2000 with the aim of facilitating access to financial resources for small and medium-sized enterprises through public guarantees. The "Cura Italia" and "Liquidità" decrees intervened to extend its operativity so that more companies could access funds. First, the decrees disposed the guarantee to be free of charge and authorized a suspension of usual access payments. In addition, the provisions established that the debt renegotiation could be covered by the guarantee and, in case of suspension or moratorium of the loan due to Covid-19, the guarantee would be automatically extended. Overall, the maximum amount guaranteed was disposed to be of 5 million euros and access was permitted to companies with up to 499 employees. The government dispositions also increased the direct coverage, setting three loan thresholds.

For loans up to 30,000 euros, of an amount up to double the company's personnel expenses or 25% of its revenues, the guarantee by the fund was of 100% for new loans. To access this kind of loans, companies needed to present to granting authorities self-

certifications of the damage faced due to Covid-19. After this, banks would evaluate and confirm creditworthiness of the applying companies.

For loans over 30,000 euros the amount was guaranteed up to 90% with no creditworthiness evaluation of the company for granting the guarantee. There was also the possibility of a 100% guarantee for companies with revenues up to 3.2 million euros who presented a self-certification of damages due to Covid-19. The guarantee was 90% guaranteed by the state and 10% by a third party (e.g. "Confidi").

A relevant notice that must be made in light of our considerations is that the decree, with the exception of loans over 30,000 euros, imposed access to this kind of support only if companies were *in bonis*, i.e. free from any kind of impaired debt position as classified by the banking system. This condition tried to discriminate worthiness of companies, but still allowed access to companies with bank classifications as "probable defaults" or "past due or bordering on impaired" or that were for any reason able to be classified again as "performing". Overall, the fund aimed at issuing guarantees for a total of over 100 billion euros in business financing.

Another fundamental measure introduced by the government was the possibility to access guarantees by the State for loans, leasing, factoring and debt securities. These were extraordinary instruments introduced in collaboration with SACE, the Italian export credit agency, in order to grant financing to economic and business activities damaged by the Covid-19 emergency.
SACE S.p.A., *Sezione Speciale per l'Assicurazione del Credito all'Esportazione,* is a state agency established in 1977 and is now controlled by Cassa Depositi e Prestiti S.p.A., an Italian financial institution owned by the Ministry of Economy and Finance for 83% and by banking foundations for 16%. Before the outbreak of the pandemic, SACE S.p.A. was specialized in offering a wide range of instruments for credit insurance, investment protection, bonding, financial guarantees and factoring. Its activity was primarily oriented toward sustainment and promotion of Italian companies in internationalization.
With the Covid-19 pandemic, SACE created in collaboration with Abi (*Associazione bancaria italiana*) the programme called "Garanzia Italia" in order to manage liquidity requests coming from small, medium and large sized companies. The firms in need would have to rely on banks or financial institutions to access any type of guarantee. To do that,

the request had to be presented to the referring bank, which would control eligibility conditions for accessing the guarantee. Then the bank or financial institution would request the guarantee to SACE on an online portal, which would automatically check the information. SACE specialists would then analyse the request and confirm to the bank the result of the evaluation. At the end of the process, referring banks would inform the firms of the granting of the financing.

The procedure was differentiated depending on the dimension of requesting firms, with a simplified procedure (procedura semplificata) for companies with an individual turnover of up to 1.5 billion euros and no more than 5,000 employees in Italy and for loans of less than 375 million euros. The ordinary procedure (procedura ordinaria) was reserved to companies with a turnover of more than 1.5 billion euros or with a number of employees in Italy greater than 5,000 or for financing loans for more than 375 million euros. From the moment the SACE guarantee was introduced, there was an expected timing for the funding disbursement: for simplified procedures, the funding had to be disbursed within 30 days, while within 45 for the ordinary procedure.

The cost of the guarantee was in the form of annual commissions due by the businesses to SACE through the intermediation of the financing institution. In particular for SMEs 25 basis points would have to be paid in relation to the guaranteed amount in the first year, 50 in the second and third, 100 in the fourth, fifth and sixth. For other companies, the cost established was higher: 50 basis points during the first year, 100 for the second and third, 200 for the fourth, fifth and sixth years.

The guarantee covered the issuing of loans, leasing, confirming and factoring.

In particular, loans guarantees were implemented for a value of 200 billion euros to ensure access to liquidity to companies in Italy, with 30 billion euros destined to support small and medium enterprises. Any company, regardless of business sector, legal form or size could request the guarantee until the end of 2020. In this case, there was no relevant constraint on worthiness of the company, but some conditions had to be met. First, companies requesting the guarantee had to certificate that they did not approve or commit to distribute dividends or repurchase shares in 2020. Second, the involved company had to commit to keeping production within the Italian national territory and to certificate commitment on employment management through involvement of trade union agreements. For SMEs a third condition to access the guarantee concerned the usage of the “Fondo Centrale di Garanzia”. In fact, in order to benefit from the guarantee, SMEs

needed to have already fully used the "Fondo Centrale di Garanzia" or any other accessible guarantee (such as the ISMEA guarantee for primary sector activities). The SACE guarantee was first-demand, explicit and irrevocable. The maximum amount coverable was 25% of the firm's turnover in 2019 or double the personnel costs in 2019 and the set duration of the loan was limited to 6 years.

Leasing guarantees applied to the issuing of guarantees by SACE S.p.A. to leasing companies or transactions. The established company requirements to access the guarantee were the same as those for loan guarantees. These guarantees could be used to support the purchase of any type of goods and any kind of immovable and movable properties. They also covered payment of instalment loans due between March 1st 2020 and December 31st 2020, considered objectively impossible to repay because of the pandemic or of containment measures, and not exceeding 20% of the disbursed amount.
The duration of these leasing operations was limited to 8 years from the delivery date of the asset to the beneficent company and in any case could not exceed the deadline of December 31st 2029.

Factoring and confirming guarantees referred to the issuing by SACE S.p.A. of guarantees for such operations in favour of banks and factoring companies.
Factoring consists in the possibility for a company to access immediate liquidity by giving an existing credit to a bank or credit agency (*factor*). The credit, which is usually towards a client and has normally a certain maturity, is immediately paid for a certain percentage (usually 80%) of its value by the bank who basically "buys" it. The bank retains a commission on the amount and charges an interest rate on the amount advanced. Two types of factoring exist in the Italian system: factoring *pro soluto*, where the insolvency risk lies on the bank who acquired the credit and no claim on the company is allowed, and factoring *pro solvendo*, where the bank can claim the credit payment to the company who "sold" it if the original debtor is insolvent.
Confirming, instead, is an operation where a company can refer to a bank to immediately pay debts (usually trade payables). The company then commits to repay the debts at the agreed natural maturity considering the financial cost of the advance payment. This operation is usually chosen by companies to strengthen relationships with suppliers, who benefit from immediate liquidity.
Given their importance for the liquidity matter, these operations were included in the state

guarantees granted by SACE S.p.A.. In order to access the guarantee some conditions were specified. The financing could be destined to support personnel costs or other costs related to rents or leasing of business units; they could also be allocated for a limit of 20% of the amount disbursed to the payment of loan instalments, similarly to what was established for loan guarantees. Refinancing transactions, however, were not allowed. The deadline for disbursal was until December 31st 2020.

The government also introduced guarantees for debt securities which could be issued in favour of banks, financial institutions and other agencies that provide the same kind of services. All types of companies had to fulfil these criteria to access the guarantees: be registered in Italy, be not "in difficulty" as at December 31st 2019 and have a rating of at least BB- or equivalent.

As was previously pointed out, one of the main objectives of SACE S.p.A. concerned the support to internationalization of Italian companies. For this aim, a co-insurance system was introduced by the government through SACE mediation. In particular, the Italian government established that "90% of SACE's insurance commitments would be taken by the state" (D.L. 23/2020). This operation allowed to free an additional amount of 200 billion euros in resources used in order to strengthen exports.

Liquidity of households was mainly supported with the so called "Fondo di solidarietà" for mortgages to purchase main dwellings. It was basically an extension of an existing fund, the "Fondo Gasparrini", aimed at allowing the suspension for up to 18 months of mortgage repayments for main dwellings in the case of temporary difficulties. With the Covid-19 outbreak, the access to the fund was extended to categories impacted by the emergency, such as employees with suspension of work, self-employed workers and professionals with a drop in revenues of over 33% compared with their turnover in the last quarter of 2019.

Another category included in government liquidity measures were local authorities. In particular, the "Agosto" decree increased the "Fondo per l'esercizio delle funzioni degli enti locali" ("fund for local authorities to perform their functions"), reaching an amount of 5.17 billion euros. The "Fondo per l'esercizio delle funzioni delle regioni e delle province autonome" ("fund for regional authorities and autonomous provinces to perform

their functions") was increased by 2.8 billion euros for 2020. Other resources were allocated for the aid of local public support (400 million euros) and local authorities with a structural deficit (180 million euros). Additional investment measures were improved for municipalities and local authorities to support small works (with contributions of 500 million euros in 2021), to final and detailed planning (300 million euros per year for 2020 and 2021).
In addition, to guarantee solvency of public administrations, the Ministry of Economy and Finance established a fund of 12 billion euros to give advances to regional and local authorities in liquidity shortage. The aim was to secure through the fund the payment of administrative debts due to suppliers.

2.1.5 Sectoral interventions

Considering the impact of Covid-19 on tourism and retail, the Italian government put in place specific interventions aimed at sustaining these sectors.

As for tourism, indemnities were introduced to support workers. In particular, an indemnity of 1000 euros was introduced for seasonal workers in tourism, spa and entertainment industries and an indemnity of 600 euros for seasonal sports workers.

In order to relieve activities from property taxes, the government exempted many types of property from the payment of the real estate property tax (called IMU tax). Among them, the provision exempted from the 2020 IMU payment beach establishments, hotels and guesthouses (category "D2" of the land registry). For buildings used as theatres and cinemas the exemption is for both 2021 and 2022.

Tax credits were introduced in order to sustain the sector. For instance, a tax credit for rent was established for properties for non-residential use such as commercial buildings. The tax credit was of 60% for monthly rental, covering the months of March, April, May and June 2020. July 2020 was included just for tourist facilities carrying seasonal activities. To access the tax credit a company needed to have registered "at least a 50% decrease in turnover as compared to the same month in the previous year" (D.L. 34/2020). In addition, the measure also applied to retail trade businesses with revenues or remuneration exceeding 5 million euros in 2019. For this category the established tax

credit was of “20% of the rental, leasing or concession fee and of 10% in the case of complex service agreements and business leasing contracts” (D.L. 34/2020).

Other types of tax credit were introduced to support expenses for redevelopment and improvement in the tourism and spa industry as indicated by Covid-19 containment measures. The tax credit was of 65% and the amount set aside for 2020 and 2021 was of 180 million euros.

A relevant tax credit aimed at improving the family consumption in the tourist sector was the holiday tax credit. This allowed low income families to access a tax credit of up to 500 euros for payment of tourist-accommodations and bed and breakfasts.

The Italian government also introduced many non-refundable grants for supporting single categories and areas of the country. 600 million euros were set aside to specifically support catering companies registering a drop in turnover between March and June 2020 of up to three quarters with respect to 2019. In this case, the grant was established for purchase of Italian agricultural products.

Another relevant non-refundable grant covered activities in historical centres. In particular, 500 million euros were set aside in favour of retailers in Italy’s city centres who registered a significant drop in foreign visitors and who recorded a drop of two-thirds in turnover in June 2020 if compared to the previous year.

Government measures also created specific funds for cultural activities. For the “Fondo emergenze imprese e istituzioni culturali” (“Enterprise and cultural institutions emergency fund”) an amount of 231.5 million euros was set aside. The amount for the “Fondo emergenze cinema, spettacolo e audiovisivo” (“Cinema, entertainment and audio-visual sector emergency fund”) was of 335 million euros. The government also allocated nearly 90 million euros to the Strategic Plan “Grandi Progetti Beni Culturali”, created for relaunching territorial competitiveness with interventions and investments on sites of considerable national importance.

Particular attention was also given to travel agencies, tour operators and tourist guides. In fact, a specific fund called “Fondo emergenze agenzie di viaggio e tour operator” was established in their support with the “Rilancio” decree and was increased by 265 million euros for 2020.

3. Empirical analysis

3.1 Data

3.1.1 Dataset

The analysis considers mainly data from the Aida data base (*Analisi informatizzata delle aziende italiane*). This data base is source for a variety of comprehensive information on companies in Italy. The focus was on balance sheet information of companies of the retail sector (considered in a broad sense), selected by NACE Code. In particular, NACE codes included are displayed in detail in Table I.A [Appendix A].

The dataset was constructed at an individual company level and for each company information and balance sheet variables were collected. In particular, company name, CCIAA number and province, legal status, legal form, year of founding and NACE Revision 2 code were included. This information, downloaded from the Aida database, was used to control for regional fixed effects, for age fixed effects (deriving age of each company) and to analyse the legal situation of each firm. In fact, Aida records every legal procedure occurring to companies, with a detailed and wide range of possible events. These were used in the analysis to determine failures of companies, discriminate between active companies and companies with previous insolvencies and to classify them. With reference to this, it is important to point out that insolvencies, failures and bankruptcies are regulated by the national insolvency regime which involves complex procedures.
For instance, it is unusual for a company to go straight to the failure declaration, but there are often some "intermediate" or alternative states, introduced in the failing system in order to preserve the existence of the company. For example "scioglimento" (dissolution) of a company and "liquidazione" (liquidation) of a company usually occur before failure of it, but can also simply lead to the liquidation of assets, which can take even years, without any failure declaration. There are also states such as the "stato d'insolvenza" (insolvency state) and "liquidazione giudiziaria", which are considered by the legislator as comparable to a failure[13].

[13] In particular, art. 5 of the RD 16/2/1942, establishes that "the entrepreneur in a state of insolvency is declared bankrupt". The institution of the "liquidazione giudiziaria", instead, equiparable to previous "fallimento" (failure), is part of the reform of insolvency procedures and is contained in the legislative decree number 14 of January 12, 2019 ("Codice della crisi d'impresa e dell'insolvenza")

As previously stated, Aida allows access to information about companies as they declare it on the database. The fact that companies are not obliged to declare all balance sheet information leads the sample to be characterized by a certain amount of missing values. In particular, the variables total debt and total assets are characterized by the same percentage of missing values each year, with 46.10% for 2014; 37.99% for 2015; 35.03% for 2016; 31.96% for 2017; 28.97% for 2019.

Variables for debt components display higher shares of missing values for each year, with percentages ranging between 44.64% and 52.01%. This is understandable, given that these variables are single debt components sometimes omitted given their inclusion in the total debts variable.

Ebitda, instead, is characterized by 46.10% of missing values for 2014; 37.99% for 2015; 35.03% for 2016; 31.96% for 2017; 28.97% for 2018; 28.85% for 2019.

The number of employees is characterized by a 46.30% share of missing values for 2014; 38.70% for 2015; 35.84% for 2016; 32.77% for 2017; 30.48% for 2018; 30.35% for 2019. For more detailed information, see Tables II-VIII [Appendix B].

The sectoral impact of Covid-19 was measured with the shock in household consumption. In particular, data of the Household budget survey (HBS) available at Istat was used. This survey collects data on the average (monthly) family expenditure for consumption and, in agreement with Eurostat, uses the ECoicop codes (European Classification Of Individual COnsumption by Purpose), harmonized international classification of voices aimed at ensuring cross-country comparability.

In order to access the shock, correspondences between ECoicop codes and NACE Rev.2 codes were constructed, as displayed in Table I.A [Appendix A]. The shock was measured as the variation in household expenditure between 2019 and 2020.

3.1.2 Variables

The choice of the variables to include in a model for bankruptcy analysis is complex because of the possible options available. The existing literature on the matter usually focuses on two main variables: firm productivity and firm indebtedness. Other studies tend to consider additional information, such as current liquidity or interest coverage. However, these studies usually have a smaller sample than the one considered in this work and refer to periods previous to the pandemic (Horváthová et al., 2018; Blanchard et al., 2012). It is the case for example of studies by Blanchard et al. (2012), where the sample is of around 6,000 firms. For this reason, the main reference study for this analysis is the one conducted by Cros et al. (2021), where the sample considered is associable and even larger than the one of this study (nearly 400,000 observations for the retail sector). In addition, it is one of the first analyses focusing on bankruptcy dynamics and the Covid-19 shock. Therefore, with a possible comparative perspective in mind, the variables chosen for this model are the same as the ones in the model by Cros et al. (2021): labour productivity, indebtedness ratios overall and by component, number of employees, age and sector of the firm. In addition to these, the analysis includes also geographical controls by means of a regional categorical variable.

Failures

Failures are identified with a dummy variable, taking value 1 if the company has failed and 0 if the company is still active in the considered year. The dummy variable was constructed by year, so that failures from previous periods where registered as missing values in the following period. In fact, failure of a company meant that it would be excluded from the sample of bankruptcies in the following year.

Labour Productivity

Labour productivity is a fundamental indicator within business and macroeconomic statistics and usually refers to the "output per unit of labour input" (OECD, 2002). In fact, it is a useful indicator for both the state of a single firm and of a productive segment overall. Its interpretation is relatively simple: growing productivity is usually associated with businesses able to produce more goods or services per unit of input. This is usually linked to better working skills, better management structures, better technological assets and innovation. From a macroeconomic perspective, labour productivity as GDP per

worker is considered an "essential driver of changes in living standards" (OECD, 2022), reflecting the degree of use of capital or of high-productivity workers, the general efficiency of an economy and the degree of innovation of both a company and a sector.

Labour productivity at the firm-level may be calculated in many ways. In this model, it was calculated using the following formula and is measured as thousands of euros per worker:

$$Labor\ Productivity = \frac{Ebitda}{n°\ of\ employees}$$

Given previous considerations, higher levels of labour productivity should be associated with better firm performances and therefore usually correspond to a lower probability of failure. Previous studies, such as the one by Baily et al. (1992), actually show that the probability of failure is higher for firms with low productivity levels. Other more recent studies confirm this result: Blanchard et al. (2012) use French firm level data from 1996 to 2002 and show that productivity has a negative impact on the probability of firm exit.

Debt ratios

Indebtedness levels are considered a relevant issue for companies, given that the impossibility to meet maturities often puts firms at risk of insolvency and of bankruptcy. To access the indebtment level of the analysed companies, different debt ratios were included in the model.

Total debt over assets

Total debt over assets was considered as a fundamental variable in the model. This ratio shows how much money a company has borrowed from creditors compared to the amount of assets owned by shareholders. It is a measure of debt capacity and it reflects the ability of a company to service its current debt and to raise such debt in case of need. A higher ratio corresponds to higher leverage for the company and is often associated with higher risk of insolvency.

$$Total\ debt\ over\ assets = \frac{Total\ debt}{Total\ assets}$$

Debt components

It was important for the aim of this work to differentiate debt ratios by debt component in order to better understand the impact of the types of debts in bankruptcy determination, most in light of the Covid-19 crisis. In fact, as chapter 2 displayed, some public interventions were specifically targeted at ensuring liquidity in the form of bank debts (such as loans) or at preserving supply chain dynamics.

For this reason, the debt components considered are three:

Bank debt over assets

It includes both long and short term bank debts. This ratio represents the degree of dependence of the company on banks.

$$Bank\ debt\ over\ assets = \frac{Short\ term\ bank\ debt + Long\ term\ bank\ debt}{Total\ assets}$$

Supplier debt over assets

It includes both long and short term supplier debts. These are debts that a company owns to their supplier and are fundamental during the Covid-19 shock because of the impact the pandemic had on supply chain dynamics. Similarly to the previous ratio, this one represents the degree of dependence of a company on its suppliers.

$$Supplier\ debt\ over\ assets = \frac{Short\ term\ supplier\ debt + Long\ term\ supplier\ debt}{Total\ assets}$$

Other debts over assets

It consists of both long and short term other debts. It includes, among others, debts due to shareholders for declared dividends, amounts due to tax and social security institutions, and also amounts due to employees.

$$Other\ debt\ over\ assets = \frac{Short\ term\ other\ debt + Long\ term\ other\ debt}{Total\ assets}$$

Size

The size of the considered companies was included in the model as the number of employees. To reduce the magnitude order of the data, the variable used in the model is a logarithm transformation of the number of employees.

Age

The age of companies was included in the model and four categories were created:

Class	Age range of the company
Class 1	Age: 0 to 5 years old
Class 2	Age: 6 to 10 years old
Class 3	Age: 11 to 30 years old
Class 4	Age: 31 years old to maximum age

Sector

The sector of the company was also included in the model, creating a categorical variable with 15 categories, divided by NACE Rev. 2 codes.

N°	Sector
1	Accommodation
2	Funeral and related activities
3	Hairdressing and other beauty treatment
4	Retail sale of automotive fuel in specialised stores
5	Retail sale of cultural and recreation goods in specialised stores
6	Retail sale of food, beverages or tobacco in specialised and non-specialised stores
7	Retail sale of information and communication equipment in specialised stores
8	Retail sale of medical and related goods
9	Retail sale of other goods in specialised stores
10	Retail sale of other household equipment in specialised stores (repair included)
11	Sale of motor vehicles
12	Sports activities and amusement and recreation activities
13	Taxi operation
14	Travel agency, tour operator and other reservation service and related activities
15	Retail sale of clothing, textile, leather and related activities

The highest share of companies belongs to the *Accommodation* sector (39.18%), while the second sector with highest share is *Sale of motor vehicles* (11.73%), followed by *Retail sale of clothing, textile, leather and related activities* (9.38%).

Sector	Freq	Percent
Accommodation	102,859	39.18
Funeral and related activities	2,252	0.86
Hairdressing and other beauty treatment	7,665	2.92
Retail sale of automotive fuel in specialised stores	2,906	1.11
Retail sale of cultural and recreation goods in specialised stores	5,328	2.03
Retail sale of food, beverages or tobacco in specialised and non-specialised stores	23,284	8.87
Retail sale of information and communication equipment in specialised stores	3,661	1.39
Retail sale of medical and related goods	3,737	1.42
Retail sale of other goods in specialised stores	6,686	2.55
Retail sale of other household equipment in specialised stores (repair included)	18,372	7.00
Sale of motor vehicles	30,782	11.73
Sports activities and amusement and recreation activities	21,193	8.07
Taxi operation	1,373	0.52
Travel agency, tour operator and other reservation service and related activities	7,797	2.97
Retail sale of clothing, textile, leather and related activities	24,614	9.38
Total	**262,509**	**100.00**

Table 1 Frequency and percentage sectoral distribution of companies in the sample of analysis. Data source: Aida dataset.

Region

The analysis included a geographic variable, in particular for the region of the company, extracted from the CCIAA number. Given the geographic structure of Italy, the categories are 20, including all Italian regions.

The majority of companies is located in Lazio (18.79%). Most of the companies in the region operate in the *Accommodation* sector (40.78%), with a smaller percentage share for other sectors (*Sale of motor vehicles* is 9.92% of the sample and *Retail sale of clothing, textile, leather* constitutes 9.51% of it).
The second and third regions where most of the sample is located are Lombardia (14.06%) and Campania (11.8%).

Region	Freq	Percent
Abruzzo	6,299	2.40
Basilicata	2,316	0.88
Calabria	7,073	2.69
Campania	30,986	11.80
Emilia Romagna	16,064	6.12
Friuli-Venezia Giulia	3,333	1.27
Lazio	49,334	18.79
Liguria	544	2.07
Lombardia	36,904	14.06
Marche	6,158	2.35
Molise	1,307	0.50
Piemonte	10,398	3.96
Puglia	17,654	6.73
Sardegna	4,022	1.53
Sicilia	23,745	9.05
Toscana	17,926	6.83
Trentino Alto Adige	3,512	1.34
Umbria	3,835	1.46
Valle d'Aosta	525	0.20
Veneto	15,678	5.97
Total	**262,509**	**100.00**

Table 2 Frequency and percentage regional distribution of companies in the sample of analysis. Data source: Aida dataset.

Covid Shock

The Covid shock is measured as the percentage variation in the average monthly expenditure by families by ECoicop code as collected in the Household Budget Survey (HBS). For detailed information, see Table I.B [Appendix A]. ECoicop codes are particularly useful in this case because they discriminate between single goods and services in a very detailed way. The survey focuses on the main expenditures Italian resident households did to purchase "goods and services exclusively devoted to household consumption (self-consumptions, imputed rentals and presents included)" with exclusion of "every other expenditure for a different purpose" (Istat, HBS), such as business expenditures and fees.

This variable proxies the Covid turnover shock considering the shock on consumption that households faced. It ensures a certain level of exogeneity with respect to other possible measures of the shock, such as the shock on sales faced by companies during the crisis (which could be calculated as the variation in the sales revenues).
However, it has some limits. It is constructed at a sectoral level, so that the measure is not actually firm-level based, but sector-level based.
In addition, the variable captures the shock at the national household level, so that it takes the point of view of Italian consumers. In this sense, an important factor that this measure is missing is the possible relevance of import/export: it may be that some companies highly internationalized were not much affected by the Covid shock, while national consumption in the sector was highly impacted. However, the assumption is that the relevance of foreign demand is limited in the retail sector and in particular for sectors of our analysis, considering that containment measures limited the direct access of foreign consumer to retail activities.

3.1.3 Descriptive statistics

The firms' full sample is characterized by a large share of SMEs (≤ 250 employees) and a relatively smaller of larger companies (>250 employees). Specifically, in 2014 the share of large companies was of 0.34%, while for the following years (2015, 2016, 2017, 2018, 2019) the share stabilized around 0.25%, with 2020 registering the highest share (0.43%)[14]. This notice is understandable considering the characteristics of the Italian economy. In light of this consideration, the analysis focuses on SMEs.

It must be noted that a considerable share of the firms in the sample is constituted by self-employed workers (with VAT number) or by legal forms that by legal status do not present a hierarchical structure with employees and employer. It is the case, for example, of s.n.c. companies (*società in nome collettivo*) and cooperatives. These companies therefore correctly register a null number of employers (equal to zero). However, by construction of the labour productivity variable in the dataset, all these companies are automatically excluded from the models.

Tables 3 to 12 display the summary statistics for labour productivity, total debt over assets, bank debt over assets, supplier debt over assets, other debt over assets, employees, age and, for 2020, the Covid shock for years 2016-2020. By model construction, data for each years' failures is of the two prior years. Therefore, data for 2016's failures is of 2014, for 2017 of 2015, for 2018 of 2016, for 2019 of 2017 and for 2020 of 2018.

To better understand the sample composition, two summary statistics are presented: the first one includes all the observations available in the sample, while the second one restricts it focusing on SMEs with labour productivity between -100 and 300 thousand euros, total debt over assets between 0 and 1 and with no "scioglimento" or "liquidazione" procedure registered. As the descriptive statistics themselves show, the reason for this choice is justified by the need to clean data. For instance, even if larger companies are in a small amount in the sample they may register a very high number of employees (for

[14] These shares are calculated as the number of larger companies on the total of companies that registered the number of employees (therefore missing values are not accounted for). A particular notice on the 2020's result is needed because such increase in the share depends on the fact that when this dataset was constructed balance sheet information for 2020 were not completely uploaded on Aida. Therefore, the number of total observations for 2020 is much lower than previous years.

example, the number of employees registered in 2014 reaches a maximum of 20,381). This is confirmed also by values in the standard deviation, which registers peaks of 122.3277 for the employees in the 2020's failures sample.
The sample also has some companies with labour productivity registering very high or low results. For example, the sample of 2017's failures registers a maximum of 47066.5 euros per worker for labour productivity and a minimum of -5613.94. As for employees' number, also for labour productivity standard deviation registers considerably high values. For example, in the 2019's failures sample the standard deviation for labour productivity is of 189.9374.
The variable which probably registers the highest level of variability is the total debt over assets ratio. In this case, the standard deviation takes considerably high values: for the 2020's failures sample it reaches a value of 3424.164.

These notices need to be accounted for when constructing the model.
The model constructed for this investigation is a dynamic model, where the focus is on bankruptcy dynamics and possible distortions of them. Considering companies with very high debt leverage tends to complicate the analysis because of how difficult it is to interpret such information. High indebtedness may come from momentaneous financing choices that will repay in the longer run, or they may be a relevant sign of risk of default. Given this, it is tricky to keep such companies in the sample considering that for 2020, our year of interest, evaluations on the matter are impossible because of unavailability of data. The chosen solution was therefore to put some restrictive conditions at the cost of loss in observations.

The restricted samples appear quite similar. This is understandable considering that companies are followed over time and may actually be included in the sample each year.

For the sample including 2016's failures, the average firm is 13 years old and has an average of 9 employees, with labour productivity of 10.61 thousand euros per worker. The debt leverage ratios register an average of total debt over assets of 68%, while the average bank debt over assets is of around 12%, supplier debt over assets of around 24% and other debt over assets of around 6.4%.

Similar results are registered for the following years. For 2017, the average firm is 12

years old, with an average of 8 employees. Average labour productivity is of 10.8 thousand euros per worker. Average leverage ratios are of 68% for total debt over assets, 12% for bank debt over assets, 24% for supplier debt over assets and 6.6% for other debt over assets.

For 2018, the average firm is 12 years old with an average number of 9 employees. Average labour productivity is of 10.9 thousand euros per worker. Average debt ratios are of 68% for total debt over assets, 9.8% for bank debt over assets, 20.7% for supplier debt over assets and 5.3% for other debt over assets.

For 2019, the average firm is 12 years old with an average number of 9 employees. Average labour productivity is of 10.7 thousand euros per worker. Average debt ratios are of 68% for total debt over assets, 9.6% for bank debt over assets, 20% for supplier debt over assets and 5.1% for other debt over assets.

For 2020, the average firm is 12 years old with an overage number of 9 employees. Average labour productivity is of 10.4 thousand euros per worker. Average debt ratios are of 68% for total debt over assets, 9.6% for bank debt over assets, 18.7% for supplier debt over assets and 5.1% for other debt over assets.
The average contraction registered due to the Covid shock is of -24.82%.

2016 – Summary statistics for whole sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	105,823	8.09008	89.93152	-10619.9	11000.85
Total debt/Assets	141,495	13.98752	1650.425	0	489155
Bank debt/Assets	126,095	1.419139	223.2702	0	49629
Supplier debt/Assets	126,026	3.891583	737.603	-0.1941677	234954
Other debt/Assets	125,987	2.407271	685.8441	-0.0777163	242765
Employees	140,971	9.177015	119.2354	0	20381
Age	150,183	10.77246	12.57698	0	150

Table 3 Summary statistics for the whole sample of observations for failures declared in 2016; balance sheet data 2014; Data source: Aida.

2016 – Summary statistics for restricted sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	86,453	10.61567	23.3138	-99.611	297.8553
Total debt/Assets	86,453	0.6844062	0.2327902	0	1
Bank debt/Assets	76,339	0.123704	0.1816389	0	0.9700782
Supplier debt/Assets	76,299	0.2395092	0.2229525	-0.0079005	0.9951541
Other debt/Assets	76,279	0.0643099	0.113148	-0.0777163	1.153407
Employees	86,453	8.592912	15.92843	1	250
Age	86,439	12.837	12.79914	0	150

Table 4 Summary statistics for the restricted sample of observations for failures declared in 2016; balance sheet data 2014; Data source: Aida.

2017 – Summary statistics for whole sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	119,848	8.162649	154.8175	-5613.94	47066.5
Total debt/Assets	162,779	40.29721	3585.829	0	754793
Bank debt/Assets	145,329	1.785159	269.7067	0	60190
Supplier debt/Assets	145,329	10.02025	1802.329	0	592453
Other debt/Assets	145,329	8.595967	1504.63	0	404732
Employees	160,926	8.726489	112.268	0	404732
Age	170,241	10.31757	12.40741	0	151

Table 5 Summary statistics for the whole sample of observations for failures declared in 2017; balance sheet data 2015; Data source: Aida.

2017 – Summary statistics for restricted sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	97,726	10.7902	23.51354	-99.889	298.182
Total debt/Assets	97,726	0.6852337	0.233337	0	1
Bank debt/Assets	86,458	0.117428	0.177474	0	0.9889613
Supplier debt/Assets	86,458	0.2413263	0.2247552	0	0.997849
Other debt/Assets	86,458	0.065978	0.114632	0	0.994577
Employees	97,726	8.482297	15.4648	1	248
Age	97,713	11.60298	12.71053	0	151

Table 6 Summary statistics for the restricted sample of observations for failures declared in 2017; balance sheet data 2015; Data source: Aida.

2018 – Summary statistics for whole sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	125,416	8.829844	189.9374	-5106.594	62660.5
Total debt/Assets	170,558	29.95459	3318.749	0	807173
Bank debt/Assets	131,956	2.426382	727.9969	0	261946
Supplier debt/Assets	131,956	1.17785	303.4613	0	110152
Other debt/Assets	131,956	0.3470074	45.36572	0	11468
Employees	168,414	9.03052	121.2314	0	21760
Age	190,605	10.03669	12.23275	0	152

Table 7 Summary statistics for the whole sample of observations for failures declared in 2018; balance sheet data 2016; Data source: Aida.

2018 – Summary statistics for restricted sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	103,507	10.87228	22.86105	-99.613	299.032
Total debt/Assets	103,507	0.6863289	0.2314719	0	1
Bank debt/Assets	80,801	0.0986615	0.1649039	0	0.975208
Supplier debt/Assets	80,801	0.2069061	0.2248646	0	0.997563
Other debt/Assets	80,801	0.0532053	0.1037582	0	0.9933059
Employees	103,507	8.734289	15.92252	1	250
Age	190,605	10.03669	12.23275	0	152

Table 8 Summary statistics for the restricted sample of observations for failures declared in 2018; balance sheet data 2016; Data source: Aida.

2019 – Summary statistics for whole sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	131,489	8.685471	121.2082	-4647.414	35890
Total debt/Assets	178,610	26.63153	2680.256	0	781566
Bank debt/Assets	135,679	0.3931862	93.14186	0	34146
Supplier debt/Assets	135,679	0.6793762	150.7747	0	55501
Other debt/Assets	135,679	1.56749	393.0953	0	137289
Employees	176,489	9.230762	121.2206	1	22004
Age	211,344	9.841159	12.06968	0	153

Table 9 Summary statistics for the whole sample of observations for failures declared in 2019; balance sheet data 2017; Data source: Aida.

2019 – Summary statistics for restricted sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	109,614	10.71725	22.86214	-99.393	299.7435
Total debt/Assets	109,614	0.6823677	0.2321108	0	1
Bank debt/Assets	84,212	0.0957499	0.1609495	0	0.975481
Supplier debt/Assets	84,212	0.20046	0.2218789	0	0.9953803
Other debt/Assets	84,212	0.0506763	0.0981124	0	0.9997181
Employees	109,614	8.94123	16.11486	1	250
Age	109,602	11.58014	12.75779	0	153

Table 10 Summary statistics for the restricted sample of observations for failures declared in 2019; balance sheet data 2017; Data source: Aida.

2020 – Summary statistics for whole sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	135,662	8.446407	148.7347	-13254.44	48765.04
Total debt/Assets	186,461	31.69577	3424.164	0	807173
Bank debt/Assets	140,080	1.988083	699.8872	0	261947
Supplier debt/Assets	140,080	1.18452	297.8242	0	110151
Other debt/Assets	140,080	1.423574	379.2104	0	137289
Employees	182,489	9.318123	122.3277	0	22362
Age	230,813	9.783526	11.93085	0	154
Covid Shock	262,509	-25.77381	18.76897	-56.73	54.95

Table 11 Summary statistics for the whole sample of observations for failures declared in 2020; balance sheet data 2018; Covid shock measured with data of the Household Budget Survey (2019-2020); Data source: Aida.

2020 – Summary statistics for restricted sample

Variable	Obs.	Mean	Std. dev.	Min	Max
Labour productivity	115,419	10.38095	21.63739	-99.66125	297.1693
Total debt/Assets	115,419	0.6777661	0.2329186	0	1
Bank debt/Assets	87,889	0.0960473	0.1613069	0	0.9707043
Supplier debt/Assets	87,889	0.1875644	0.2143668	0	0.9957792
Other debt/Assets	87,889	0.0516297	0.097092	0	0.9951677
Employees	115,419	9.066653	16.11173	1	250
Age	115,410	11.56722	12.76637	0	154
Covid Shock	115,419	-24.82102	19.21668	-56.73	54.95

Table 12 Summary statistics for the restricted sample of observations for failures declared in 2020; balance sheet data 2018; Covid shock measured with data of the Household Budget Survey (2019-2020); Data source: Aida.

3.1.4 Failures

It is interesting to present an overview of bankruptcies within our sample, further analysing the characteristics of the failed firms.

Sectoral distribution of failures

The sectoral distribution of failures is a relevant aspect to investigate to understand if between 2019 and 2020 there was any relevant change in the sectoral share of failures.

The number of failures for the considered years changes considerably. In fact, 2016 registered a total of 247 failures, 2017 a total of 601, 2018 registered 799 failures while 2019 registered the highest number of failures (1,161). In 2020, instead, the number of failures in the sample was of 885.

Table 13 displays the sectoral distribution of failures in percentage terms. The highest share of failures is usually in the *Accommodation* sector, with 2020 registering a share of 37.18%. Another sector registering high shares of failures is *Retail sale of clothing, textile, leather and related activities*, constituting 14.64% of failures in 2018 and 16.38% for 2020.

Considering the aim of this investigation, it may be interesting to compare possible changes in sectoral failures between 2019 and 2020. For this reason, a series of two-sample tests of proportions was carried in order to understand if the proportion of failures was significantly different between the two years. The analysis considered the percentage (proportion) of failures in 2019 and 2020 on the total of firms (both active and failed). For detailed results, see Appendix C.

Results for bilateral tests show that there is no significant difference for *Funeral and related activities*, *Hairdressing and other beauty treatment*, *Retail sale of automotive fuel in specialised stores*, *Retail sale of information and communication equipment in specialised stores*, *Retail sale of medical and related goods*, *Retail sale of other goods in specialised stores*, *Sports activities and amusement and recreation activities*, *Taxi operation*, *Travel agency, tour operator and other reservation service and related activities*, *Retail sale of clothing, textile, leather and related activities*. The p-values for

these sectors are higher than 0.1, leading to acceptance of the null hypothesis.
This notice is interesting considering that some of the included sectors were expected to be particularly affected by the pandemic. For instance, *Hairdressing and other beauty treatment*, *Taxi operation* and *Travel agency, tour operator and other reservation service and related activities* were impacted by the pandemic because of containment measures. Even if this assessment is limited in possible interpretation, it gives a first insight on the fact that government measures may have had a key role in the hibernation of the economy.

However, results also show that some sectors actually registered a significant change in the share of failures between the two years. It is the case of *Retail sale of cultural and recreation goods in specialised stores*, *Accommodation*, *Retail sale of other household equipment in specialised stores (repair included)* and *Sale of motor vehicles*.

The first sector (*Retail sale of cultural and recreation*) registers a relatively higher p-value (0.088), which is however still less than 0.1. For this reason, it is quite tricky to give an interpretation.

For other sectors, the p-value is less than 0.01, giving a high significance. The interpretation of this result is interesting for this work. For instance, the *Accommodation* sector is one of those believed to be highly impacted by the pandemic crisis. The fact that the shares of failures significantly changes between the two years indicates that either the impact was not absorbed by government measures or, on the contrary, such measures were excessive. Results for unilateral tests show the difference is significatively greater than 0, meaning that the proportion of failures in 2019 is significantly greater than the one for 2020. The same holds true for another highly impacted sector: *Sale of motor vehicles*. Even in this case, unilateral tests suggest that the share of failures in 2019 is higher than the one for 2020.
Interpreting this result is not easy because of its possible causes. It may be that the difference is related to a certain slowdown in the legal processing of failures. It is however also possible that this result may be an early sign of an excessive intervention by the government in the market.

Sector	2016	2017	2018	2019	2020
Accommodation	28.74	25.62	28.16	35.31	37.18
Funeral and related activities	0	0	0.5	0.17	0.23
Hairdressing and other beauty treatment	0.4	0.33	1.25	1.72	1.69
Retail sale of automotive fuel in specialised stores	0.81	0.83	0.5	0.6	1.24
Retail sale of cultural and recreation goods in specialised stores	4.05	2.16	2.13	2.24	1.69
Retail sale of food, beverages or tobacco in specialised and non-specialised stores	9.72	15.64	14.64	13.61	12.2
Retail sale of information and communication equipment in specialised stores	1.62	1.33	0.75	1.29	1.58
Retail sale of medical and related goods	0.81	0.83	0.63	0.43	1.02
Retail sale of other goods in specialised stores	2.83	1.83	2	1.55	1.58
Retail sale of other household equipment in specialised stores (repair included)	6.88	10.65	10.39	9.13	7.68
Sale of motor vehicles	14.98	14.98	12.52	12.06	9.27
Sports activities and amusement and recreation activities	8.91	5.16	7.13	5.51	5.65
Taxi operation	0	0	0	0.34	0.23
Travel agency, tour operator and other reservation service and related activities	4.45	2.5	2.88	1.89	2.37
Retail sale of clothing, textile, leather and related activities	15.79	18.14	16.52	14.13	16.38

Table 13 Percentage share of failures by sector in years 2016-2020. The share is calculated as the amount of failed companies in a sector over the total number of failures in a certain year. Data source: Aida

Geographical distribution of failures

Looking at the regional distribution of failures may be interesting in order to understand if there was any relevant geographical change between the pre and post pandemic period. In fact, detecting any regional change may allow for considerations on the impact of regional restrictive measures and infection rates.

Table 14 gives an insight on the matter. The share of failures by region seem to be quite stable over time. This intuition is confirmed by a series of two-sample tests of proportions, where the possible difference in proportion of failures on the overall number of companies in a given region was investigated.

Results, displayed in Appendix C, show that there is no significant difference in the share of failures between 2019 and 2020 for Abruzzo, Basilicata, Calabria, Emilia-Romagna, Friuli-Venezia Giulia, Liguria, Marche, Molise, Puglia, Sardegna, Sicilia, Trentino-Alto Adige and Valle d'Aosta. In fact, p-values of bilateral tests for these regions are very high, leading to acceptance of the null hypothesis. However, a very significant result is detected for Lazio, where the p-value is equal to zero so that the share of failures seems to change between 2019 and 2020. The same, even if with different p-values, holds true for Campania (p-value=0.067), Lombardia (p-value=0.025), Piemonte (p-value=0.026), Toscana (p-value=0.017), Umbria (p-value=0.035) and Veneto (p-value=0.013). Interestingly, but in line with the sectoral result, all these regions seems to register a proportion of failures higher in 2019. Similarly to what was said before, it is difficult to give an exact interpretation of this result, but it seems that regardless of sector and of regional distribution, the share of failures in 2020 either stayed unchanged or decreased with respect to 2019.

Region	2016	2017	2018	2019	2020
Abruzzo	2.83	2.33	2.13	1.98	1.81
Basilicata	0.4	0.83	0.88	0.52	0.45
Calabria	0.81	3.99	2	2.33	3.16
Campania	7.29	7.99	7.88	7.67	7.46
Emilia-Romagna	6.48	5.99	6.26	5.17	6.55
Friuli-Venezia Giulia	1.62	1.83	0.88	0.78	1.69
Lazio	12.55	13.98	14.39	15.07	11.64
Liguria	2.02	2.33	2.38	2.58	3.16
Lombardia	21.46	18.3	22.03	20.07	21.02
Marche	2.02	1.66	3.25	1.98	2.6
Molise	0.4	0.17	0.13	0.78	0.56
Piemonte	6.48	3.66	5.26	6.8	5.99
Puglia	4.05	5.49	4.63	5	5.2
Sardegna	0	0.67	1	0.69	0.79
Sicilia	10.93	7.99	9.14	8.53	10.4
Toscana	10.53	10.65	9.76	9.47	8.7
Trentino-Alto Adige	1.21	1	0.63	1.03	1.13
Umbria	2.02	2.66	1.38	1.64	0.9
Valle d'Aosta	0	0.33	0	0.09	0
Veneto	6.88	8.15	6.01	7.84	6.78

Table 14 Percentage share of failures by region in years 2016-2020. The share is calculated as the amount of failed companies in a region over the total number of failures in a certain year. Data source: Aida

Age distribution of failures

The age distribution of failures from 2016 to 2020 is displayed in the Table 15. The largest share of bankruptcies is registered for younger firms, with age between 0 and 5 years old, whereas older firms tend to constitute a smaller share of failures for each year. This is in line with the age composition of the sample, characterized by a large amount of SMEs, and with literature on the matter, which points out how smaller businesses tend to be more exposed to bankruptcy (Aleksanyan et al., 2016).

As for the sectoral composition of failures, it may be interesting to check if there is any relevant difference between 2019 and 2020 in the proportion of failed companies by age group. The set of two sample tests for proportions, displayed in detail in Appendix C, shows that for Class 2 there is no relevant difference in the proportion of failed companies on the total of firms in the two years. In fact, the p-value for the null hypothesis is equal to 0.478. On the contrary, the test detects a significant difference in the share of failed companies for Class 1, Class 3 and Class 4. For these classes, the p-value is equal to 0 or to 0.016.

The interpretation of this remark should be cautious. It appears that the share of failures on the total of companies in a given age class changes between 2019 and 2020, but it is hard to tell why. For this reason, it is best to consider this evidence as a preliminary notice of possible relevance of the Covid shock and the consequent government supports for bankruptcy dynamics.

		2016	2017	2018	2019	2020
Class 1	0-5 years old	35.19	37.28	40.68	43.35	40.32
Class 2	6-10 years old	23.18	23.5	21.9	22.16	26.84
Class 3	11-30 years old	33.91	30.39	29.34	26.15	27.42
Class 4	31 years and older	7.73	8.83	8.08	8.33	5.41

Table 15 Percentage share of failures by age class in years 2016-2020. The share is calculated as the amount of failed companies in a single age class over the total number of failures in a certain year. Data source: Aida

3.1.5 Labour productivity and Total debt over assets distributions

An interesting preliminary way to check possible differences in the characteristics of companies between failed and active companies and between failed firms in 2019 and in 2020 is to observe the density distributions of labour productivity and total debt over assets.

The distributions of labour productivity in 2019 displays a larger share of failed companies with very small or negative labour productivity two years prior to failure. On the contrary, active companies have a distribution slightly skewed toward the right side, where higher labour productivity is registered.

A similar situation is displayed for labour productivity in 2020. Failed companies exhibit a distribution with higher densities for negative values than active companies do.

Finally, the comparison between failed companies in 2019 and 2020 confirms a certain level of similarity in distributions. In this case, both distributions have a high share of companies with labour productivity around zero or negative. In the 2020 case, the share seems to be concentrated in values near zero.

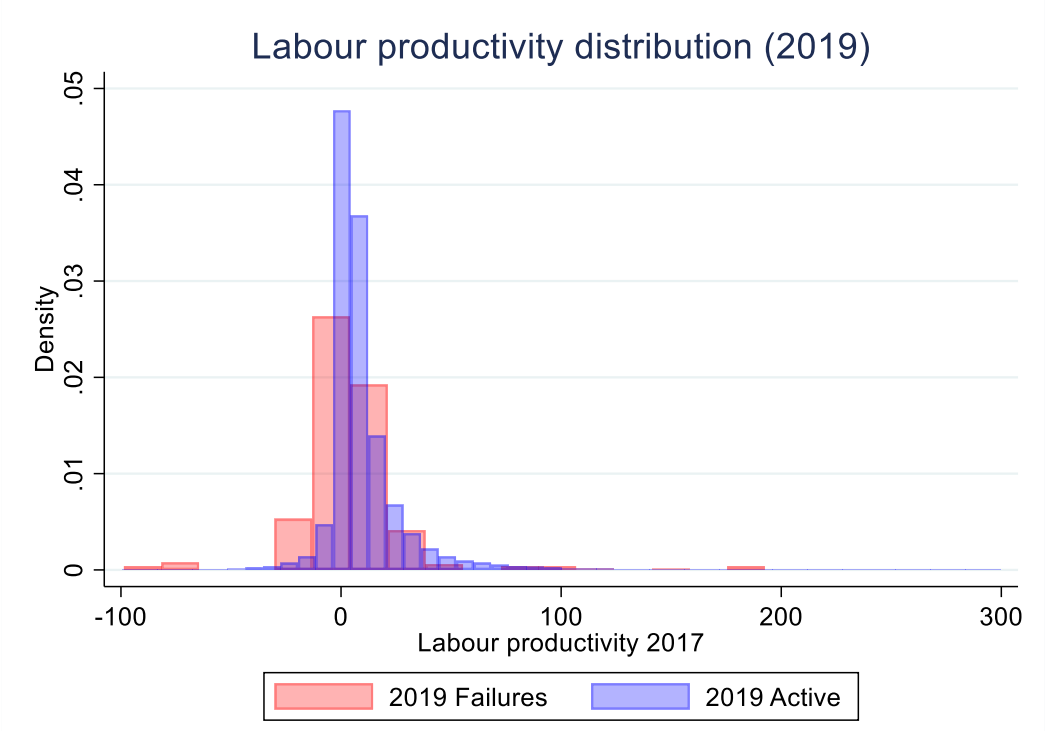


Figure 9 Labour productivity distribution of failed and active companies in 2019. Data source: Aida

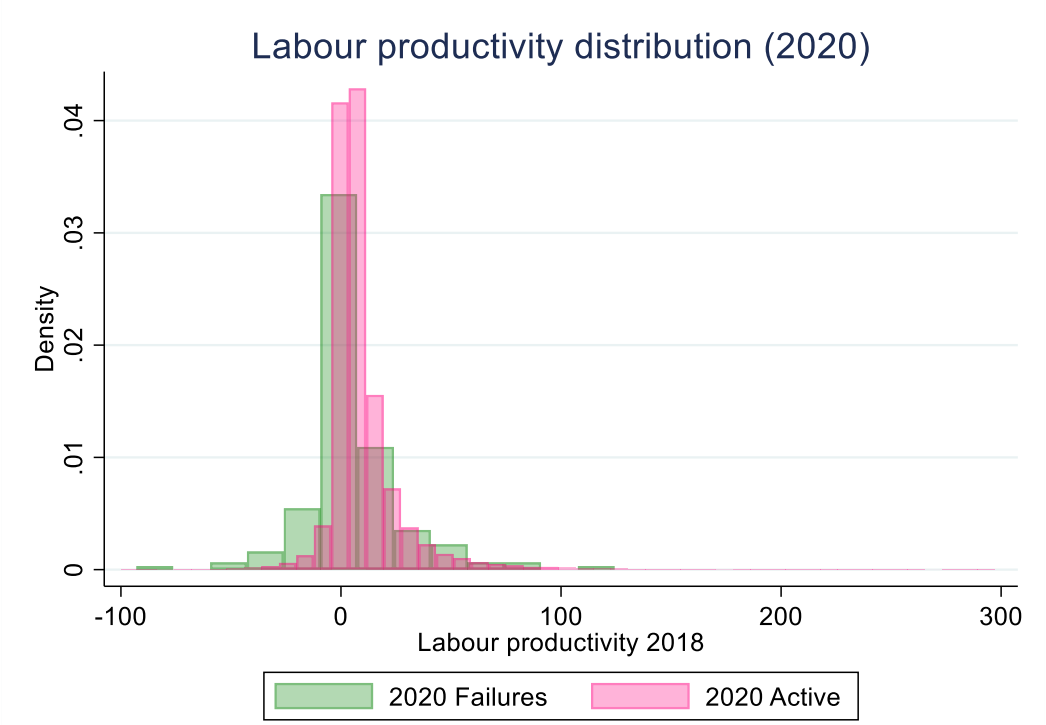


Figure 10 Labour productivity distribution of failed and active companies in 2020. Data source: Aida

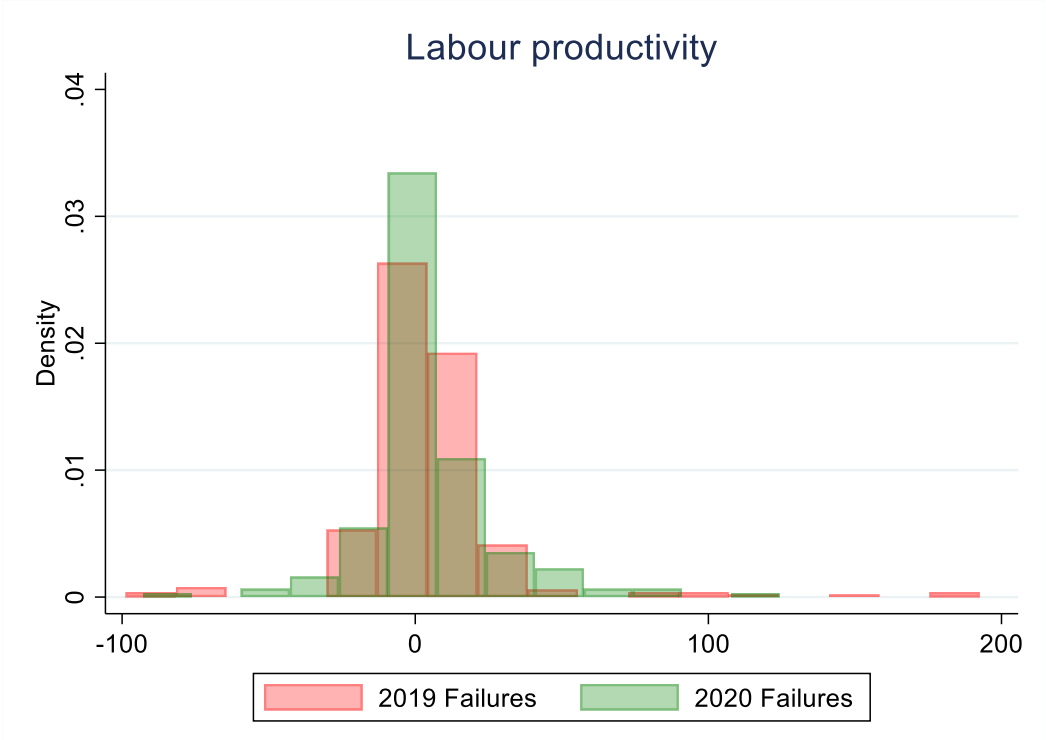


Figure 11 Labour productivity distribution of failed companies in 2019 and 2020. Data source: Aida

Figure 12 displays the distribution of total debt over assets between active and failed companies in 2019. The graph shows that the debt leverage ratio for failed companies is concentrated in values near 1.

The interesting aspect is that the distribution for the leverage for active companies is actually quite similar to the one of failed companies, displaying a distribution skewed toward the right side (higher leverage values). This seems to suggest that in general the entire Italian sample of our consideration is characterized by high leverage levels.
This result is quite different from the one by Cros et al. (2021), where the distributions of active and failed companies behaved quite oppositely and active companies display a distribution skewed toward the left side (low leverage).

In 2020 the distribution for failed and active companies is similar to the one displayed for 2019. For 2020's failed companies, it must be noted that the distribution actually seems to be exponential, with the highest share of companies with leverage near 1.

In conclusion, the comparison between total debt over assets distribution for failed companies in 2019 and 2020 confirms a certain level of similarity. In this case, both distributions have a high share of companies with leverage near 1.

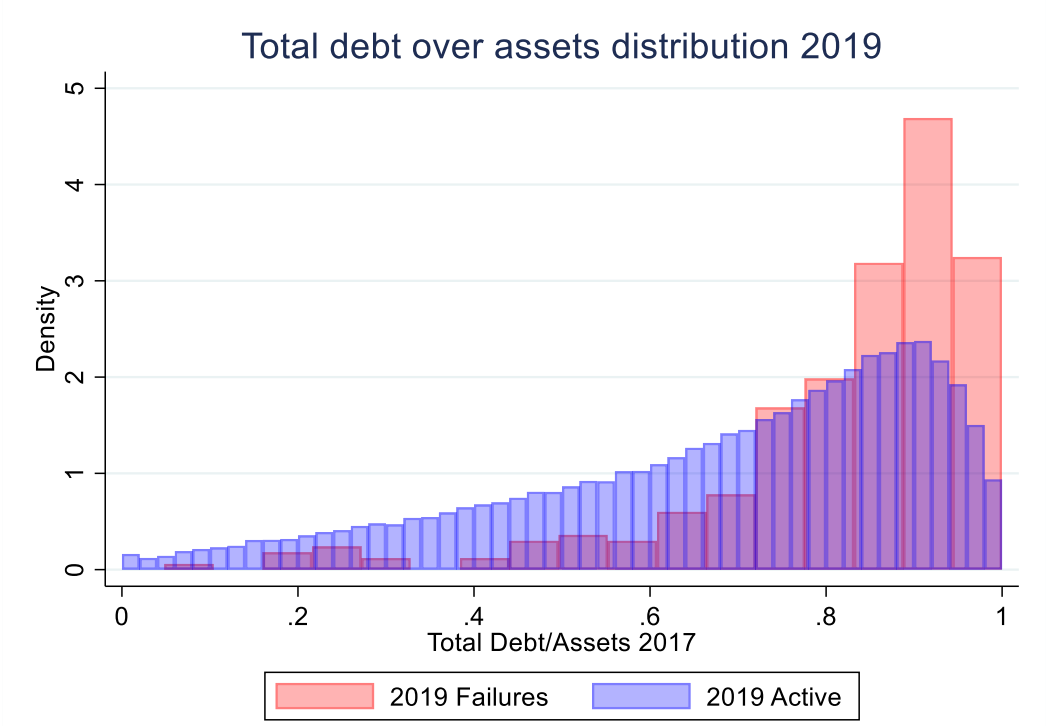


Figure 12 Total debt over assets distribution of failed and active companies in 2019. Data source: Aida

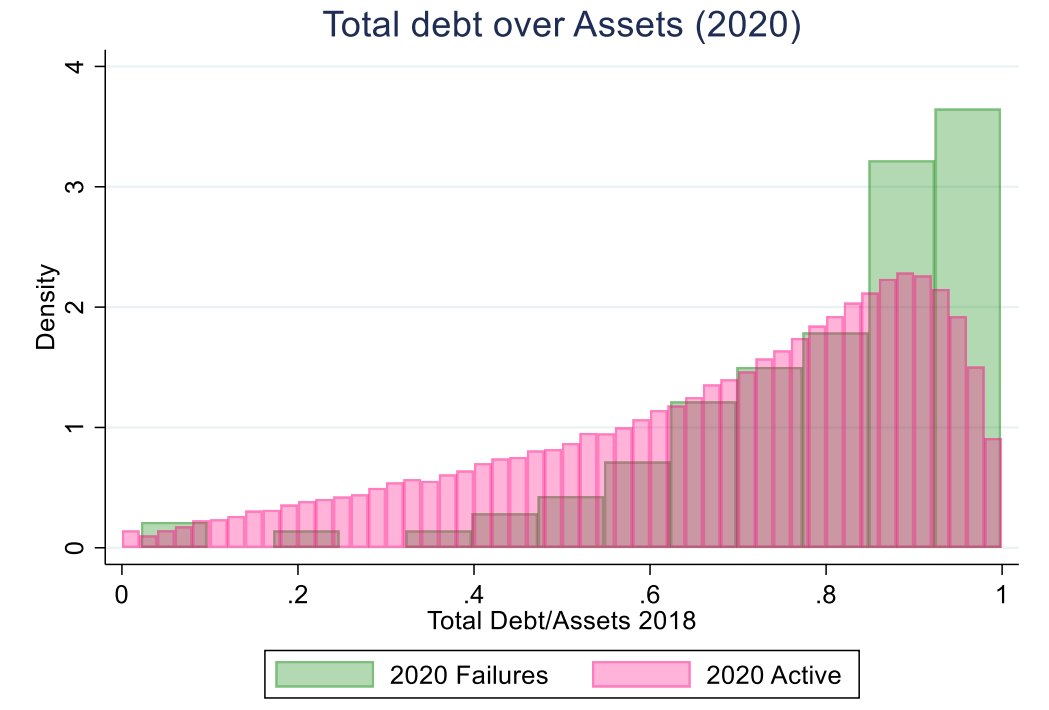


Figure 13 Total debt over assets distribution of failed and active companies in 2020. Data source: Aida

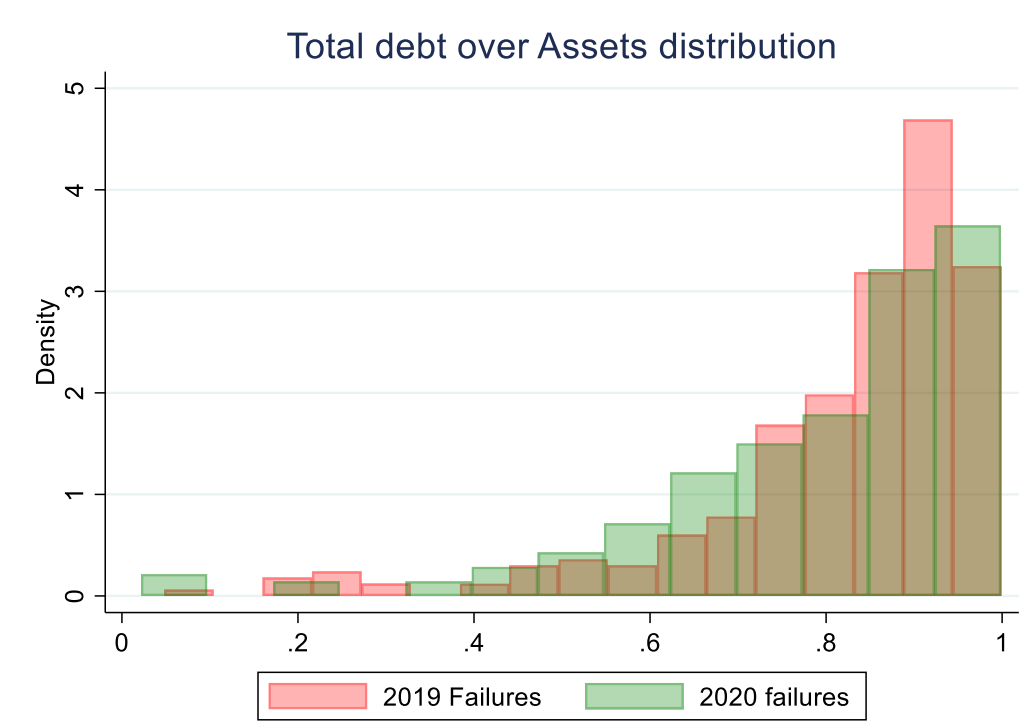


Figure 14 Total debt over assets distribution of failed companies in 2019 and 2020. Data source: Aida

3.2 Model

3.2.1 Models for bankruptcy analysis

There is a great variety of models used in literature to analyse the bankruptcy probability of firms. The main issue encountered in modelization of failures concerns the rarity of such events. In fact, bankruptcies tend to constitute a very small share of observations in a considered sample and occur as "exceptional" events, even if considered physiological in an overall economy. This issue is somehow reduced for our sample because of the number of total observations, which is considerably high (Williams, 2016).

First models used for bankruptcy analysis rely on the discriminant analysis. It is the case, for example, of the analysis by Altman (1968), where the author develops a multiple discriminant analysis to investigate financial determinants of failure. This technique consists in the "classification of observations into one of several a priori groupings dependent upon the observation's individual characteristics" (Altman, 1968). In this case, the groupings considered should be "bankrupt" and "not bankrupt". In the end, the multivariate discriminant methodology derives a linear combination of characteristics which best discriminate between the groups.

Despite its early usage, this methodology has many limits. Lennox (1999) showed how the assumption of normality for the independent variables, which is at the basis of the discriminant analysis, was often violated. For this reason, later studies tend to rely on other methodologies: linear probability models and logistic regressions.

The first to apply the linear probability model to such kind of analysis were Meyer and Pifer (1970), while logistic regression models were used by Martin (1977).
Both kind of analyses have their limits in their application for bankruptcy prediction.

The linear probability model can be considered a special case of an OLS regression, with the difference that the dependent variable is binary. In fact, in the case of bankruptcies, the dependent is a dummy with "failed" and "not failed" as conditions.
In general, the equation is in the following form:

$$Y = \alpha + X\beta + \varepsilon$$

Where Y identifies the probability of failure (in terms of the dummy variable), α is the constant term, $X\beta$ is the set of regressors with coefficients and ε is the error term.
The limits of the linear probability model start from the fact that in bankruptcy models the assumption of a constant error variance is usually not met. In addition, one of the major issues for bankruptcy analysis is that the predicted probabilities may be lower than zero or exceed one, making the model less meaningful. Finally, as Collins et al. (1982) point out, the assumption of linear relationship between the probability of failure and financial ratios is not very satisfying. However, the authors point out that despite this the linear probability model "does a very respectable job of forecasting" (Collins et al., 1982) in the bankruptcy case, making it a valuable model to include in this investigation.

Most of the issues related to the linear probability modelization are overcome with the logistic regression model. In such case, the logistic function is used to model the dependent variable. By construction, the problem of values greater than 1 or smaller than 0 is excluded because of the functional form assumption. In fact, the logistic cumulative function is a sigmoid curve that asymptotically approaches 0 and 1. The model equation is therefore the following:

$$Y = \frac{1}{1 + e^{-(\alpha + X\beta)}} + \varepsilon$$

Where, as before, Y identifies the probability of failure (in terms of the dummy variable), α is the constant term, $X\beta$ is the set of regressors with coefficients and ε is the error term.
The logistic regression in fact seems to be the most correct one but despite this it has important interpretative limitations. When the model is in the linear form its coefficients represent the incremental effects of X on the log-odds ratio. In particular:

$$ln(\frac{Y}{1 - Y}) = \alpha + X\beta + \varepsilon$$

For this reason this investigation tries to include both models in order to give a complete insight of the failing dynamics in Italy.
The LPM model allows for easier interpretation of coefficients, but its assumptions do not apply too well to the bankruptcy analysis. Therefore, the logit model is included given its better theorical and statistical appeal.

3.2.2 Linear probability model

The linear probability model for the analysis object of this work considers the determinants of failure as regressors for bankruptcy probability. In particular, the equation of interest is the following:

$$Y_t = \alpha + \beta x_{it-2} + \mu_s + \varepsilon$$

The dependent variable is Y, the probability of failure in a certain year. The regressors are the information on the company (*i*) from the two prior years, so that the failing probability in *t* is determined by the firm characteristics in *t-2*.The model also includes the constant term α and some fixed effects (μ_s), which are age fixed effects, sectoral fixed effects and regional fixed effects.

In order to have a more complete overview of the bankruptcy determinants, the analyses conducted are two. The first one includes total debt over assets as the main leverage regressor, while a second one decomposes this variable into bank debt over assets, supplier debt over assets and other debt over assets.

Tables 16, 17, 18 and 19 display the coefficients of the linear probability model. For each variable three values are reported: coefficients of the linear probability model with significance level indicated (expressed as: ***: p<0.01; **: p<0.05; *: p<0.1), the robust standard errors (in brackets) and the standardized (also called beta) coefficients.
A separate table is created for each model: one for the model including debt leverage as total debt over assets, one for the model differentiating between debt components.

Results for the model considering total debt over assets show that the significant determinants for bankruptcy in the considered years are primarily debt leverage and the number of employees. The coefficients are positive for both regressors, even if their magnitude is relatively contained. This means that, coherently with theory, a company is more at risk of failure the more it is indebted. For what concerns the number of employees, instead, the possible reason for a positive coefficient concerns the costs related to employees. However, it must be noted that for most years this regressor has coefficients quite smaller than the ones of debt leverage. Labour productivity, instead, is not significant for most of the considered years except for 2016, where the coefficient is

negative. This is coherent with theory: the higher the productivity per worker of a company, the lower the risk of going bankrupt.

Looking at the model by debt component, it is possible to note that the number of employees remains significant as previously seen, with a positive coefficient for all years. The most significant leverage variables for bankruptcy probability are bank debt over assets and supplier debt over assets. All coefficients are positive, with a certain distinction for bank debt, where the significance is high ($p<0.01$) for three years (2017, 2019, 2020).

These notices give us an overview of the situation of bankruptcy dynamics before Covid-19. Significant coefficients tend to vary little and no significant change in sign is detected for any of the considered years.

Linear probability model

	2016	2017	2018	2019	2020
Labour productivity	-0.0000148**	-0.0000123	5.95e-06	-0.0000136	-7.40e-06
	(5.98e-06)	(7.93e-06)	(9.85e-06)	(8.84e-06)	(5.85e-06)
	-0.0111149	-0.005952	0.0028409	-0.0059625	-0.0039802
Total debt / assets	0.0025774***	0.0051656***	0.0046771***	0.0067339***	0.0032463***
	(.0004583)	(0.0006613)	(0.0006449)	(0.0006736)	(.0005025)
	0.0192838	0.0247625	0.0225212	0.0298977	0.0187546
Ln(nb of employees)	0.000067	0.0006544***	0.0007728***	0.0008058***	0.0008099 ***
	(.0001082)	(.0001609)	(0.0001698)	(0.0001825)	(0.0001413)
	0.0022978	0.0141559	0.0170466	0.0163536	0.0208318
Constant	-0.0008821	-0.0030473***	-0.0029197***	-0.0054732***	-0.003368***
	(.0008024)	(0.0010766)	(.0010368)	(0.0009)	(0.0006307)
Sectoral FE	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes
Obs.	86,347	97,573	103,331	109,426	115,225
R^2	0.0010	0.0017	0.0015	0.0023	0.0017
Bankruptcy percentage	0.09%	0.23%	0.23%	0.27%	0.16%

Table 16 Outcomes of the linear probability model by predictors of bankruptcy probability (years 2016-2020). Coefficients with significance level (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets and the standardized coefficients are also included. Data source: Aida.**

Linear probability model					
	2016	2017	2018	2019	2020
Labour productivity	-.0000159	-0.0000185**	3.74e-06	-0.0000255	-7.85e-06
	(5.98e-06)	(7.93e-06)	(0.0000118)	(0.0000102)	(6.59e-06)
	-0.0125675	-0.0091528	0.0018021	-0.0119669	-0.0044568
Bank debt / assets	0.0011873**	0.0033316***	0.0023021**	0.0050702***	0.0028087***
	(0.0005912)	(0.0009732)	(0.0010659)	(0.0013821)	(0.0009977)
	0.0073301	0.0124899	0.0079163	0.0163139	0.0115186
Supplier debt / assets	0.0010474*	0.002835***	0.0015771*	0.0015583*	0.0010101
	(0.0006261)	(0.0008618)	(0.0009588)	(0.0009339)	(0.0007361)
	0.0079325	0.0134548	0.0073935	0.0069097	0.0055041
Other debt / assets	0.0012539	0.0003181	0.0037342*	0.0017406	0.0023264
	(0.0009981)	(.0010188)	(.0022303)	(0.0017483)	(0.001787)
	0.0048198	0.0007702	0.0080814	0.0034143	0.0057437
Ln(nb of employees)	-0.0000103	0.000683***	0.0007763***	0.0007127***	0.0006899***
	(.000109)	(.0001609)	(0.0001925)	(0.0002052)	(0.0001623)
	-0.0003739	0.0152546	0.017338	0.0153117	0.0185118
Constant	.0003277	-0.0002871	0.0005589	-0.0014588**	-0.0012792**
	(0.0006211)	(0.0009891)	(0.0012375)	(0.0006576)	(0.0005825)
Sectoral FE	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes
Obs.	76,106	86,321	80,635	84,036	87,710
R^2	0.0007	0.0016	0.0013	0.0017	0.0015
Bankruptcy percentage	0.086%	0.22%	0.23%	0.25%	0.15%

Table 17 Outcomes of the linear probability model by predictors of bankruptcy probability (years 2016-2020). Coefficients with significance level (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets and the standardized coefficients are also included. Data source: Aida.**

It is then interesting to focus on the possible changes between 2019 and 2020 and to consider, in particular, the relevance of the Covid-19 Shock. Tables 18 and 19 focus on this issue.

It is possible to notice that the difference between coefficients between 2019 and 2020 is not null, but however quite contained. The Covid shock variable, instead, is a significant determinant of failures for 2020 with a p-value of 0.089. The coefficient, as we would expect, is positive: the more a company was hit by the shock, measured in terms of sectoral household expenditure shock, the higher the risk of default.
This is interesting for our analysis: the Covid shock variable is still significant (even if at lower levels than other variables), so that it appears that the shock was not fully absorbed by policies. However, the coefficients do not seem to change much between 2020 and the previous years. This is particularly true in the case of significant coefficients, which display very little differences.

However, when it comes to considering the leverage ratios by debt component, additional notices arise. It holds true that the coefficients for significant variables do not seem to change much: the logarithm of the number of employees displays a very similar coefficient, while bank debt over assets shows little difference between the two years. However, in such case the Covid shock regressor loses its significance in the model. This could lead to believe that the Covid shock is actually not relevant in the model, but this result must be interpreted cautiously. In this case, the preference is to stick in the interpretation to the model with the highest R^2 (that is, understandably, the one considering all debt components so the total debt over assets leverage ratio). The main take out point of this analysis is that it emerges that among considered debt components, the most significant one is bank debt.

Linear probability model				
	2018	2019	2020	2020 Covid Shock
Covid Shock				0.0000275*
				(0.0000162)
				0.0131545
Labour productivity	5.95e-06	-.0000136	-7.40e-06	-7.57e-06
	(9.85e-06)	(8.84e-06)	(5.85e-06)	(5.87e-06)
	0.0028409	-0.0059625	-0.0039802	-0.004076
Total debt / assets	0.0046771***	0.0067339***	0.0032463***	0.003249***
	(0.0006449)	(0.0006736)	(.0005025)	(0.0005026)
	0.0225212	0.0298977	0.0187546	0.0187703
Ln(nb of employees)	0.0007728***	0.0008058***	0.0008099 ***	0.0008077***
	(0.0001698)	(0.0001825)	(0.0001413)	(0.0001413)
	0.0170466	0.0163536	0.0208318	0.0207751
Constant	-0.0029197***	-0.0054732***	-0.003368***	-0.0023111***
	(.0010368)	(0.0009)	(0.0006307)	(0.0008313)
Sectoral FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes
Obs.	103,331	109,426	115,225	115,225
R^2	0.0015	0.0023	0.0017	0.0017
Bankruptcy percentage	0.23%	0.27%	0.16%	0.16%

Table 18 Outcomes of the linear probability model by predictors of bankruptcy probability (years 2018-2020 and 2020 with Covid shock included). Coefficients with significance level (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets and the standardized coefficients are also included. Data source: Aida**

Linear probability model				
	2018	2019	2020	2020 Covid Shock
Covid Shock				0.0000131
				(0.0000158)
				0.0065161
Labour productivity	3.74e-06	-0.0000255	-7.85e-06	-7.95e-06
	(0.0000118)	(0.0000102)	(6.59e-06)	(6.61e-06)
	0.0079163	0.0163139	0.0115186	-0.0045131
Bank debt / assets	0.0023021**	0.0050702***	0.0028087***	0.0028075***
	(0.0010659)	(0.0013821)	(0.0009977)	(0.0009975)
	0.0079163	0.0163139	0.0115186	0.0115138
Supplier debt / assets	0.0015771*	0.0015583*	0.0010101	0.001003
	(0.0009588)	(0.0009339)	(0.0007361)	(0.0007363)
	0.0073935	0.0069097	0.0055041	0.0054652
Other debt / assets	0.0037342*	0.0017406	0.0023264	0.0023298
	(.0022303)	(0.0017483)	(0.001787)	(0.0017869)
	0.0080814	0.0034143	0.0057437	0.0057523
Ln(nb of employees)	0.0007763***	0.0007127***	0.0006899***	0.0006893***
	(0.0001925)	(0.0002052)	(0.0001623)	(0.0001624)
	0.017338	0.0153117	0.0185118	0.0184941
Constant	0.0005589	-0.0014588**	-0.0012792**	-0.000773
	(0.0012375)	(0.0006576)	(0.0005825)	(0.000765)
Sectoral FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes
Obs.	80,635	84,036	87,710	87,710
R^2	0.0013	0.0017	0.0015	0.0015
Bankruptcy percentage	0.23%	0.25%	0.15%	0.15%

Table 19 Outcomes of the linear probability model by predictors of bankruptcy probability (years 2018-2020 and 2020 with Covid shock included. Coefficients with significance level (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets and the standardized coefficients are also included. Data source: Aida**

3.2.3 Logistic regression

The logistic regression model developed in this study for the analysis of the bankruptcy dynamics in Italy for the considered years is comparable to the one by Cros et al.(2021). The model explains the probability of bankruptcy in a given year *t* based on balance sheet information of firms in year *t-2*.
The constructed models are two. A first model includes as regressors labour productivity, leverage as total debt over assets, the logarithm of the employees and controls for age fixed effects, sectoral fixed effects and regional fixed effects. The second model, instead, regresses leverage by debt component, including bank debt over assets, supplier debt over assets and other debt over assets.

The model equation is therefore:

$$Y_t = \frac{1}{1 + e^{-(\alpha+\beta x_{it-2}+\mu_s)}} + \varepsilon$$

Or, alternatively, expressed as a generalized linear model (looking at the log-odds of the outcome):

$$ln(\frac{Y_t}{1 - Y_t}) = \alpha + \beta x_{it-2} + \mu_s + \varepsilon$$

where Y_t is the probability of failure; x_{it-2} is the vector of regressors with β vector of coefficients and μ_s is the vector of fixed effects.

Tables 20, 21, 22 and 23 display results of the logistic regressions for each year separately. As for the linear probability model case, significances tend to vary over time. Labour productivity is a significant determinant of failures for 2016, with a negative coefficient, coherently with literature. Except for 2018, all other coefficients are negative, even if not significant (p>0.1). This suggests that the more productive a firm is, the less is the probability for it to default.

Total debt over assets, instead, is a significant determinant for failures in all the considered years. The magnitude of coefficients is of difficult interpretation, however it is possible to notice that all are positive. Therefore, the more a company is indebted, the higher is the risk of facing bankruptcy. Finally, the log of the number of employees is

significantly positive for 2017, 2018, 2019 and 2020. This is in line with findings of the linear probability model and suggests again that there may be a certain relevance for the number of employees in a SMEs, possibly in terms of costs faced.

The regression including leverage by debt component gives somehow slightly different results. The significance of labour productivity is still different from one year to the other, but the sign of coefficients is still negative for all significant cases.

The interesting aspect concerns the significance of bank debt over assets. All coefficients are highly significant ($p<0.01$) for all the considered years, showing that the indebtedness of companies toward banks is very relevant for bankruptcy risk.

Supplier debt over assets, instead, displays lower levels of significance and a positive coefficient for all years considered. This shows that the level of indebtedness toward suppliers is still relevant in bankruptcy determination and that the more a company is indebted toward suppliers, the higher the possibility for it to go bankrupt.

Other debt over assets is the least significant leverage ratio in the model, displaying a positive coefficient for all years.

Lastly, the log number of employees is significant for years 2017, 2018, 2019 and 2020. As before, it displays positive coefficients for all years.

Logistic regression					
	2016	2017	2018	2019	2020
Labour productivity	-0.0256452***	-0.0108319	0.0030344	-0.0107705	-0.0093797
	(0.0086486)	(0.007854)	(0.004535)	(0.0078666)	(0.0083572)
Total debt / assets	4.080862***	3.457367***	2.991726***	3.984668***	2.974955***
	(0.8728002)	(0.5634655)	(0.4854488)	(0.4934551)	(0.5471931)
Ln(nb of employees)	0.1317108	0.2759623***	0.3170407***	0.2951157***	0.4586834***
	(0.0996351)	(0.056818)	(0.0598283)	(0.0559121)	(0.0636039)
Constant	-10.34727***	-9.622223***	-9.29998***	-10.66563***	-11.13898***
	(1.122083)	(0.7383598)	(0.6038055)	(0.718221)	(1.18418)
Sectoral FE	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes
Obs.	79,179	94,483	101,123	105,523	110,600
Pseudo R^2	0.0730	0.0553	0.0478	0.0669	0.0719
Bankruptcy percentage	0.10%	0.24%	0.23%	0.28%	0.17%

Table 20 Outcomes of the logistic regression by predictors of bankruptcy probability (years 2016-2020). Coefficients and significance levels (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets. Data source: Aida**

Logistic regression					
	2016	2017	2018	2019	2020
Labour productivity	-0.0289096***	-0.0176409**	0.0016162	-0.0199179**	-.0089025
	(0.0097179)	(0.0080226)	(0.0054395)	(0.008686)	(0.0089018)
Bank debt / assets	1.43738***	1.551904***	1.028139***	1.769805***	1.712702***
	(0.5893142)	(0.3725294)	(0.3793129)	(0.3616922)	(0.4532912)
Supplier debt / assets	1.32945*	1.261172***	0.7269629*	0.7094462**	0.7666145*
	(0.7323686)	(0.3571608)	(0.3740075)	(0.3494718)	(0.4174079)
Other debt / assets	1.467094*	0.2558212	1.55023**	0.8141121	1.552118*
	(0.9056139)	(0.6263463)	(0.6595331)	(0.6514553)	(0.8182043)
Ln(nb of employees)	0.0451247	0.2915523***	0.3096104***	0.2783613***	0.397409***
	(0.1141171)	(0.0615341)	(0.0679585)	(0.0693068)	(0.0792297)
Constant	-7.996693***	-7.423948***	-6.973605***	-8.469681***	-8.901587***
	0.9815811	(0.6074367)	(0.483636)	(1.004865)	(1.021452)
Sectoral FE	Yes	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes	Yes
Obs.	69,915	82,232	78,978	81,077	82,648
Pseudo R^2	0.0502	0.0472	0.0392	0.0468	0.0586
Bankruptcy percentage	0.09%	0.24%	0.24%	0.26%	0.16%

Table 21 Outcomes of the logistic regression by predictors of bankruptcy probability (years 2016-2020). Coefficients and significance levels (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets. Data source: Aida**

The analysis of the regressions including the Covid-19 shock gives interesting results. The significance of coefficients for the model including total debt over assets is high for all variables except labour productivity.

Looking at the sign of coefficients for years previous to 2020 and for 2020 excluding the shock, there is no relevant change. However, the shock displays a high significance ($p<0.01$), suggesting that the impact of the sectoral shock is actually a relevant determinant of failures for 2020. The coefficient is positive, so that the more a company was hit by the pandemic shock, the more it would face the risk of bankruptcy. This is a

very important result in this analysis because it suggests that the government measures were not able to completely absorb the sectoral shock.

However, as for the linear probability model, also in this case the model with leverage differentiated by debt component gives different results. The Covid-19 shock appears to be no longer significant, while the most significant variables are bank debt over assets and the number of employees. Even in this case it is hard to interpret such result from the point of view of the shock. However, the most complete model is surely the one including total debt over assets (it also displays a higher pseudo R^2). The regression, even in this case, is more useful to give an insight on the relevance of single debt components. The level of indebtedness toward banks is the most significant determinant for bankruptcy in 2020 if compared to supplier debt over assets and other debt over assets. The two latter ratios, however, are still significant in the model.

Logistic regression				
	2018	2019	2020	2020 Covid shock
Covid Shock				0.0171224***
				(0.0083135)
Labour productivity	0.0030344	-0.0107705	-0.0093797	-0.0095881
	(0.004535)	(0.0078666)	(0.0083572)	(0.008404)
Total debt / assets	2.991726***	3.984668***	2.974955***	2.981027***
	(0.4854488)	(0.4934551)	(0.5471931)	(0.5469949)
Ln(nb of employees)	0.3170407***	0.2951157***	0.4586834***	0.4591869***
	(0.0598283)	(0.0559121)	(0.0636039)	(0.0636473)
Constant	-9.29998***	-10.66563***	-11.13898***	-10.48865***
	(0.6038055)	(0.718221)	(1.18418)	(1.17202)
Sectoral FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes
Obs.	101,123	105,523	110,600	110,600
Pseudo R^2	0.0478	0.0669	0.0719	0.0730
Bankruptcy percentage	0.23%	0.28%	0.17%	0.17%

Table 22 Outcomes of the logistic regression by predictors of bankruptcy probability (years 2018-2020 and 2020 with Covid shock included). Coefficients and significance levels (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets. Data source: Aida**

Logistic regression				
	2018	2019	2020	2020 Covid Shock
Covid Shock				0.0110052
				(0.0098949)
Labour productivity	0.0016162	-0.0199179**	-.0089025	-0.008949
	(0.0054395)	(0.008686)	(0.0089018)	(0.008908)
Bank debt / assets	1.028139***	1.769805***	1.712702***	1.710965***
	(0.3793129)	(0.3616922)	(0.4532912)	(0.4523387)
Supplier debt / assets	0.7269629*	0.7094462**	0.7666145*	0.7516179*
	(0.3740075)	(0.3494718)	(0.4174079)	(0.4187592)
Other debt / assets	1.55023**	0.8141121	1.552118*	1.564839*
	(0.6595331)	(0.6514553)	(0.8182043)	(0.8160376)
Ln(nb of employees)	0.3096104***	0.2783613***	0.397409***	0.3989958***
	(0.0679585)	(0.0693068)	(0.0792297)	(0.0792545)
Constant	-6.973605***	-8.469681***	-8.901587***	-8.478138***
	(0.483636)	(1.004865)	(1.021452)	(1.002652)
Sectoral FE	Yes	Yes	Yes	Yes
Age FE	Yes	Yes	Yes	Yes
Regional FE	Yes	Yes	Yes	Yes
Obs.	78,978	81,077	82,648	82,648
Pseudo R^2	0.0392	0.0468	0.0586	0.0589
Bankruptcy percentage	0.24%	0.26%	0.16%	0.16%

Table 23 Outcomes of the logistic regression by predictors of bankruptcy probability (years 2018-2020 and 2020 with Covid shock included). Coefficients and significance levels (*: p<0.01; **: p<0.05; *: p<0.1) are displayed. Standard errors are in brackets. Data source: Aida**

3.2.4 Analysis of R^2

The decomposition of R^2 is an interesting analysis that allows access to the relative importance of each predictor in a model.

R^2 (determination coefficient) is in fact a coefficient that in general identifies the proportion of variation in the dependent variable that is explained by the independent variables included in the model. In an ordinary least squares model (OLS) it is usually calculated as:

$$R^2 = 1 - \frac{\sum_{i=1}^{N}(y_i - \hat{y}_i)^2}{\sum_{i=1}^{N}(y_i - \overline{y})^2}$$

With *N* number of observations, *y* dependent variable; $\hat{y}$ value predicted by the model; $\overline{y}$ the mean of the *y* values. The numerator of the ratio identifies the Residual Sum of Squares (RSS= $\sum_{i=1}^{N}(y_i - \hat{y}_i)^2$); the denominator is the Total Sum of Squares (TSS = $\sum_{i=1}^{N}(y_i - \overline{y})^2$).

Given that RSS can be thought of as the variability in the dependent variable not predicted by the considered model, the ratio can be seen as the proportion of total variability unexplained by the model.

In linear probability models the R^2 can be interpreted as the percentage of explained variance in the model. In this sense, it has the same interpretation of the OLS model, given that the linear probability model is a special case of OLS regression.

However, logit models do not have an R^2 as present in OLS regressions, because the regression rely on maximum likelihood estimates that are calculated through an iterative process. Despite this, the logistic regression presents what is referred at as Pseudo-R^2 or the McFadden R^2. It is defined as follows:

$$Pseudo - R^2 = 1 - \frac{\ln(L_f)}{\ln(L_0)}$$

Where the numerator of the ratio is the log likelihood of the fitted model, while the denominator is the log likelihood of the null model (including only the intercept as predictor).

The interpretation of the Pseudo-R^2 is slightly different than the one for OLS R^2. The Pseudo-R^2 in fact represent the improvement in model likelihood over a null model.
This qualitative differentiation is relevant when performing analyses on the decomposition of R^2 and Pseudo-R^2. Among the existing techniques that do this, we rely on the so called dominance analysis and the Shapley value decomposition of R^2, which allow in different ways to understand the importance of each regressor in the model.

3.2.5 Dominance analysis

Dominance analysis is a methodology often used to compare the relative importance of predictors in multiple regressions. In fact, it "determines the dominance of one predictor over another by comparing their additional R^2 contributions across all subset models" (Azen et al., 2006). In particular, it performs "pairwise comparisons of all predictors in the model as they relate to the outcome variable" (Azen et al., 2006). Methodologically, dominance analysis performs a series of comparisons for all possible combinations of independent variables by "aggregating fit metrics across multiple models"[15]. In this sense, the outcome is based on a series of estimations and does not constitute a postestimation analysis of a single outcome.

Dominance analysis in its underlying meaning may be useful for this work because it may add some remarks on the relative importance of the predictors of failure probability. Therefore, it may be interesting to perform it for the linear probability model and the logistic regression for 2019 and 2020, including the shock variable. The conducted analyses are two: one with total debt over assets as leverage and the other with ratios by debt component. The primary interests in interpretation are the detection of relevant changes in the dominance ranking between the two years and in the ranking of the Covid-19 shock.

[15] Details on the methodology used can be found at the following link: https://github.com/jluchman/domin#:~:text=Dominance%20Analysis-,A%20Stata%20Implementaion,%2C%202007%20for%20a%20discussion).

Linear probability model

The dominance analysis for the linear probability models in 2019 and 2020 displays the following contributions for the overall R^2 (table 24 and 25).

Results for the analysis including total debt over assets detect some interesting changes between the two years. In 2019 the three most important predictors of failure are the leverage level (total debt over assets), the regional location and the sector of belonging. This is understandable: given that the indebtment level is quite relevant for the risk of bankruptcy, one would coherently expect it to have one of the first places. Regional location and sector of belonging, instead, are two understandable determinants because of possible intrinsic differences in failure dynamics. In particular, we can suppose that the importance of the regional location is linked to the structure of the Italian economy, where companies tend to be clustered. This guess is somehow confirmed in the dataset: as we have seen in previous paragraphs, the distribution of companies in the sample is itself clustered in some locations (such as Lazio and Lombardia). The consideration for the sector of belonging is somehow similar: there is a certain major distribution of failures in some sectors, while it is also possible that by market characteristics one sector registers more failures than others.

The 2020 dominance analysis including total debt over assets somehow declasses the order of relevance of indebtment leverage, which is still among the most important variables. The relevance of the regional location becomes the primary contributor for R^2, while the second is the number of employees.

The Covid shock is the least ranked contributor to the overall R^2, confirming the idea that the shock was correctly absorbed by government policies and that overall there are no particular changes in the impact of usual variables in bankruptcy dynamics between the two years.

Dominance analysis for LPM
(Rankings)

	2019	2020
Labour productivity	5	6
Total debt/assets	1	3
ln(nb employees)	4	2
Sector	3	4
Region	2	1
Age	6	5
Covid Shock	/	7

Table 24 Dominance analysis for the linear probability model including leverage as total debt over assets. Data source: Aida.

It is however interesting to further observe the contribution of indebtment by single debt component. For this reason, we analyse the dominance analysis including as leverage ratios bank debt over assets, supplier debt over assets and other debt over assets.

This analysis shows that among debt components the most important one is indebtment toward banks, as also confirmed by the regressions presented in paragraph 3.2.3.

However, it must be noted that an interesting change in the most important determinant is detected in this dominance analysis: the first contributor to failure probability in 2020 is the sector of belonging, while for 2019 it was the third. This is an interesting notice in light of the possible sectoral impact of the coronavirus crisis on different sectors. In this sense, this result can be seen as a suggestion and confirmation that the overall sectoral heterogeneity of the Covid-19 shock may have not been completely absorbed by policies. In addition, even in this case the shock itself stays at the last ranking position as the least important contributor for probability of failure.

Dominance analysis for LPM
(Rankings)

	2019	2020
Labour productivity	5	8
Bank debt/assets	4	4
Supplier debt/assets	6	5
Other debt/assets	8	7
ln(nb employees)	2	3
Sector	3	1
Region	1	2
Age	7	6
Covid Shock	/	9

Table 25 Dominance analysis for the linear probability model including leverage ratios by debt component. Data source: Aida.

Logistic regression

The dominance analysis for the logistic regressions in 2019 and 2020 gives results quite similar to those of the linear probability model.

As before, for the model including total debt over assets the rankings between the two years are basically the same. Minimal changes are detected for total debt over assets, which is the most important contributor in 2019, second in 2020, and regional location, second contributor in 2019 and first in 2020.

Even in this case, the Covid shock is the last determinant for the probability of default in 2020, confirming the evidence from logistic regression coefficients that government policies correctly hibernated the economy.

Dominance analysis for logit
(Rankings)

	2019	2020
Labour productivity	5	5
Total debt/assets	1	2
ln(nb employees)	3	3
Sector	4	4
Region	2	1
Age	6	6
Covid Shock	/	7

Table 26 Dominance analysis for logit model including leverage as total debt over assets. Data source: Aida.

The analysis differentiating by debt component gives a result which is comparable to the one obtained with the dominance analysis of the linear probability model. In this case, the rankings remain quite similar between 2019 and 2020, with bank debt being the most important determinant of failures among the debt leverage variables considered.

However, as for the linear probability model, a relevant change in the sector of belonging is detected: while the sector is the fifth contributor in the overall R^2 of the model in 2019, it becomes the most important for 2020. The result can be interpreted as done for the linear probability model case. Even if in general the importance of the sector in determining failures is understandable, such change may be actually related to the inability of government measures to completely absorb the sectoral heterogeneity of the shock.

Dominance analysis for logit
(Rankings)

	2019	2020
Labour productivity	3	7
Bank debt/assets	4	4
Supplier debt/assets	6	5
Other debt/assets	8	8
ln(nb employees)	2	3
Sector	5	1
Region	1	2
Age	7	6
Covid Shock	/	9

Table 27 Dominance analysis for the logit model including leverage ratios by debt component. Data source: Aida.

3.2.6 Shapley value decomposition of R^2

The discussion on the dominance analysis is quite useful for the aim of this work, but is limited in its methodological basis. In fact, it is somehow an analysis in itself that is not applied to a specific model. For this reason, it may be interesting to try and access the decomposition of R^2 through another methodology: the Shorrocks-Shapely decomposition. This is a postestimation methodology used to decompose the R^2, allowing to see the relative contribution of each regressor included in the model in percentage terms.

However, as a premise, it is important to point out that by software limitations it was not possible to perform this analysis on the whole model including fixed effects. For this reason, the Shapley value decomposition was performed on linear probability models and logistic regression models without the inclusion of fixed effects. This is a very relevant point to take into account when interpreting the Shapley values, which are expressed in percentage contributions to the overall R^2 in the model. The exclusion of fixed effects somehow makes the comparison between 2019 and 2020 less meaningful and the Covid-19 relevance interpretation needs to be more cautious, considering the fact that it is in the model with fixed effects that it is a significant determinant of failures. Despite this

limitation, the choice is to include this analysis in light of its methodological relevance.

The presented analyses are two: one including leverage as total debt over assets, the other differentiating by debt component (bank debt over assets, supplier debt over assets and other debt over assets).

Linear probability model

The Shapley value decomposition for the linear probability models (excluding fixed effects) shows that the most relevant variables for the model including leverage as total debt over assets are indebtment level and number of employees. It may be interesting to notice the considerable change in share for total debt over assets between the two years, so that it seems that the indebtment level became quantitatively less important in 2020. However, we choose to give little interpretation of this remark, given the methodological restrictions of this analysis.

The Covid-19 shock displays a very limited quantitative impact on the probability of default if compared to the other factors. This is in line with the result of the dominance analysis.

The analysis by debt component displays results quite similar to the one considering leverage as total debt over assets.

The Covid shock confirms its small but not null quantitative importance in failure probability.

Most important debt components appear to be bank debt and supplier debt. There is an interesting change in importance for supplier debt, which displays a higher share with respect to 2019 and among debt components in 2020. This remark is interesting if we think about the expected impact of the pandemic on supply chain dynamics, with expected struggles in payments to suppliers. However, the interpretation should be cautious given the methodological limitations of this analysis and the fact that such result did not emerge so strongly in the empirical estimations.

Shapley decomposition for LPM
(Percentages)

	2019	2020
Labour productivity	6.41%	4.98%
Total debt/assets	68.08%	46.22%
ln(nb employees)	25.51%	48.38%
Covid Shock	/	0.42%

Table 28 Shapley decomposition of R^2 for the linear probability model including leverage as total debt over assets. Data source: Aida.

Shapley decomposition for LPM
(Percentages)

	2019	2020
Labour productivity	20.88%	5.46%
Bank debt/assets	30.78%	19.94%
Supplier debt/assets	13.55%	20.34%
Other debt/assets	1.85%	6.07%
ln(nb employees)	32.94%	48.01%
Covid Shock	/	0.18%

Table 29 Shapley decomposition of R^2 for the linear probability model including leverage ratios by debt component. Data source: Aida.

Logistic regression model

The Shapley value decomposition for the logistic regression models (excluding fixed effects) shows similar results to those of the linear probability model. As before, the model with leverage as total debt over assets displays the indebtment level and the number of employees as most relevant contributors to R^2. Even in this case a certain change between 2019 and 2020 for the importance of total debt over assets is detected, but its interpretation should be cautious.

The Covid-19 shock is still quantitatively much less important with respect to other variables in both models.

Similarly to the linear probability model case, also for the logistic regression Shapley

percentage values show that the most important leverage components are bank debt and supplier debt. A certain change in the relevance of these two components between 2019 and 2020 is detected also for the logit model. The possible interpretation is comparable to the one for the linear probability model.

Shapley decomposition for logit
(Percentages)

	2019	2020
Labour productivity	8.48%	7.37%
Total debt/assets	70.33%	50.06%
ln(nb employees)	21.19%	42.14%
Covid Shock	/	0.43%

Table 30 Shapley decomposition of R^2 for the logit model including leverage as total debt over assets. Data source: Aida.

Shapley decomposition for logit
(Percentages)

	2019	2020
Labour productivity	30.42%	7.82%
Bank debt/assets	25.21%	19.11%
Supplier debt/assets	12.95%	20.59%
Other debt/assets	1.76%	6.04%
ln(nb employees)	29.67%	46.26%
Covid Shock	/	0.19%

Table 31 Shapley decomposition of R^2 for the logit model including leverage ratios by debt component. Data source: Aida.

Conclusions

Main results

The crisis generated by the Covid-19 pandemic put at risk economies in a very uncertain way, given it extraordinary characteristics. The supposed and forecasted initial impact of infection rates in terms of human capital loss were uncertain because the development of pandemics is quite difficult to predict given the possibility for virus' mutations.
The measures put in place to avoid the spread of the virus such as lockdowns and travel restrictions are those that most impact the economy, but are highly unpredictable as they are linked to the uncertainty of the pandemic itself.
For this reason, governments had a hard time taking policy decisions to find the best balance between containment measures and economic preservation.

The aim of this work is to ex-post evaluate the choices taken by the Italian government during the first year of the pandemic crisis in terms of supports to companies.
In particular, given that during 2020 the number of company failures decreased considerably, the research focuses on understanding whether the government was able to correctly hibernate the economy or it actually over supported companies leading to high risks of zombification. To understand this issue the approach focuses on bankruptcy dynamics, trying to understand two main points: first if after the crisis any significant change in usual failure determinants is detected and second if the Covid-19 shock itself constitutes a significant determinant of failures.

The results from the conducted analyses suggest that, overall, government measures were able to partially hibernate the economy in the short run. In fact, the determinants of failures in 2020 do not actually change much with respect to previous years. The most important ones are employees number and indebtment levels, with bank debt over assets as the most relevant leverage ratio.

However, it seems that the government measures did not actually completely absorb the sectoral heterogeneity of the shock. This is confirmed by the significant relevance of the Covid-19 shock in more complete models including the total leverage level. In addition, dominance analyses of the relative importance of predictors for the probability of failure

show that in 2020 the sector of belonging of companies became the first predictor for failures, while it was not even in the top three the previous year.

These result appear to be in line with other preliminary analyses for the Italian case. It is highly possible that the decrease in failures depends on a certain slowdown in the court system, as suggested by forecasting by Giacomelli et al. (2021). In such case we would expect failures to increase in the years after the pandemic, but it is hard at the current time to correctly access such data, given that the Covid-19 crisis is still ongoing even if containment measures have been weakened in the past year.

The evidence that the Italian government was unable to completely absorb the sectoral heterogeneity of the shock may lead to think that policy measures were not correctly targeted toward sectors in the economy. Another possible explanation could refer to the time implementation of policies. At the outbreak of the pandemic, many analyses revealed that in Italy the policy implementation was relatively slow, most if in comparison with other countries (Confindustria, 2020).

Italy and France

The similarities between this work and the one by Cros et al. (2021) allow to compare results of government measures in Italy and France in a preliminary way.

However, before doing so, it is important to recall the main differences and similarities between this work and the one by Cros et al. (2021).

First, this study and the French one focus on the retail sector with the aim of understanding if the pandemic and government measures distorted somehow the usual bankruptcy dynamics. The focus is on SMEs in both cases and the sample restrictive assumptions are basically comparable.
The methodology chosen in the French work is primarily the use of logistic regressions analyses. In this study we try to add results obtained through the linear probability model and conduct further analyses on the R^2.

Results, however, are quite similar. Also in the French case bankruptcy determinants seems to have changed little between 2019 and 2020. The Covid-19 shock is a significant determinant of default probability in France as it is in Italy.

However, interesting differences in bankruptcy dynamics and policy implementation can be found between the two countries.

Firm characteristics differ quite a lot between the Italian and French sample. In particular, French active companies appear to be significantly less leveraged than Italian ones, as the distribution of the total debt over assets variable confirms.
A peculiar difference in bankruptcy dynamics concerns the sign for the coefficient of employees. In fact, in the French case the coefficient has a negative significant sign, while in Italy it is positive. This suggests a difference in employees' costs faced by SMEs in the two countries or in the general organizational management of employees within corporate activities.

The containment measures implemented in Italy and France are comparable, with Italy having slightly stronger containment measures, as indicated by the stringency index[16].

From the policy implementation point of view, it is known that monetary policy in France and Italy is common since it is determined by the European Central Bank. For this reason, main differences can be revealed at the fiscal policy level.
The fact that the preliminary results appear quite similar in both cases leads to imagine that fiscal policy implementation could be comparable, considering also that both countries operate under the recommendations of the European Commission.

It is actually true that quite similar policy choices have been implemented to sustain the economy during the pandemic.
France, similarly to Italy, chose to focus on the same areas of intervention: family and work, businesses and liquidity.

The interventions implemented for work and families are comparable to the Italian ones,

[16] For detailed comparison refer to: https://www.bsg.ox.ac.uk/research/research-projects/covid-19-government-response-tracker

with the introduction of indemnities for hours of work lost (with the introduction of "Normal partial activity" and "Long term partial activity") and the establishment of the "Employee sharing", a system for which workers could shift employment and work in sectors with a shortage of employees. The latter is an additional policy with respect to Italian ones.
Similarly to Italy, France introduced allowances for parents and vulnerable workers and postponed tax payments and social security charges.

To support businesses and liquidity, France introduced state guaranteed loans and a solidarity fund ("Fund de solidarité") for SMEs.
State guaranteed loans are regulated similarly to Italian ones, with comparable eligibility criteria. However, in the French case no guarantee is set to completely cover 100% of loans, differently from the Italian case.
A wide variety of aids was also set for most affected sectors in the economy, just as done in Italy. In particular, included ones are catering, tourism, events, sports, culture and local commerce.

Even if the kinds of interventions are quite similar, their magnitude differ significantly.
France focused on general above the line measures, with an amount of 174 billion euros (7.7% of GDP) set. These measures include additional spending and forgone revenue. Italy, instead, allocated a smaller amount of 112 billion euros (6.2% of GDP) for this kind of measures.
As of December 31st 2020, also below the line measures were different between the two countries. These policy choices include asset purchases, debt assumptions, loans and equity injections. In France, these were implemented for an amount of 21 billion euros (0.9% of GDP), while in Italy the amount was considerably lower (3.3 billion euros, 0.2% of GDP).
State guarantees, instead, were the most used policy in Italy, with an amount of 579 billion euros (35.3% of GDP) set aside, against 335 billion euros (14.8% of GDP) allocated by France.

It is quite early to be able to compare the two policies in terms of results, given also that in the future the countries will have access to additional funds at the European level.

However, it is interesting to note that both countries implemented analogous policies leading to preliminary very similar outcomes, as the comparison between this study and the one by Cros et al. (2021) shows.
An interesting note, however, should be made on the possible future impact of such policies. We have seen that in our sample the leverage characteristics for Italian companies were quite different from French ones, with higher leverage levels even for active companies. In addition, Italy chose to prefer guarantees on loans as the main policy for the liquidity issue. These two aspects combined lead to suspect that, compared to France, in the long run Italy may face additional firm insolvency issues and higher guarantee state coverage if these loan guarantees were directed toward zombie firms.

Limits

The study of the phenomena of firm bankruptcy dynamics during the pandemic crisis is characterized by certain limitations related to the fact that despite a significant improvement in the overall situation, the pandemic is still ongoing an its main consequences from a long run perspective have not yet materialized.

Given these considerations, it is important to point out the main limitations that are present in this work and that must be accounted for both in its interpretation and for possible further research.

The measurement of the Covid shock is one of the main issues that were encountered during this work. Being able to find the best variable measuring the sectoral impact of the pandemic while limiting its endogeneity at the same time is quite hard.
The compromise found using the change in average monthly expenditure by families between 2019 and 2020 is a good solution, but it is not free from limitations. This variable tries to capture the shock in consumption in order to proxy the shock in firm's turnover, but even if the considered sector is the retail one (which has a strong direct link with consumers), in this case it was not possible to account for the level of internationalisation of companies and, most importantly, for their level of digitalization. The pandemic lockdowns shifted consumer's preferences toward the e-commerce dimension, which is an aspect we could not account for in this analysis.

Other important issues are related to possible omitted variables in the model. This is quite understandable, also considering the fact that R^2 in general is quite low in our models (even if with levels comparable to the study by Cros et al.). An example could be the management level in companies or the supply chain quality. This characteristic in particular adds another important limit to our analysis, given that possible supply chain effects could not be correctly detected in our analysis. In fact, the possible effects of the impact of suppliers for certain retailers could not be accounted for in both working ways: it was not possible to discriminate between companies affected negatively (where suppliers stopped furnishing goods) or positively (where companies benefitted from struggles of competitors).

Another relevant limit in the model concerns the choice to somehow simplify the categorization of failed companies without completely differentiating among possible legal histories' conditions. Qualitatively speaking, it is hard to think that a company failing in a certain year without other relevant previous events is comparable to a company that struggles to meet maturities and has a legal history characterized by insolvencies of any kind (for example procedures of debt rearrangement).

This issue was addressed in the analysis by excluding companies which registered procedures of dissolution or liquidation before the considered failing year. This solves two kind of problems: it excludes companies that had relevant struggles before failure, but it also accounts for the possibility that qualitatively speaking a company closed for reasons different from indebtment or default. In fact, it was important to account for company closure related to other possible causes, such as meeting of the aim of the firm or of voluntary closure of activity related to other causes.
Despite this, a more detailed analysis at a micro level would be more complete in correctly categorizing qualitatively firms and failures.

Future research

The study conducted with this thesis gives some relevant preliminary insights on the matter of public policies during Covid-19 and of the threat of zombification as a possible consequences of excessive supports to firms during the crisis.

The conclusions of this work are still at an early stage of the crisis and further research may serve to better understand some matters that could not be covered in light of unavailability of data.

It would be useful and interesting to extend the approach used in this thesis to failures in the next couple of years, to check not only if the determinants of failures have changed, but also if the number of failures in absolute terms have come back to levels prior to the crisis, confirming the hypothesis that the contraction in failures was due to causes related to a slowdown in the court system and not to an actual decrease in firm bankruptcies.

The conclusion of this work states that the partial hibernation aim of early public policies was correctly reached, given that bankruptcy dynamics have not been significantly distorted. However, the threat of zombification appears to be still relevant and possible ideas for further research should focus on this matter, given its importance in the long run.

For instance, this work was able to access bankruptcy dynamics at the retail level, but it would be quite enriching to be able to include the bank dimension. This would be useful especially in light of the characteristics of zombification, where the relevance of credit institutions is comparable to the one of government support. Research could be carried on including the credit sector and data on creditworthiness of companies in order to better understand the quality of indebtment and not just indebtment itself.

In addition, one of the main policy issues expected to be encountered by Italy in the next few years is the matter concerning the huge amount of public guarantees on loans offered by the government.
This policy measure creates two different issues. First, it creates a relevant threat for the State's budget in case of massive insolvencies; second, it makes zombification very hard to evaluate. In fact, the access to loans will make indebtment levels at the firm level rise considerably, but it would be really hard to understand at which extent changes are indicative of real default probability and which are instead understandable consequences of the pandemic relief measures. This calls for further research on the relevant variables and thresholds used to identify zombies, given the importance of understanding worthiness of companies in policy choices.

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Appendix A

Table I.A: correspondences between ECoicop and Nace codes

ECoicop		NACE codes	
01	Food and non-alcoholic beverages	4711	Retail sale in non-specialised stores with food, beverages or tobacco predominating
011	Food	4729	Other retail sale of food in specialised stores
0112	Meat	4722	Retail sale of meat and meat products in specialised stores
0113	Fish and seafood	4723	Retail sale of fish, crustaceans and molluscs in specialised stores
0111 0118	Bread and cereals; Sugar, jam, honey, chocolate and confectionery	4724	Retail sale of bread, cakes, flour confectionery and sugar confectionery in specialised stores
0116 0117	Fruits Vegetables	4721	Retail sale of fruit and vegetables in specialised stores
-	NON_FOOD	4719	Other retail sale in non-specialised stores (non food)
022	Tobacco	4726	Retail sale of tobacco products in specialised stores
012 021	Non-alcoholic beverages Alcoholic beverages	4725	Retail sale of beverages in specialised stores
031	Clothing	4771	Retail sale of clothing in specialised stores
03141	Cleaning of clothing	9601	Washing and (dry-)cleaning of textile and fur products
032	Footwear	4772	Retail sale of footwear and leather goods in specialised stores
0322	Repair and hire of footwear	9523	Repair of footwear and leather goods
043	Maintenance and repair of the dwelling	9521; 9522; 9524; 9529	Repair of consumer electronics; Repair of household appliances and home and garden equipment; Repair of furniture and home furnishings;

			Repair of other personal and household goods
0511	Furniture and furnishings	4759	Retail sale of furniture, lighting equipment and other household articles in specialised stores
0512	Carpets and other floor coverings	4753	Retail sale of carpets, rugs, wall and floor coverings in specialised stores
052	Household textiles	4751	Retail sale of textiles in specialised stores
053	Household appliances	4754	Retail sale of electrical household appliances in specialised stores
0532	Small tools and miscellaneous accessories	4752	Retail sale of hardware, paints and glass in specialised stores
0612	Other medical products	4773	Dispensing chemist in specialised stores
0611 0613	Pharmaceutical products and Therapeutic appliances and equipment	4774	Retail sale of medical and orthopaedic goods in specialised stores
0711	Motor cars	4511; 4519	Sale of cars and light motor vehicles; Sale of other motor vehicles
07120	Motorcycles	4540	Sale, maintenance and repair of motorcycles and related parts and accessories
0721	Spare parts and accessories for personal transport equipment	4532	Retail trade of motor vehicle parts and accessories
0722	Fuels and lubricants for personal transport equipment	4730	Retail sale of automotive fuel in specialised stores
0723	Maintenance and repair of personal transport equipment	4520	Maintenance and repair of motor vehicles
07322	Passenger transport by taxi and hired car with driver	4932	Taxi operation
09113	Portable sound and vision devices	4743	Retail sale of audio and video equipment in specialised stores

0913	Information processing equipment	4741; 4742	Retail sale of computers, peripheral units and software in specialised stores; Retail sale of telecommunications equipment in specialised stores
0931	Games, toys and hobbies	4765	Retail sale of games and toys in specialised stores
09321	Equipment for sport	4764	Retail sale of sporting equipment in specialised stores
0933 0934	Gardens, plants and flowers Pets and related products	4776	Retail sale of flowers, plants, seeds, fertilisers, pet animals and pet food in specialised stores
0941	Recreational and sporting services	9300; 9310; 9311; 9312; 9313; 9319; 9320; 9321; 9329; 9604	Sports activities and amusement and recreation activities; Sports activities; Operation of sports facilities; Activities of sport clubs; Fitness facilities; Other sports activities; Amusement and recreation activities; Activities of amusement parks and theme parks; Other amusement and recreation activities; Physical well-being activities
0951	Books	4761	Retail sale of books in specialised stores
0952 09541	Newspapers and periodicals Paper products	4762	Retail sale of newspapers and stationery in specialised stores
096	Package holidays	7900; 7910; 7911; 7912; 7990	Travel agency, tour operator reservation service and related activities; Travel agency and tour operator activities; Travel agency activities; Tour operator activities; Other reservation service and related activities
111	Catering services	5610; 5621; 5629; 5630	Restaurants and mobile food service activities; Event catering activities; Other food service activities; Beverage serving activities
1120	Accommodation services	5520	Holiday and other short-stay accommodation

11201	Hotels, motels, inns and similar accommodation services	5510	Hotels and similar accommodation
11202	Holiday centres, camping sites, youth hostels and similar accommodation services	5530	Camping grounds, recreational vehicle parks and trailer parks
11203	Accommodation services of other establishments	5590	Other accommodation
1211	Hairdressing salons and personal grooming establishments	9602	Hairdressing and other beauty treatment
12132	Articles for personal hygiene and wellness, esoteric products and beauty products	4775	Retail sale of cosmetic and toilet articles in specialised stores
1231	Jewellery, clocks and watches	4777	Retail sale of watches and jewellery in specialised stores
12313	Repair of jewellery, clocks and watches	9525	Repair of watches, clocks and jewellery
12703	Funeral services	9603	Funeral and related activities

Table I.B: percentage variation in average household monthly payments by ECoicop code

ECoicop		2019	2020	Percentage variation
01	Food and non-alcoholic beverages	464.27	467.56	0.71%
011	Food	426.82	431.21	1.03%
0112	Meat	98.29	101.68	3.45%
0113	Fish and seafood	41.22	41.08	-0.34%
0111 0118	Bread and cereals; Sugar, jam, honey, chocolate and confectionery	95.62	94.02	-1.67%
0116 0117	Fruits Vegetables	105.63	106.54	0.86%
-	NON_FOOD	2095.58	1860.68	-11.21%
022	Tobacco	23.85	19.78	-17.06%
012 021	Non-alcoholic beverages Alcoholic beverages	59.70	59.11	-0.99%
031	Clothing	86.93	67.20	-22.70%
03141	Cleaning of clothing	4.89	2.63	-46.22%
032	Footwear	27.71	20.78	-25.01%
0322	Repair and hire of footwear	0.87	0.62	-28.74%
043	Maintenance and repair of the dwelling	11.48	10.50	-8.54%
0511	Furniture and furnishings	27.22	22.37	-17.82%
0512	Carpets and other floor coverings	0.40	0.60	50.00%
052	Household textiles	3.80	3.08	-18.95%
053	Household appliances	15.28	16.15	5.69%

0532	Small tools and miscellaneous accessories	3.57	4.70	31.65%
0612	Other medical products	3.84	5.95	54.95%
0611 0613	Pharmaceutical products and Therapeutic appliances and equipment	61.33	54.34	-11.40%
0711	Motor cars	79.21	66.84	-15.62%
07120	Motorcycles	2.88	2.38	-17.36%
0721	Spare parts and accessories for personal transport equipment	16.66	12.62	-24.25%
0722	Fuels and lubricants for personal transport equipment	127.86	93.68	-26.73%
0723	Maintenance and repair of personal transport equipment	19.75	16.35	-17.22%
07322	Passenger transport by taxi and hired car with driver	0.97	0.60	-38.14%
09113	Portable sound and vision devices	0.04	0.04	0.00%
0913	Information processing equipment	2.88	3.80	31.94%
0931	Games, toys and hobbies	9.37	7.44	-20.60%
09321	Equipment for sport	3.40	2.23	-34.41%
0933 0934	Gardens, plants and flowers Pets and related products	21.47	18.93	-11.83%
0941	Recreational and sporting services	18.13	11.76	-35.14%
0951	Books	9.88	9.04	-8.50%
0952 09541	Newspapers and periodicals Paper products	7.45	6.24	-16.24%
096	Package holidays	20.20	8.74	-56.73%
111	Catering services	114.59	69.82	-39.07%

1120	Accommodation services	15.39	9.59	-37.69%
11201	Hotels, motels, inns and similar accommodation services	13.99	8.42	-39.81%
11202	Holiday centres, camping sites, youth hostels and similar accommodation services	0.96	0.86	-10.42%
11203	Accommodation services of other establishments	0.44	0.31	-29.55%
1211	Hairdressing salons and personal grooming establishments	43.35	31.06	-28.35%
12132	Articles for personal hygiene and wellness, esoteric products and beauty products	27.51	26.23	-4.65%
1231	Jewellery, clocks and watches	5.94	3.79	-36.20%
12313	Repair of jewellery, clocks and watches	0.16	0.19	18.75%
12703	Funeral services	6.09	7.53	23.65%

Appendix B

Tables II-VIII: Missing values

Table II: missing values in Total debt

Variable	Missing	Total	Percent Missing
Total debt 2014	121,014	262,509	46.10
Total debt 2015	99,730	262,509	37.99
Total debt 2016	91,951	262,509	35.03
Total debt 2017	83,899	262,509	31.96
Total debt 2018	76,048	262,509	28.97
Total debt 2019	75,731	262,509	28.85
Total debt 2020	219,000	262,509	83.43

Table III: missing values in Total assets

Variable	Missing	Total	Percent Missing
Total Assets 2014	121,011	262,509	46.10
Total Assets 2015	99,728	262,509	37.99
Total Assets 2016	91,951	262,509	35.03
Total Assets 2017	83,899	262,509	31.96
Total Assets 2018	76,048	262,509	28.97
Total Assets 2019	75,731	262,509	28.85
Total Assets 2020	219,000	262,509	83.43

Table IV: missing values in Bank debt (long+short term debt)

Variable	Missing	Total	Percent Missing
Bank debt 2014	136,414	262,509	51.97
Bank debt 2015	117,180	262,509	44.64
Bank debt 2016	130,553	262,509	49.73
Bank debt 2017	126,830	262,509	48.31
Bank debt 2018	122,429	262,509	46.64
Bank debt 2019	123,532	262,509	47.06
Bank debt 2020	232,963	262,509	88.74

Table V: missing values in Supplier debt (long+short term debt)

Variable	Missing	Total	Percent Missing
Supplier debt 2014	136,483	262,509	51.99
Supplier debt 2015	117,180	262,509	44.64
Supplier debt 2016	130,553	262,509	49.73
Supplier debt 2017	126,830	262,509	48.31
Supplier debt 2018	122,429	262,509	46.64
Supplier debt 2019	123,532	262,509	47.06
Supplier debt 2020	232,963	262,509	88.74

Table VI: missing values in Other debt (long+short term debt)

Variable	Missing	Total	Percent Missing
Other Debts 2014	136,522	262,509	52.01
Other Debts 2015	117,180	262,509	44.64
Other Debts 2016	130,553	262,509	49.73
Other Debts 2017	126,830	262,509	48.31
Other Debts 2018	122,429	262,509	46.64
Other Debts 2019	123,532	262,509	47.06
Other Debts 2020	232,963	262,509	88.74

Table VII: missing values in EBITDA

Variable	Missing	Total	Percent Missing
EBITDA 2014	121,016	262,509	46.10
EBITDA 2015	99,730	262,509	37.99
EBITDA 2016	91,951	262,509	35.03
EBITDA 2017	83,899	262,509	31.96
EBITDA 2018	76,049	262,509	28.97
EBITDA 2019	75,731	262,509	28.85
EBITDA 2020	219,000	262,509	83.43

Table VIII: missing values in Employees number

Variable	Missing	Total	Percent Missing
Employees 2014	121,538	262,509	46.30
Employees 2015	101,583	262,509	38.70
Employees 2016	94,095	262,509	35.84
Employees 2017	86,020	262,509	32.77
Employees 2018	80,020	262,509	30.48
Employees 2019	79,684	262,509	30.35
Employees 2020	219,963	262,509	83.79

Appendix C

Two-sample tests of proportions - Sector

Sectoral distribution of failures on total number of companies

	2019			2020		
Sector	Failed	Tot.	Share	Failed	Tot.	Share
Accommodation	410	102373	0.004004962	329	101963	0.003227
Funeral and related activities	2	2248	0.00088968	2	2246	0.00089
Hairdressing and other beauty treatment	20	7651	0.002614037	15	7631	0.001966
Retail sale of automotive fuel in specialised stores	7	2893	0.002419634	11	2886	0.003812
Retail sale of cultural and recreation goods in specialised stores	26	5286	0.004918653	15	5260	0.002852
Retail sale of food, beverages or tobacco in specialised and non-specialised stores	158	23043	0.006856746	108	22885	0.004719
Retail sale of information and communication equipment in specialised stores	15	3642	0.004118616	14	3627	0.00386
Retail sale of medical and related goods	5	3725	0.001342282	9	3720	0.002419
Retail sale of other goods in specialised stores	18	6650	0.002706767	14	6632	0.002111
Retail sale of other household equipment in specialised stores (repair included)	106	18202	0.005823536	68	18096	0.003758
Sale of motor vehicles	140	30545	0.004583402	82	30405	0.002697
Sports activities and amusement and recreation activities	64	21064	0.003038359	50	21000	0.002381
Taxi operation	4	1373	0.002913328	2	1369	0.001461

Travel agency, tour operator and other reservation service and related activities	22	7747	0.002839809	21	7725	0.002718
Retail sale of clothing, textile, leather and related activities	164	24326	0.006741758	145	24162	0.006001

Bilateral tests for sectoral difference in failure proportions between 2019 and 2020

	2019		2020		Difference:	
Sector	Mean	St. Error	Mean	St. Error	2019-2020	P value
Accomodation	0.004005	0.0001974	0.0032267	0.0001776	0.0007783	0.003
Funeral and related activities	0.0008897	0.0006288	0.0008905	0.0006294	-7.92e-07	0.999
Hairdressing and other beauty treatment	0.002614	0.0005838	0.0019657	0.000507	0.0006484	0.402
Retail sale of automotive fuel in specialised stores	0.0024196	0.0009134	0.0038115	0.001147	-0.0013919	0.342
Retail sale of cultural and recreation goods in specialised stores	0.0049187	0.0009623	0.0028517	0.0007353	0.0020669	0.088
Retail sale of food, beverages or tobacco in specialised and non-specialised stores	0.0068567	0.0005436	0.0047192	0.000453	0.0021375	0.003
Retail sale of information and communication equipment in specialised stores	0.0041186	0.0010612	0.0038599	0.0010296	0.0002587	0.861
Retail sale of medical and related goods	0.0013423	0.0005999	0.0024194	0.0008055	-0.0010771	0.283
Retail sale of other goods in specialised stores	0.0027068	0.0006371	0.002111	0.0005635	0.0005958	0.484
Retail sale of other household equipment in specialised stores (repair included)	0.0058235	0.000564	0.0037577	0.0004548	0.0020658	0.004

Sale of motor vehicles	0.0045834	0.0003865	0.0026969	0.0002974	0.0018865	0.000
Sports activities and amusement and recreation activities	0.0030384	0.0003792	0.002381	0.0003363	0.0006574	0.195
Taxi operation	0.0029133	0.0014545	0.0014609	0.0010323	0.0014524	0.416
Travel agency, tour operator and other reservation service and related activities	0.0028398	0.0006046	0.0027184	0.0005924	0.0001214	0.886
Retail sale of clothing, textile, leather and related activities	0.0067418	0.0005247	0.0060012	0.0004969	0.0007406	0.306

Two-sample tests of proportions – Region

Regional distribution of failures on total number of companies

	2019			2020		
	Failed	Tot	Share	Failed	Tot	Share
Abruzzo	23	6261	0.00367353	16	6238	0.00256492
Basilicata	6	2303	0.00260529	4	2297	0.00174140
Calabria	27	7026	0.00384286	28	6999	0.00400057
Campania	89	30841	0.00288576	66	30752	0.00214620
Emilia-Romagna	60	15959	0.00375963	58	15899	0.00364802
Friuli-Venezia Giulia	9	3309	0.00271985	15	3300	0.00454545
Lazio	175	49094	0.00356459	103	48919	0.00210552
Liguria	30	5402	0.00555349	28	5372	0.00521221
Lombardia	233	36547	0.00637535	186	36314	0.00512199
Marche	23	6115	0.00376124	23	6092	0.00377544
Molise	9	1304	0.00690184	5	1295	0.00386100
Piemonte	79	10311	0.00766172	53	10232	0.00517982
Puglia	58	17569	0.00330126	46	17511	0.00262692
Sardegna	8	4010	0.00199501	7	4002	0.00174912
Sicilia	99	23592	0.00419633	92	23493	0.00391606
Toscana	110	17748	0.00619788	77	17638	0.00436557
Trentino-Alto Adige	12	3497	0.00343151	10	3485	0.00286944
Umbria	19	3799	0.00500131	8	3780	0.00211640
Valle d'Aosta	1	523	0.00191204	0	522	0.10309278
Veneto	91	15558	0.00584908	60	15467	0.00387922

Bilateral tests for regional difference in failure proportions between 2019 and 2020

	2019		2020		Difference:	
Region	Mean	St. Error	Mean	St. Error	2019-2020	P value
Abruzzo	0.0036735	0.0007646	0.0025649	0.0006404	0.0011086	0.267
Basilicata	0.0026053	0.0010622	0.0017414	0.0008699	0.0008639	0.529
Calabria	0.0038429	0.0007381	0.0040006	0.0007545	-0.0001577	0.881
Campania	0.0028858	0.0003054	0.0021462	0.0002639	0.0007396	0.067
Emilia Romagna	0.0037596	0.0004845	0.003648	0.0004781	0.0001116	0.870
Friuli-Venezia Giulia	0.0027199	0.0009054	0.0045455	0.001171	-0.0018256	0.217
Lazio	0.0035646	0.000269	0.0021055	0.0002072	0.0014591	0.000
Liguria	0.0055535	0.0010111	0.0052122	0.0009824	0.0003413	0.809
Lombardia	0.0063754	0.0004163	0.005122	0.0003746	0.0012534	0.025
Marche	0.0037612	0.0007828	0.0037754	0.0007857	-0.0000142	0.990
Molise	0.0069018	0.0022927	0.003861	0.0017234	0.0030408	0.290
Piemonte	0.0076617	0.0008587	0.0051798	0.0007097	0.0024819	0.026
Puglia	0.0033013	0.0004328	0.0026269	0.0003868	0.0006743	0.245
Sardegna	0.001995	0.0007046	0.0017491	0.0006605	0.0002459	0.799
Sicilia	0.0041963	0.0004209	0.0039161	0.0004075	0.0002803	0.632
Toscana	0.0061979	0.0005891	0.0043656	0.0004964	0.0018323	0.017
Trentino Alto Adige	0.0034315	0.0009889	0.0028694	0.0009061	0.0005621	0.675
Umbria	0.0050013	0.0011445	0.0021164	0.0007475	0.0028849	0.035
Valle d'Aosta	0.001912	0.0019102	0	0	0.001912	0.318
Veneto	0.0058491	0.0006114	0.0038792	0.0004998	0.0019699	0.013

Two-sample tests of proportions – Age Classes

Age class distribution of failures on total number of companies

	2019			2020		
	Failed	Tot	Share	Failed	Tot	Share
Class 1 (0-5 years old)	489	120773	0.004049	350	120354	0.002908
Class 2 (6-10 years old)	250	46337	0.005395	233	46057	0.005059
Class 3 (11-30 years old)	295	60251	0.004896	238	59927	0.003971
Class 4 (31 years and older)	94	17421	0.005396	47	17324	0.002713

Bilateral tests for age difference in failure proportions between 2019 and 2020

	2019		2020		Difference:	
Age Class	Mean	St. Error	Mean	St. Error	2019-2020	P value
Class 1	0.0040489	0.0001827	0.0029081	0.0001552	0.0011408	0.000
Class 2	0.0053953	0.0003403	0.0050589	0.0003306	0.0003363	0.478
Class 3	0.0048962	0.0002844	0.0039715	0.0002569	0.0009247	0.016
Class 4	0.0053958	0.000555	0.002713	0.0003952	0.0026828	0.000