Insolvency Risk of European SMEs during Pandemic

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Abstract

Covid-19 pandemic poses an existential threat to European SMEs' financial resilience with significant consequences for the European economy. Using a unique firm-level survey data on SME financing conditions and a new measurement approach, this paper focuses on the insolvency risk of European SMEs and their access to finance around pandemic. We show that SME insolvency risk increased, on average, by around 21% during the pandemic. Finding customers and the cost of production and labor have contributed notably to SME insolvency risk around this period. Heightened insolvency risk results in deterioration in expected access to finance in general. During the pandemic, though, no particular worsening is observed in access to bank lending. Overall, our results have important policy implications for designing suitable policy measures to mitigate SME liquidity shortages and avoid unnecessary insolvencies during and in the aftermath of the pandemic.

Jel Codes: G32, G33, G2, M1

Keywords: Pandemic, SMEs, Insolvency risk, Access to Finance

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I. Introduction

In contrast to the previous financial crisis, the Corona crisis is unique in many ways, i.e., truly exogenous, uncertain, and global (Claudio (2020)). In the eyes of observers, the crisis is already transitioning from the illiquidity to the insolvency phase, and challenges policymakers and market participants alike. Even though, the economic upheaval caused by Covid-19 was unexpected and severe for a broad spectrum of economic agents, the hit was particularly hard for European small and medium-sized enterprises (SMEs), who are the backbone of the European economy. SMEs saw a massive drop in demand for their products and services due to nationwide lock-downs and changes in consumer behavior. While revenues came down remarkably, SMEs' financial obligations remain mostly due. Even more, the depth and length of the pandemic downturn and the trajectory of the recovery are uncertain. In these unpredictable times, SMEs' financial backdrop might deteriorate fast if they lack liquidity and collateral to bridge the financial upheaval or if they face access to finance problems until the market conditions stabilize. This, meanwhile, might push a large number of SMEs into bankruptcy with significant consequences for the European economy (Gourinchas, Kalemli-Ozcan, Penciakova, and Sander (2020)). Indeed, 25 million SMEs in Europe employ 100 million people, generate approximately two-thirds of total turnover, and make around half of the value-added (EC (2020)). Therefore, European SMEs' bankruptcy risk around pandemic and the impact of this risk on SMEs' access to finance is of central importance for policy-makers and market participants alike.

In this paper, we focus on the insolvency risk of European SMEs and their access to finance at the onset of and during the pandemic. In doing so, we utilize survey data on SMEs' perceptions and expectations around the pandemic and propose a new approach to estimate SMEs' bankruptcy risk based on categorical survey data. The survey data allows us to model the links between backward- and forward-looking SME-specific aspects such as SMEs' access to bank lending, growth prospects, or most pressing problems and SMEs' insolvency risk. Put differently, survey data-based insolvency measures provides flexibility beyond balance sheet items and complements the existing research based on financial statements. For our analysis, we utilize a large EU-wide data set provided by the European Central Bank (ECB) and construct an insolvency risk measure based on individual SME survey responses. We select SMEs located in the largest euro area countries: Germany, France, Italy, Spain, and the Netherlands. Therefore, our sample consists of a large number of SMEs and a broad cross-section of countries. As

the ECB is conducting the survey bi-annually, we are able to shed light on changes in SMEs' economic activities, financing conditions, and future expectations over time.

In our framework, micro-level responses proxy traditional financial ratios, which have been suggested by the previous literature as indicators of a firms' health (Altman and Sabato (2007) and McGuinness, Hogan, and Powell (2018)). To build an insolvency risk score for each SME in our sample, we utilize a data reduction technique based on polychoric correlations. By doing so, our approach takes the categorical nature of the survey responses into account. Our study extends the previous literature by providing an alternative estimation method and by employing a new set of indicators to predict SME insolvency risk. The survey nature of the data allows us to relate insolvency risk predictions to various micro-level SME specific information such as the most pressing problems for SMEs or their access to finance trends. Moreover, as we focus on standardized questionnaire responses, our approach partly overcomes cross-country differences in legal and accounting reporting requirements as well as a lack of harmonization in balance sheet definitions across European countries.

The results of our paper show that the pandemic leads to a surge in European SMEs' insolvency risk. To be specific, SME insolvency risk increased, on average, by around 0.56 of its standard deviations or by some 21% during the pandemic. The hike is robust to the inclusion of firm-specific controls, sector dummy variables, macro indicators as well as time and country-specific fixed effects. To shed some light on which sub-groups of SMEs are hit the hardest, we focus on insolvency risk in sub-samples. Our results indicate that small and medium-sized enterprises suffer from heightened insolvency risk the most compared to micro firms. Most probably due to their lower funding needs, micro firms could cover their costs via public support measures more efficiently. Even though small and medium-sized firms also benefited from support measures, their higher fixed costs base is more vulnerable to a sudden drop in demand. This resulted in a surge in insolvency risk, most likely. Exporting SMEs also saw a broad jump in insolvency risk at the onset of the pandemic. As export firms are more vulnerable to reduced global trade flows, they suffer from a drop in demand or problems along the supply chain and transport and logistics the probably the most (OECD (2020)).

We further delve deeper into potential external factors that might increase the SMEs' insolvency risk. To do so, we focus on factors such as problems in finding customers, facing heightened competition, or employee costs. Our results indicate that, in general, SMEs that report finding customers, competition, and employee costs among their most pressing problems

are more likely to face insolvency risks. During pandemic though, finding customers and cost of production and labor have contributed notably to SME insolvency risk in Europe. To be specific, firms that report finding customer or cost of production and labor as a pressing problem during pandemic were 10% and 5% more likely to face insolvency respectively risk. The implementation of strict and long lockdown measures to tackle the pandemic leads to a demand shock for SMEs in the services sector and increases the insolvency risk most probably.

As a next step, we examine access to finance difficulties in conjunction with the pandemic outbreak and the insolvency risk. An estimation that involves current access to finance and insolvency risk might suffer from simultaneity drawbacks. Therefore, we focus on expected access to finance of SMEs. We document that, in general, firms that have solvency risks in the past are more likely to have excess to external debt issues in the future. Our results on this front show that the onset of the pandemic led to a deterioration in expected access to finance channels across the board. On the contrary though, during pandemic, SMEs' expectations did not reflect access to finance problems. Turning to terms of conditions of bank loans around the pandemic, SMEs seem to benefit from favorable interest levels and other costs. Probably public support measures such as government-guarantees on loans during pandemic lead to these results. Finally, we study the types of SMEs that foresee favorable access to finance dynamics during pandemic. SMEs that used the last funding round before pandemics' onset for refinancing or paying off obligations and for inventory and other working capital foresees enhanced bank lending availability access. This might indicate that government support measures are partly allocated to financially weak firms who are in this shape even without the pandemic. And these measures might keep otherwise unprofitable companies in the market via bank lending. The main takeaway from our results is that European SMEs faced a turbulent era with heightened bankruptcy risk, which might have far-reaching consequences for the real economy in years to come.

Our results have important policy implications. With the intensification of the second wave of the pandemic in many European countries, new lockdown measures have been introduced. Thereby, SMEs revenues declined, further pushing the insolvency risks to new highs as a result. This will probably lead to severe spillover effects to other parts of the economies in the years to come. For example, SMEs might default on loans, lay off employees, and cancel already planned projects. Even more importantly, several SMEs might not survive the pandemic aftermath at all. Loan defaults weighing on banks' balance sheets might lead to negative transmissions into

the banking sector. Employee layoffs might curb consumption, and the cancellation of projects might drag growth further down. The significant real economy transmissions, as a result, are inevitable. To mitigate SMEs' liquidity shortages and avoid unnecessary insolvencies, targeted policy measures should be implemented. If SMEs are more at risk of bankruptcy, for example, insolvency relief tools can be extended to give SMEs time to facilitate the restructuring and corporate workouts even after the pandemic. Even more effective are the cash flow injections via direct government participation in firms. These can encourage the banking sector to widen their lending lines to SMEs as well. Yet, in the absence of market scrutiny, moral hazard and risk of financing zombie SMEs complicate the use of these measures.

The remainder of the paper proceeds as follows. Section 2 provides a literature review on insolvency risk. Section 3 introduces the data and insolvency risk indicators. It also outlines our methodology. In Section 4, we present the empirical results of our analysis. It begins with the determinants of SME insolvency risk, with particular attention given to pandemic. It then focuses on the impact of insolvency risk and pandemic on SMEs' expected access to finance. Section 5 concludes the paper.

II. Literature

The European Commission (EC) recommendation from 2003 defines which firms fall in the SME category in Europe. The overarching criteria are that SMEs have less than 250 employees and a turnover of less than EUR 50 million or a balance sheet size of less than EUR 43 million.[1] To be specific, those firms that have less than ten employees and a turnover or balance sheet of at most EUR 2 million are considered as micro-enterprises. Those with ten to fifty employees and a turnover or balance sheet of at most EUR 10 million are considered small firms. Firms with fifty to two hundred fifty employees with a turnover of less than EUR 50 million or a balance sheet of less than EUR 43 million make the group of medium-sized firms. 99% of all firms in Europe belong to one of these categories. SMEs are the European economy's backbone and contribute significantly to employment, job creation, and value-added (EC (2019)). Therefore, the risk of bankruptcies and financial distress in the SME landscape and SMEs' access to finance trends have been in particular focus since Europe's sovereign crisis (Ferrando, Popov, and Udell (2017)). As SMEs are hit particularly hard by the pandemic, these trends become even more

[1] EC maximum thresholds are only for individual firms, and the total number of employees and turnover figures are relevant for SMEs that are part of a larger group.

crucial and are closely monitored by policymakers' in Europe. Against this background, our paper complements the existing literature by delving deeper into the measurement and evolution of SME insolvency risk around pandemic and the joint impact of pandemic and insolvency risk on SMEs' access to finance.

The list of indicators that pinpoint bankruptcy risk, in general, is vast. Early literature dedicated enhanced attention to backward-looking accounting information to compute listed companies' insolvency risk. Altman (1968) and Ohlson (1980) were among the first to identify a set of financial ratios that might point to weaknesses in a company's health and explain default risk. Building on their ideas, financial ratios measuring profitability, indebtedness, self-financing capacity are often employed in a static as well as in a dynamic setting to predict corporate bankruptcy (Grice and Ingram (2001); Altman, Brady, Resti, and Sironi (2005); Pindado, Rodrigues, and De la Torre (2008); Traczynski (2017)). Over time, higher frequency information such as the market value of a firm compared to the face value of its debt has been utilized for insolvency risk prediction (Vassalou and Xing (2004), Bongini, Laeven, and Majnoni (2002)). Despite the usefulness of these methods for predicting large firms' bankruptcy risk, they have significant limitations in the case of SMEs. Unlike large firms, only a very small fraction of the SMEs are listed, and market data such as equity, bond, or CDS prices do not exist for them (Altman, Sabato, and Wilson (2010)). Even more importantly, SMEs are typically more opaque and provide less detailed accounting data compared to large firms. It is by now widely accepted that SME bankruptcy prediction requires alternative variables due to issues around data availability (Altman and Sabato (2005)). Against this background, our paper contributes to the literature by utilizing self-reported survey data to measure SME insolvency risk and by proposing a set of indicators from survey responses that proxies financial ratios. Even though micro survey data stemming from SMEs have been used in various other applications, it has not been used in the context of SME bankruptcy prediction to the best of our knowledge.

In developing models to predict SME bankruptcy risk, the first attempts date back to the 70s (Edmister (1972)). Yet, the literature on the use of alternative approaches gained particular momentum in recent years. Using a large sample of US SMEs, Altman and Sabato (2007) argued that original Z-Score models can be improved upon by transforming financial ratios. The sample of their analysis covers relatively large SMEs located in the US. Ciampi and Gordini (2009) focused on manufacturing SMEs from Italy and concluded that quantitative and qualitative variables should be used for the SME default prediction models. Ciampi and Gordini (2013)

proposed artificial neural networks to model Italian SMEs' insolvency risk. In terms of the observations' frequency, Gupta, Gregoriou, and Healy (2015) provided evidence that discrete-time models are superior to others in SME bankruptcy prediction. More recently, McGuinness et al. (2018) model the SME bankruptcy risk utilizing Z-Score for a large sample of European SMEs. Taken together, existing studies build upon rather traditional estimation approaches. While these approaches are suitable with balance sheet information from conventional databases, they can not be applied in the context of the survey data. It is also important to stress that the definition of balance sheet variables are not harmonized across European countries. Even more, there are cross-country differences in legal and accounting reporting requirements for SMEs, which lead to missing or incomplete observations. Pooling such information in traditional models might lead to insolvency results, which actually are not comparable across countries. The second contribution of our paper is to introduce an insolvency estimation method designed for survey data. In doing so, we estimate an insolvency measure where SME bankruptcy risk comparison in a cross-country setting is suitable.

The prediction of SME insolvency risk accurately is of crucial importance for banks. Neuberger and Rathke (2009) documented that due to information asymmetries and the potential of adverse selection, SMEs might have limited access to bank lending. Inline, Dierkes, Erner, Langer, and Norden (2013) stressed that as a result of the little information on SMEs' balance sheets, their credit risk is usually higher than large enterprises. Meanwhile, it has also been documented that for growth and survival, SMEs are primarily dependent on external finance where the vast majority of this tends to come from banks (Robb and Robinson (2014), Canales and Nanda (2012)). Even more, SME lending is often concentrated at a single institution, considering the small size of loans SMEs require (Petersen and Rajan (1994), Sapienza (2002)). It has also been pointed out that SMEs maintain longer and closer banking relationships with their banks (Berger and Udell (1995). In doing so, while SMEs benefit from favorable borrowing rates, banks possess more information on SMEs' credit risk. Inline (Bottazzi, Secchi, and Tamagni (2014)) argues that access to finance also reflects the risk of investment, and insolvency risk is a critical aspect in lending decisions. Berger and Frame (2007) showed that adopting information-rich insolvency models might help increase the availability of bank credit and access to finance conditions for SMEs. This paper's third contribution is to establish a well-identified causal link between SMEs' access to finance and their insolvency risk at the onset of the pandemic. This offers an essential angle to discussing the bank lending channel's functioning during the pan-

demic crisis. Moreover, our paper provides important insights into SMEs' financial health that receive financing during the recent economic upheaval, thereby contributing to the discussion on zombie firms.

III. Data and Methodology

In this paper, we exploit a unique dataset provided by the ECB and the EC. With the euro area-wide conducted *Survey on the access to finance of enterprises (SAFE)*, ECB aims to monitor the latest developments in euro area firms' financial conditions and their access to finance trends. *SAFE* includes detailed categorical questions on firm demographics, balance sheet position, most pressing problems, availability of finance and market conditions, and expected access to finance.[2] *SAFE* is conducted bi-annually since 2009 and published in May and November to cover the six months prior to the publishing months. In the first round of 2014, the weighting scheme and sample size of the *SAFE* survey are substantially modified. Therefore, we use the waves conducted between H1-2015 and H2-2020 in our analysis. We select SMEs incorporated in one of the five largest euro area countries: Germany, France, Italy, Spain, and the Netherlands in our final sample.

The last two waves of the SAFE survey are relevant to delve deeper into the impact of the pandemic crisis. SAFE survey includes two types of horizons in data collection: backward looking questions that cover the period six months before the survey and forward looking questions that cover the next six months ahead. The data for H1-2020 of the survey has been collected between mid-March and mid-April. Therefore, the backward-looking questions from this wave span the effects of en route to the crisis and sheds light on the onset of the pandemic. The backward looking questions of the H2-2020 wave which were collected between mid-September and mid-October, present trends in the middle of the pandemic. The forward-looking questions from H1-2020 capture SMEs' expectations regarding the anticipated worsening of the SMEs expected access to finance during pandemic (Bańkowska, Ferrando, and Garcia (2020)). The forward-looking questions from H2-2020 provide a proxy for SMEs' expectations beyond the pandemic crisis.

Table I presents the summary statistics of our sample. SMEs from France, Italy, and Spain make slightly more than 20% of the sample each. One-fifth of the SMEs in our sample are from

[2]See https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html for the latest questionnaires.

Germany and 13% from the Netherlands. In Spain, Italy, and the Netherlands, firms with less than ten employees make the largest share. In Germany, around 40% of the firms have 10 to 50 employees. Firms that have less than EUR 2 million turnover is the largest group of SMEs in all countries. In Germany, though, the share of firms that have EUR 2 to 10 million turnover is larger compared to other countries. Indeed, German SMEs are documented to be larger in terms of their size compared to their European peers on average (EC (2019)). The share of exporting SMEs is more or less inline across the board, with French SMEs having a somewhat smaller exporting share. SMEs that have one owner or more than one owner makes in total 80-85% of SMEs in all countries. Unlike the US, SMEs owned by venture capital or business angel investors are almost negligible in Europe. EC (2015) documents that among different sectors, services, and retail trade sector SMEs are the largest in terms of their numbers and the most important ones in terms of value-added and employment in Europe. In our sample, around 65%-75% of the enterprises are from these sectors. Taken together, our selection of SMEs maps the European SME landscape comprehensively, and the main characteristics of our sample are in line with the official statistics.

A. Insolvency risk indicators

With the pandemic crisis, the insolvency risk of non-financial corporations became the focus of attention. Measurement of SME insolvency risk, however, is not straightforward due to data availability issues. Expressing differently, while balance sheet or capital markets information is available for large corporations, these are seldom available for SMEs. Important inferences on SME balance sheets, meanwhile, can be gained from self-reported survey responses.

For predicting insolvency risk, one of the most well-known models, thanks to its predictive power and convenience, is Altman's z-score (Altman (1968)). In a nutshell, z-score integrates a small set of financial ratios that proxy different aspects of firm health and provide information on insolvency risk. In doing so, it employs profitability, liquidity, solvency, leverage, and firm activity financial ratios. This paper follows a similar approach to Altman's z-score to construct an insolvency risk indicator for SMEs. The key deviation of our approach is to use SME survey responses that proxy financial ratios of the z-score and not necessarily the balance sheet values themselves. To be specific, we utilize SME responses to the SAFE questionnaire from sections two and four of the survey. In section two, the SAFE survey directs questions about the firm's current situation, referring to the changes experienced by the SME over the past six months.

The second question asks:

Have the following company indicators decreased, remained unchanged or increased over the past six months?

1) turnover;

2) profit;

3) inventories and other working capital;

4) debt compared to assets.

Responses for each of these questions are given on a scale of three where 1) stands for *increased*; 2) *remained unchanged* and 3) *decreased*.[3]. In our selection of variables, turnover and profit reflect the changes in profitability, inventories, and other working capital, the changes in liquidity and debt compared to assets the changes in the solvency ratio of an SME. Panel A of Table II presents responses for these indicators where presented values are the percentage of SMEs who responded as "decreased" to the respective question. Starting with turnover, an extreme deterioration is observable in all countries in H2-2020 or at the height of the pandemic crisis. The deterioration was already visible at the onset of the pandemic with twice the number of SMEs reporting a decreased turnover already in H1-2020 compared to 2019. Yet, with the intensification of lock-down measures among others, SMEs see a huge setback in their turnover and H2-2020 presents an all-time high worsening across the board. In terms of SMEs' profit, a similar trend like turnover is observable. The number of SMEs reporting a deterioration points to an all time high with 70% of SMEs saw decreased profitability in the euro area. For both indicators, SMEs from southern euro area countries such as Italy and Spain report the most considerable drop. Southern Europe are affected by the pandemic earlier and adopted lock-down measures before Germany or the Netherlands. SMEs in southern Europe therefore were confronted with a more severe demand shock and saw their turnover and profits to deteriorate markedly already in March. Concerning inventories and working capital, a smaller number of SMEs reported deterioration. Turning to debt to assets, the changes from 2019 to H2-2020 are not particularly high. Indeed, in almost all euro area countries, even before the pandemic, supportive measures have been introduced to ease SMEs' liquidity constraints.

Section four of the SAFE survey delves deeper into the SME's experience and view on their

[3]Firms can also choose not applicable to my firm or do not respond at all.

financing and market conditions. To be specific, question eleven asks:

For each of the following factors, would you say that they have improved, remained unchanged or deteriorated over the past six months?

1) Your enterprise-specific outlook with respect to your sales...;

2)Your enterprise's own capital.

Responses for each of these questions are given on a scale of three where 1) stands for *improved*; 2) *remained unchanged*, and 3) *deteriorated*. In our selection of variables, SME's outlook concerning sales reflects the changes in activity, and the enterprise's own capital reflects the changes in leverage. Panel B of Table II presents responses for these indicators where presented values are the percentage of SMEs who responded as "deteriorated" to the respective question. Starting with the outlook in terms of sales, from 2019 to H2-2020, the share of SMEs who saw deterioration in sales have more than doubled in all countries. This shows that euro area SMEs perceive a deep demand shock with recovery probably being stubbornly slow due to continued anxiety and potential changes in consumer habits. The setback was already observable in H1-2020 but again with the intensification of the pandemic and associated lockdown measures, SMEs perceive a rather gloomy outlook. Turning to capital positions, while the number of SMEs reporting a deterioration increased in H2-2020, the change from 2019 is not particularly large. Nevertheless, a persistent decline on this front might translate into access to finance problems in the future.

B. Composite insolvency risk indicator

The standard z-score approach applies a multiple discriminate analysis and builds a final score based on certain coefficients for each of the financial ratios. It then compares the final score with predefined thresholds. This approach is not applicable for our sample, considering the categorical nature of survey responses. A possible way to create a composite insolvency score based on survey responses is to use a data reduction technique such as the principal component analysis (PCA). Yet, standard PCA techniques are suitable for continuous or dummy variables only(Josse, Pages, and Husson (2011)). To maintain and control the categorical nature of SME insolvency risk indicators of the SAFE survey, we employ a polychoric PCA approach.

The polychoric PCA method relies on polychoric correlations rather than Pearson correla-

tions. To compute polychoric correlations, it is assumed that there is an underlying unobserved normally distributed variable for each categorical response. Observed categorical responses are an aggregate representation of these unobserved continuous variables. Moreover, the correlation of underlying unobserved variables follows a binomial normal distribution. The correlation coefficients between these are the polychoric correlations and take the form in Equation 1.

Lets assume that x_1^* and x_2^* are jointly bivariate normally distributed variables with a correlation of ρ. The ordinal $x1$, $x2$ are obtained by discretizing x_1^* and x_2^* according to the set of thresholds α_{k1}, ..., α_{k,K_k-1}

$$x_k = r \text{ if } \alpha_{k,r-1} < x_k^* < \alpha_{k,r} \tag{1}$$

where $\alpha_{k,0} = -\infty$ and $\alpha_{k,K_k} = +\infty$. If these variables follow a bivariate normal distribution, then the maximum likelihood estimate of polychoric correlation can be obtained by maximizing:

$$LogL(\rho, \alpha; X) = \sum_{1}^{n} log\pi(x_{i1}, x_{i2}; \rho, \alpha) \tag{2}$$

To estimate a polychoric PCA empirically, we follow the steps by Kolenikov and Angeles (2009). Building on the estimated polychoric correlations, we transform our variables into a linear combination of components in which each component represents a proportion of the total variance. We then perform a standard PCA analysis based on the eigenvectors where the variance-covariance matrix defines the weights. In doing so, we control for the categorical nature of the data for PCA analysis and compute the composite insolvency risk indicator for each SME in our sample. We standardize the final index by subtracting the mean and dividing by the standard deviation for ease of interpretation.[4]

Chart 1 presents the pairwise correlations between composite insolvency indicator and each of its underlying categorical components. All indicators other than the debt-to-equity ratio is positively correlated with the composite insolvency indicator. As already mentioned, responses to question two of SAFE survey are 1) *increased*; 2) *remained unchanged* and 3) *decreased* and to question eleven are 1) *improved*; 2) *remained unchanged*, and 3) *deteriorated*. In this respect, a positive correlation points to the fact that a decrease in profit, turnover, or working capital increases the insolvency risk. Especially, a deterioration in SMEs' profit and turnover is strongly correlated with the default risk.[5] Contrary to these, a decrease in SMEs' debt-to-equity ratio is

[4] All results presented in this paper also hold for the not standardized index variable.

[5] This is in line with the Altman's z-score where the earning ratios have the largest coefficients for the computation of the final score.

negatively correlated with the composite insolvency risk indicator. This is also in line with the expectations that a decline in SMEs' debt reduces the default risk. A deterioration in SMEs' sales and owners' equity is positively correlated with insolvency risk, too. A reduction in SMEs' sale has negative implications on turnover and profit and increases the default risk. Meanwhile, a decline in owners' equity would make it difficult to honor short term liabilities, especially increasing the insolvency risk.

Table III presents the average insolvency risk over time in each country in our sample. The average composite indicator points to a jump and all-time high insolvency risk during the pandemic in all countries. Still, significant cross-country differences are observable. In northern European countries such as Germany and the Netherlands, the insolvency risk indicator changes sign with the pandemic's onset in H1-2020. This points to a potential regime change in SME's insolvency risk. Unlike the sovereign crisis, where German SMEs face a much smaller hit, they now become much more similar to their southern counterparts. In Spain, meanwhile, already in 2019, SMEs' insolvency risk started to increase. With the beginning of the pandemic, though, SMEs' insolvency risk in Spain might take a new dimension. Lastly, SMEs in Italy face persistent insolvency problems with different degrees since the sovereign crisis. The pandemic crisis might render these problems to a level where a full-fledged SME crisis occurs in Italy. The main takeaway is that the pandemic outbreak has hit the already problematic SME landscape in Italy particularly hard and exacerbates the Spanish and French SMEs' solvency problems. Now SMEs in France present significant similarities in their insolvency risk to Italian and Spanish SMEs. Moreover, the relatively stable SMEs in Northern countries will probably be shaken and converge partly to southern SMEs strongly in years to come as well.

IV. Results

A. Determinants of SME insolvency risk

In addition to potential external shocks such as the pandemic, the firm specific-risks, macroeconomic factors, as well as country-specific characteristics might determine the insolvency risk of SMEs. In this subsection, we take a closer look at these determinants and their joint impact with the pandemic crisis. To do so, we start with the role of the pandemic outbreak in specific and delve deeper into the further factors in general. For estimation, we utilize a panel OLS with time and country fixed effects as in Equation 3:

$$Y_{itj} = \alpha + \beta X_{itj} + \theta Z_{tj} + \rho_t + \delta_j + \epsilon_{itj} \tag{3}$$

where Y_{itj} stands for the composite insolvency risk indicator for firm i in year t at country j, X_{itj} for firm-specific characteristics for firm i in year t at country j, Z_{tj} for macro factors in year t at country j, ρ_t biannual time fixed effects and δ_j country fixed effects. ϵ_{itj} is the error term. In our specifications, we begin with a smaller set of covariates and increase them step by step.

Model 1 of Table IV presents the impact of the pandemic outbreak on the SME insolvency risk, controlling for time and country fixed effects. To do so, it includes two dummy variables: 1) the onset of pandemic which covers the period en route to the crisis, and 2) during pandemic which covers the ongoing crisis. Both pandemic dummy variables enters the regression with a positively significant coefficient, which are large in magnitude. At the onset of the pandemic, SME insolvency risk increased, on average, by around 0.25 of its standard deviations or by some 10%. This shows that the slowdown in economic activity before and heading to the pandemic has led to severe difficulties for SMEs in the largest euro area countries already. During pandemic, SME insolvency risk increased, on average, by around 0.56 of its standard deviations or by some 26%. The tremendous decline in demand, which slashed the cash flows and revenues, lead to many otherwise sound SMEs probably facing significant solvency problems.

In model 2 of IV, we include standard indicators of firm sizes, such as the number of employees and the turnover in the model. Our results indicate that micro firms with less than 10 employees have a higher risk of insolvency in general. To be specific, they, on average, have around 0.14 standard deviations or some 6% higher insolvency risk within the SME landscape. Firms with 10 to 50 employees are not necessarily at higher risk of insolvency than the reference group of firms with 50 to 250 employees. Both turnover coefficients enter the regression with a positively significant coefficient. Being in the smallest turnover group leads to the insolvency risk being 0.22 standard deviations more than otherwise. The main takeaway from model 2 is that especially micro firms with less than 10 employees who have a turnover of less than EUR 2 Mio have higher insolvency risk in general. As firms grow, the insolvency risk decreases.

In model 3, we include firm ownership indicators, export company dummy variables, and sector dummy variables. Our results indicate that being an export firm decreases insolvency risk by some 0.07 standard deviations or around 3%. Exporting firms probably have higher resilience

to local shocks as they can switch between domestic and foreign markets more easily. Turning to different sectors, only SMEs from the services sector seems to have a higher insolvency risk. Probably they are affected the most by the pandemic demand shock as well. Firm ownership variables do not enter the regression with statistically significant coefficients.

In model 4 of table IV, we add macro-economic controls such as GDP growth and inflation. Both variables enter the regression with statistically significant coefficients. GDP growth has a negative sign, and one standard deviation increase in GDP growth reduces the SMEs' insolvency risk by around 0.04 standard deviations. During periods of high GDP growth, SMEs probably see favorable demand dynamics for their services and products. They have higher revenues and profitability and thereby have lower insolvency risk. On the contrary, heightened inflation increases the insolvency risk. A one standard deviation increase in inflation raises the insolvency risk by around 0.05 standard deviations. This is most likely due to SMEs' increased funding costs and the detrimental market conditions in general during high inflation periods.

We include country fixed effects in all our specifications, which are not reported for convenience but worth mentioning. Our reference country is Germany, and in our models, we include fixed effects for France, Italy, Spain, and the Netherlands. Dummy variables for Italy and Spain are positively significant in all specifications. SMEs from Italy and Spain has around 0.32 and 0.12 standard deviations higher insolvency risk, respectively, than the German SMEs. Indeed, SMEs' problems in southern Europe have been persistent since the sovereign crisis, which is reflected as a higher insolvency risk in our analysis. On the contrary, in the Netherlands, SMEs' insolvency risk is 0.25 standard deviations less than in Germany. Especially in recent years, SMEs from the Netherlands were strong performers on many fronts in Europe.

All in all, the sign and significance of SME insolvency risk determinants of this sub-section are by and large in line with the expectations. The pandemic outbreak increased insolvency risk significantly. However, there is probably significant heterogeneity in its impact with respect to some SME characteristics.

B. SME insolvency risk with respect to SME characteristics at the onset of the pandemic

The previous subsection presents the impact of single indicators on SME insolvency risk. To delve deeper into the contribution of these indicators around the outbreak of the pandemic and during its peak, we split our sample into different subsamples. In doing so, we replicate model

4 of Table IV by excluding the split variable from our analysis.[6] For convenience, we report the coefficients of the pandemic dummy variables only.

Chart 2 presents the onset of pandemic and pandemic dummy variable's coefficient when the sample is split concerning the firm size. The intuition behind this differentiation is the potential heterogeneity in the pandemic impact on business operations and financial backdrop within the SME spectrum. Among different firm sizes, the coefficient of the pandemic dummy variable takes the smallest value for the micro-firms' subsample both at the onset of the pandemic and during pandemic. The coefficients for small and medium-sized firm sub-samples are remarkably larger in both cases. Even though micro firms, in general, have higher insolvency risk, it seems that small and medium-sized enterprises were the ones to be hit the hardest at the onset of the pandemic. Shedding some more light on this conclusion, Chart 3 present a similar result when the firm size is measured with turnover. The coefficient of the pandemic dummy variable is smaller both at the onset of the pandemic and during pandemic for SMEs that have the lowest turnover. SMEs with EUR 2 to 10 Mio and EUR 10 to 50 Mio turnover have higher insolvency risk around the pandemic's outbreak and during its intensification. Micro firms with a small number of employees and turnover usually have lower funding needs and fixed costs within the SME spectrum. During the pandemic, public support measures probably covered these costs more efficiently, and micro firms' insolvency risk increased less than compared to those of small or medium-sized firms.

Chart 4 presents the results when the sample is split with respect to being a domestic or export firm. The intuition behind this split is that, domestic firms are more prone to restrictions in international demand. The coefficient of the pandemic dummy is insignificant for the domestic firm subsample at the onset of the pandemic. On the contrary, it becomes positively significant during the pandemic. Domestic SMEs are 0.4 standard deviations or have 14% higher bankruptcy risk during pandemic. This points out that while domestic firms were somewhat more resilient to insolvency risk in the first months of the pandemic, their insolvency risk also increased with national pandemic measures taking place. The coefficient of the pandemic onset and pandemic dummy variables are positively significant and large in magnitude for export firms. To be specific, exporting SMEs are 0.3 standard deviations or around 12% more likely to become insolvent at the onset of the pandemic. With the intensification of the crisis though, the risk become immense that exporting firms become 0.81 standard deviations or 20% more

[6]We only focus on sub-samples where the split variable has a significant coefficient in Model 4.

likely to go bankrupt. This is probably because export firms are more vulnerable to reduced global trade flows. The global recession, which inevitably leads to weaker foreign demand and disruption of supply chains, impact export firms more.

Chart 5 shows the differentiation concerning sector subsamples. Indeed, some sectors such as tourism and transport are hit by the pandemic much harder than others. The onset of the pandemic variable is is positively significant for all sectors. This points out that firms across the board have higher insolvency risk with different degrees. The construction sector's insolvency risk meanwhile seems to decrease at the onset of the pandemic and is negligible during the pandemic. While the construction sector is in a good position for the last ten years or so, it is noteworthy to observe that it actually benefited from the pandemic. This is probably because the construction industry entered the pandemic crisis in a much stronger position thanks to low mortgage rates, among others.

C. Most pressing problem and insolvency risk

In addition to SME characteristics, several external challenges might increase European SMEs' bankruptcy risk at the pandemic's onset. To examine these factors, section 2 of the SAFE questionnaire includes a question on the enterprises' most pressing problem. To be specific, it asks if finding customers and cost of production/labor among others was a problem for the SMEs during the last six months. Responses to these questions' are given on a scale of 1 to 10, 1 representing "not important at all" and 10 "extremely important." For ease of interpretation, we generate a dummy variable that takes the value of one for responses larger than five and zero otherwise. We include each most pressing response dummy variable separately in our regressions. Tables V and VI present the results of this analysis.

Panel A of Table V shows the impact of finding customers as the most pressing problem on insolvency risk. During periods of subdued economic activity, especially, SMEs face problems on this front. With SME clients under lockdown, it probably is the most relevant problem in the pandemic context, too. In the first column of panel A, we include the dummy variable of facing difficulties in finding customers only. The dummy variable is positively significant, and SMEs who face difficulties to find customers are 0.20 standard deviations more likely to face insolvency risk in general. Panel B present the results for the cost of labor and production as the most pressing problem. If SME have higher fixed costs, it becomes harder for them to generate high-profit margins. This meanwhile might translate into higher insolvency risk. In

line with these arguments, labor and production cost as the most pressing problem increases the insolvency risk by around 0.16 standard deviations. Meanwhile, the onset of the pandemic and pandemic dummy variables in all models of Table V are positively significant and similar in magnitude to Table IV.

To shed some light on the impact of the most pressing problems at the pandemic outbreak, we interact each most pressing problem dummy variable with the onset of the pandemic and pandemic dummy variables. The first interaction term in panel A is positively significant. As the pandemic erupts, SMEs face difficulty finding customers, which, as a result, adds around 0.10 standard deviations to their insolvency risk. Due to lockdown and several additional measures, finding customers become a central problem for SMEs during the pandemic. This is reflected in the third column of panel A of Table V where the difficulty in finding customers add around 0.25 standard deviations to insolvency risk. In column four of panel A, we include both interaction terms to present their joint impact. If an SME reports finding customers as the most pressing problem at the onset of the pandemic and during pandemic, it is around 14% more likely at the risk of insolvency. The reductions in customer demand are probably severely disruptive to SMEs solvency. Considering that the normalisation of customer demand might require a prolonged period, finding customers might remain as a key issue during next years.

Second column of panel B includes the interaction term between onset of pandemic and the cost of production and labor which is not statistically significant. This indicates that at the onset of the pandemic, cost of production being the most pressing problem did not contribute to the insolvency risk over and above its contribution during normal times. Third column of panel B includes interaction with the pandemic dummy which is positively significant. High costs increases the SME insolvency risk by around 6% during pandemic. Indeed, at the onset of the pandemic, the public support measures such as furlough schemes or rental supports probably lower the negative spillover of the crisis. As time passes though, these measures were probably not enought to cover the cost base. Many SMEs saw their revenues and profits erode while costs remaining largely constant. The demand shock they face, combined with ongoing costs, might pose an existential threat to many SMEs in years to come.

In panel A of Table VI we add the variable competition as the most pressing problem. In a market where many SMEs compete, it becomes challenging to set higher product prices. The competitive pressure becomes even more relevant during times of weak aggregate demand and, thereby, leads to higher insolvency risk. In line with these expectations, SMEs that report com-

petition as the most pressing problem has a higher insolvency risk of 0.25 standard deviations. In panel B of Table VI. we add skilled staff availability as the most pressing problem. Interestingly, the skilled staff availability decreases the insolvency risk by 0.08 standard deviations. When SMEs face difficulty finding qualified staff, the economy is probably in good shape with a low unemployment rate. Households and customers have stable incomes to spend, which most likely increases SMEs' revenues and reduces insolvency risk.

We interact the competition as the most pressing problem with the onset of the pandemic and pandemic dummy variables. The intuition behind this is that competitive pressure might actually increase due to lockdown measures, i.e. providers of online services or products capture market share from more traditional SMEs that do not offer online products. Interaction terms for this exercise are presented in panel A of Table VI which however are not statistically significant. This points out that there while heightened competition in general increases insolvency risk, this was not necessarily the case around the pandemic. Finally, we interact the pandemic dummy variables with finding skilled staff as the most pressing problem. Indeed, due to home office being the new normal during pandemic, some SMEs might have significant difficulties on finding skilled staff. In Panel B, the interaction terms on this front are also insignificant. All in all, unlike finding customers or the cost base, competition or skilled staff availability did not contribute to SME insolvency risk around pandemic over and above their contribution during normal times.

The main takeaway from this subsection is that sudden and extreme drop in demand resulted in a huge loss in revenues of European SMEs. These effects compounded with ongoing fixed costs probably leads to severe liquidity shortages. The lack of liquidity is especially problematic for SMEs and increase insolvency risk, because of their lower resilience related to their size. To bridge their liquidity needs, external or internal financing alternatives during the pandemic crisis is of pivotal importance. That said, the insolvency risk might hinder SMEs expected access to finance and requires a closer look.

D. Impact of insolvency risk and pandemic outbreak to the expected availability of finance

For European SMEs, bank loans, credit lines, and trade credit are crucial external funding alternatives. Therefore, SMEs' access to these funding channels during the pandemic needs particular attention. Deterioration in economic outlook due to pandemic shock might lead to limited availability of external funding at a point when SMEs have higher funding needs. This

might translate into a vicious circle where lack of external financing leads to higher insolvency risk and even more enhanced external funding needs.

In modeling the impact of insolvency risk on access to finance, an inherent problem is the potential reverse causality. While current access to finance might be a function of insolvency risk, the lack of external financing in the current period might increase insolvency risk simultaneously. To address potential endogeneity concerns, we focus on expected access to finance instead of the current access to finance.[7] The SAFE survey includes forward-looking access to finance questions to shed light on the SMEs' expectations on this front. To be specific, question 23 asks "*if SMEs expect the availability of different funding alternatives to improve, deteriorate or remain unchanged over the next six months*". The responses to this question are given on a scale of: 1 representing "will improve", 2 "will remain unchanged", and 3 "will decrease". For ease of interpretation, we recode the dependent variables as -1 for "will decrease", 0 for "will remain unchanged," and 1 for "will improve" responses. In Table VII, we present the results for this analysis. For the sake of brevity, the table shows the impact of the onset of the pandemic, pandemic, the role of insolvency risk, and macro-economic factors to the expected access to finance of SMEs. Yet, in all specifications, we control for SME characteristics, country, and time fixed effects. Dependent variables are SMEs' perception regarding the expected availability of bank loans, credit lines and overdrafts, and trade credit.[8]

In column one of Table VII, we start with the determinants of expected access to bank lending. The pandemic dummy variable is negatively significant, indicating that the pandemic's outbreak points to a deterioration in SMEs' expectations regarding bank loan availability by around 17%. Interestingly though, during pandemic, SMEs were not expecting any difficulties in bank loan availability. Indeed, many of the policy measures implemented to support SMEs during pandemic are through bank lending channel. Inline with this, OECD (2020) reports that bank lending to SMEs has rapidly increased to EUR 71 bn, EUR 103 bn and EUR 91 bn in the months of March, April, and May of 2020, respectively in Europe. Therefore, SMEs expectations regarding bank loan availability are actually justified. Insolvency risk enters the regression also with a negatively significant coefficient. A one standard deviation increase in insolvency risk

[7]It is important to stress that our approach does not rely on lagged variables. The dependent variable is obtained in the current period, yet, by definition, is based on SMEs' expectations. Forward-looking identification alleviates the endogeneity by disentangling present insolvency risk from current financing problems.

[8]Bank loans refer to a precise amount of loan where repayment dates are fixed. In the case of credit lines and overdrafts, SMEs can draw only part of the funds at discretion up to an agreed maximum balance. The interest of the credit lines is charged only on the amount withdrawn. Trade credit indicates that SMEs can pay their suppliers at the later agreed date after delivering the purchased goods or services.

leads to around 16% deterioration in expected access to bank loans. This suggests that, in general, firms that have insolvency problems in the past are more likely to have access to bank lending problems in the future. The dependent variables in columns three and five are credit line and overdraft, and trade credit, respectively. For both columns, the sign and magnitude of the onset of the pandemic, pandemic and insolvency risk variables are similar to those of bank loan availability. This shows that insolvency risk as a general factor is detrimental to access to external finance. While the onset of the pandemic pointed to a deterioration in external funding expectations, during pandemic crisis, thanks to public support measures, negative expectations are somewhat normalised.

Also presented in Table VII is the impact of macro variables such as GDP growth and inflation on different funding alternatives. GDP growth has a positively significant coefficient across the board. In terms of access to finance and growth nexus, economic growth seems to have a supportive role in access to finance. Inflation meanwhile enters the regressions with a negatively significant coefficient for bank lending. For other dependent variables, inflation is either weakly significant or insignificant. An increase in inflation leads to a reduction in the availability of bank lending and credit lines, probably due to banks' risk aversion and deleveraging during inflationary periods.

In columns two, four, and six of Table VII, we add interaction terms for onset of the pandemic and the pandemic dummy variables with the insolvency risk. Interaction terms are positively significant for bank loans and credit lines and bank overdrafts. This points to the fact that SMEs with higher insolvency risk foresee their access to bank lending to improve at the onset of and during the pandemic. Meanwhile, the interaction term is either insignificant or weakly significant for the trade credit-dependent variable. This is a noteworthy observation in the sense that unprofitable firms with high indebtedness expect banks to widen credit lines to them. In contrast, they do not foresee the same from their suppliers or trading counterparts. A potential explanation for this might be the expectations around government support via the banking sector. In Europe, governments introduce several measures to support lending to SMEs during the pandemic as public guarantees, among others.

E. Terms and conditions of bank loans around the pandemic

As a further step, we extend our analysis by studying whether insolvency risk, in addition to expected access to finance, also affects the price and non-price terms and conditions of bank

financing around pandemic. For this purpose, we utilize question 10 of the SAFE survey. Q10 asks SMEs about the terms and conditions of bank financing they received over the past six months. Since the loan is already received, this question refers to a sub-sample of SMEs that were already eligible for bank lending. Q10 has five main categories; i) the level of interest of the loan received; ii) the level of other costs, such as charges and fees; iii) size of the loan; iv) maturity of the loan; and v) collateral requirements such as guarantees, information requirements or loan covenants. SMEs could choose the responses among three different categories such as 1) was increased; 2) remained unchanged; 3) was decreased by the bank. For ease of interpretation, we recode the dependent variables as -1 for "was decreased", 0 for "remained unchanged," and 1 for "was increased". The explanatory variables remain the same as in the benchmark regression in column four of Table IV.

In Table VIII we report the results of this analysis for the pandemic dummy variables, insolvency risk, and their interactions. Columns 1 and 2 show that the level of interest of the bank loan has been increased at the onset of the pandemic, probably due to the risk aversion of banks at the beginning of the crisis. However, during a pandemic, there has been no further changes. Insolvency risk in general, increases the interest rates that banks demand from SMEs. The interaction terms point out that pandemics onset and insolvency risk were not jointly significant. However, those firms that have higher insolvency risk seem to enjoy tightened interest margins during the pandemic. Banks did not increase fees and commissions at the pandemic's onset and actually decreased these during a pandemic. While SMEs with a higher insolvency risk face higher charges and fees in general, they seem to benefit from reduced costs during the pandemic. This indicates that, banks ease price terms and conditions of loans to those firms that have higher insolvency risk during the crisis.

Turning to the size of maturity of loans, pandemics onset and its intensification does not significantly affect these variables. Meanwhile, the insolvency risk shortens the loan's maturity in general and leads to a smaller size of loans being available for SMEs. Results for collateral requirements point to an interesting trend. Both at the onset of the pandemic and during the pandemic, even more, banks reduced their collateral requirements by around 6% and 20%, respectively. While they demand higher collateral for those SMEs with higher insolvency risk by around 8%, banks reduced their requirements around pandemic significantly on this front. Expressing differently, firms with higher insolvency risk enjoyed reduced collateral requirements than those that do not suffer from this risk. Combined with the results from the previous

section, the results of this subsection point out that price and non-price terms and conditions of bank loans are improved for SMEs with higher insolvency risk.

F. Purpose of financing and insolvency risk

The previous sub-section results point out that SMEs with a higher insolvency risk expect their bank lending access to improve during the pandemic and have favorable terms and conditions for loans that they received. These might be explained by public support measures that provide bridge or working capital loans through private or public banks. Undoubtedly, measures are necessary to protect healthy and profitable SMEs from a temporary external demand shock. Yet, SMEs that would typically exit or be forced to restructure in a competitive market might benefit from these measures and remain in the market via public support, too. In this context, there is a continuous debate around zombie SMEs in Europe. This term is used to describe SMEs that are neither profitable nor condemned to liquidation or takeover but remain in the market via financing that covers their debt interest. These firms are usually detrimental to growth and crowd out investment in and employment at more productive firms. Thus, the type of SMEs who foresees enhanced access to finance during the pandemic is central for the real economy's future.

Observing SMEs during the pandemic and its immediate aftermath probably leads to the observation that otherwise healthy SMEs present significant similarities to zombie firms. Indeed, the pandemic posed an existential threat to SMEs across the board, and a considerable share of healthy SMEs would not survive without the public support measures throughout this period. This makes a differentiation between two types of firms during the pandemic particularly hard. The pandemic shock, which is compounded by several idiosyncratic factors, also hampers the utilization of a counterfactual sample. To shed some light on the differences between healthy and potentially zombie SMEs, though, backward-looking indicators such as the purpose of financing in the previous periods before the pandemic might provide essential insights.

Question Q6A of the SAFE survey asks, "For what purpose was financing you received used by your enterprise during the past six months?" Answers can be given on categories such as for i) fixed investments, ii) hiring and training of employees, iii) refinancing or paying off obligations, and iv) inventory and other working capital. The responses are either yes or no (or no response) to this question. We divide our sample into two groups based on their answers. Specifically, the first group represents those SMEs who used the funding received for investment or hiring

of employees. This group stands for healthy SMEs. The second group used the funding for refinancing or working capital and makes the potentially zombie SME sub-sample.

Table IX presents the results of this sample split. Column one reports the results for healthy SMEs who used bank lending for investments in property, plant, or equipment or hiring and training of employees. For this group, the pandemic's onset harms bank loans' expected availability at statistically significant levels. Also, insolvency risk decreases the expected availability of bank lending. The interaction term for pandemic and insolvency risk is not statistically significant at conventional levels. In column two are the results for potentially zombie SMEs. The sign and statistical significance of pandemic and insolvency risk variables are similar to the first column. Remarkably though, the interaction term here is positively significant and large in magnitude. SMEs that use the last funding round for refinancing or paying off obligations and inventory and other working capital foresees enhanced access to bank lending availability. This might indicate that public support measures have provided the bridge financing that some zombie SMEs needed in Europe.

The results from the sub-section indicate that support measures during pandemic might keep otherwise unprofitable companies in the market via enabling them to borrow. It has been documented that the zombie firm's ratio increases with decreasing firm size. This indicates that the zombie firm problem will intensify in the aftermath of the pandemic crisis, especially in the micro firm segment. While zombie firms might also achieve revivals, otherwise healthy SMEs might turn into zombies due to over-indebtedness in the aftermath of the pandemic crisis. When the economy recovers, SMEs should, therefore, remain cautious to keep their indebtedness levels under control. Policymakers, meanwhile, might conduct individual firm screening to prevent a prolonged zombie firm problem in Europe.

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V. Conclusion

With their customers under lockdown, businesses closed, and cash flows coming down, the Covid-19 pandemic poses an existential threat to European SMEs' financial resilience. This paper uses unique firm-level survey data on SMEs' financing conditions and a new approach to estimate their insolvency risk around the pandemic outbreak. We find that SME insolvency risk increased, on average, by around 10% with the outbreak of the pandemic and 21% during

the pandemic. In particular, small and medium-sized exporting firms are affected by the shock. Finding customers and ongoing fixed costs have contributed notably to SME insolvency risk around this period. Our results show that heightened insolvency risk gives rise to a deterioration in expected access to finance channels in general. However, SMEs with a higher insolvency risk foresee their access to bank lending to improve during the pandemic. Bank meanwhile, ease price terms and conditions of loans to those SMEs that have higher insolvency risk during the crisis. Moreover, these SMEs enjoyed reduced collateral requirements. These results are robust to the inclusion of a rich set of firm-specific controls, macroeconomic factors, and country-specific and time-specific trends.

Our results have important implications in designing relevant policy measures to avoid SME failures in Europe. For many SMEs with a profitable and stable business model, the sudden nature of the outbreak gave very little time to adjust and figure out how to sail through a prolonged downturn. The public support programs and changes in insolvency laws were vital to protect SMEs' resilience and prevent an insolvency tsunami. For example, in several European countries, the liquidity support programs that cover operating costs gave affected SMEs some breathing space during the lockdown. Still, many otherwise financially stable SMEs will find themselves over-indebted after the pandemic is over. Moreover, SMEs in poor health, which typically exit or be forced to restructure in a competitive market, benefited from generous access to finance conditions, too. Therefore, the question is whether the decisions made so far can prevent the number of insolvencies from rising significantly in the long term.

Availability of external funding is of central importance for SME investment decisions and sustainable recovery in the aftermath of the pandemic crisis. Policymakers should give priority to measures that address the high indebtedness of SMEs. Governments might consider investing directly equity in profitable SMEs to lower their debt levels. Efforts that provide companies time to reorganize their business and implement restructuring measures would also be beneficial. Meanwhile, SMEs need to keep an even better eye on their financial and liquidity planning than before the pandemic. In doing so, the threat of follow-on insolvencies might be avoided in years ahead.

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Table I: Summary statistics

Countries	DE	ES	FR	IT	NL	Total
% of total	20.4	22.2	20.5	23.8	13.1	100
# Employees<10	23.9	45.1	37.5	52.1	38.2	40.0
$10 \leq$ # Employees < 50	38.6	32.6	33.7	30.7	32.1	33.5
$50 \leq$ # Employees < 250	37.5	22.4	28.7	17.2	29.7	26.5
Turnover < EUR 2 m.	41.7	60.2	49.7	61.4	47	52.8
2≤ Turnover < EUR 10 m.	33	24.6	27.2	23.3	28	27.0
10≤ Turnover < EUR 50 m.	25.4	15.2	23.1	15.3	25	20.2
Exporting firm	44.8	40.1	34.3	44.9	43.7	41.5
Sole owner	49.5	29.2	42.7	29.8	46	38.4
More than one owner	36.1	52.6	32.7	56.5	38.5	44.2
Other enterprise	8.8	13.6	18.6	9.3	9.9	12.1
Public firm	0.7	1.2	2.2	0.4	2.1	1.2
Venture capital firm	1.6	0.6	0.4	0.3	0.6	0.7
Industrial	25.2	20.4	25.7	31.2	15.6	24.4
Construction	14.8	9.8	13.9	8.1	12.2	11.6
Services	19.7	24.9	25.2	21.4	24.1	23.0
Retail trade	40.2	44.9	35.2	39.3	48.1	41.0

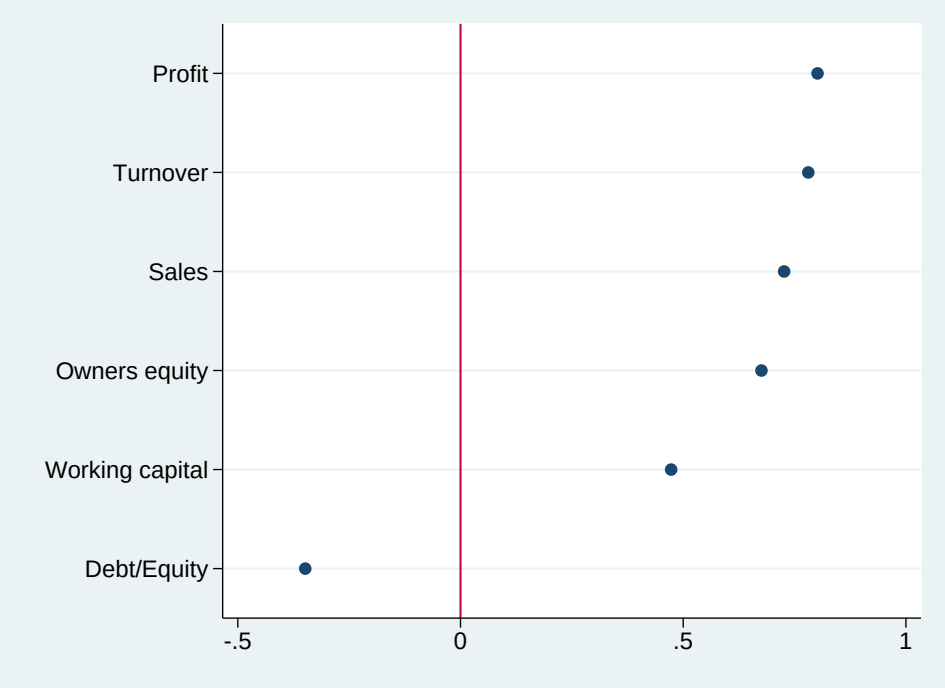
This table presents the summary statistics of the company-specific variables used in this paper. Presented values are the percent averages of the respective explanatory variables. In columns are countries. % of total refers to share of the sample from the respective country. # Employees<10 refers to firms that have less than ten employees, $10 \leq$ # Employees < 50 to those with ten to fifty employees and $50 \leq$ # Employees < 250 to those fifty to two hundred fifty employees. Turnover < EUR 2 m. refers to firms that have an annual turnover of less than two million euros, 2≤ Turnover < EUR 10 m. refers to firms that have an annual turnover of more than EUR two million but less than EUR ten million and 10≤ Turnover < EUR 50 m. refers to firms with an annual turnover of more than EUR ten million but less than EUR fifty million. The exporting firm refers to those firms that comprise sales of goods or the provision of services to non-residents. Sole owners and more than one owner refer to firms with one owner or more than one owner, respectively. Other enterprise means another firm owns the largest stake of the firm. Public firms are listed companies. Venture capital firms refer to firms whose largest stake is held by venture capitalists or business angels. Industrial, Construction, Services, and Retail trade are the respective sectors.

Table II: Deterioration in SMEs' position with respect to different indicators

PANEL A													
		2015		2016		2017		2018		2019		2020	
Turnover	DE	15	13	14	12	12	11	11	12	13	15	29	54
	ES	26	19	23	20	18	17	18	18	18	20	33	67
	FR	35	33	33	30	28	23	22	20	24	17	33	67
	IT	35	25	26	23	28	18	21	19	23	23	43	56
	NL	21	19	15	16	14	11	12	14	13	15	27	57
Profit	DE	25	22	22	21	22	21	22	23	25	25	35	57
	ES	35	27	30	28	28	24	26	29	31	31	40	67
	FR	46	43	43	39	39	36	34	34	34	27	38	63
	IT	49	37	36	33	38	30	32	29	35	35	50	66
	NL	30	23	21	22	20	19	17	21	22	22	32	56
Inventories and working capital	DE	13	11	11	10	10	10	12	10	10	10	13	19
	ES	16	13	16	12	12	8	12	9	10	10	18	11
	FR	27	23	24	20	21	17	17	14	19	12	19	16
	IT	24	14	15	15	13	12	13	11	13	12	19	12
	NL	21	18	13	12	15	11	10	7	9	10	14	22
Debt to Assets	DE	23	24	26	25	26	29	23	23	25	25	24	26
	ES	29	29	27	28	26	27	26	24	24	21	24	31
	FR	28	26	28	28	29	24	27	24	23	27	28	30
	IT	20	20	20	21	22	21	19	22	21	18	17	28
	NL	38	37	36	37	39	40	33	34	32	31	31	25
PANEL B													
		2015		2016		2017		2018		2019		2020	
Outlook with respect to sales	DE	14	14	12	12	11	11	9	12	15	19	37	42
	ES	14	12	15	17	11	12	12	18	18	24	44	61
	FR	35	34	32	31	24	21	18	22	22	22	35	47
	IT	22	15	17	17	14	13	13	12	14	18	37	35
	NL	12	14	13	11	8	7	5	9	11	16	36	46
Capital	DE	9	7	8	6	6	5	9	8	7	7	15	24
	ES	10	8	5	5	3	3	4	4	4	4	7	10
	FR	24	23	24	19	15	14	13	15	16	11	20	26
	IT	19	11	12	12	9	8	6	7	9	7	18	20
	NL	12	11	10	9	6	7	8	9	9	11	19	29

This table presents the responses to selected questions of the SAFE survey. Panel A includes responses to section two while panel B responses to section four. Presented values are percentage of SMEs who responded as "decreased" and "deteriorated" to the respective question in Panel A and Panel B respectively. Columns present the changes over time and in rows are different euro area countries. In Panel A, turnover; profit; inventories and working capital; and debt to assets are the responses to section two, question two, sub-question (c), (e), (h) and (j) respectively. In Panel B, outlook with respect to sales; and capital are the responses to section four, question eleven, sub-question (c) and (d) respectively. First half of 2020 presents the results for the onset of the pandemic and second half during the pandemic

Figure 1. Correlation with composite insolvency risk indicator



This chart presents the correlation of categorical variables with the composite insolvency risk indicator. Presented values are pooled pairwise correlations for the entire sample.

Table III: Insolvency risk by country over time

	Wave											
Country	2015		2016		2017		2018		2019		Pandemic	
DE	-0.219	-0.255	-0.257	-0.277	-0.314	-0.355	-0.311	-0.243	-0.201	-0.155	0.197	0.604
ES	-0.114	-0.234	-0.107	-0.129	-0.180	-0.224	-0.171	-0.099	-0.028	0.042	0.312	0.909
FR	0.316	0.295	0.233	0.147	0.050	0.002	-0.086	-0.027	0.041	-0.103	0.221	0.802
IT	0.404	0.135	0.169	0.148	0.136	-0.018	0.024	-0.008	0.136	0.160	0.551	0.842
NL	-0.377	-0.437	-0.490	-0.547	-0.613	-0.656	-0.632	-0.568	-0.476	-0.357	-0.002	0.522

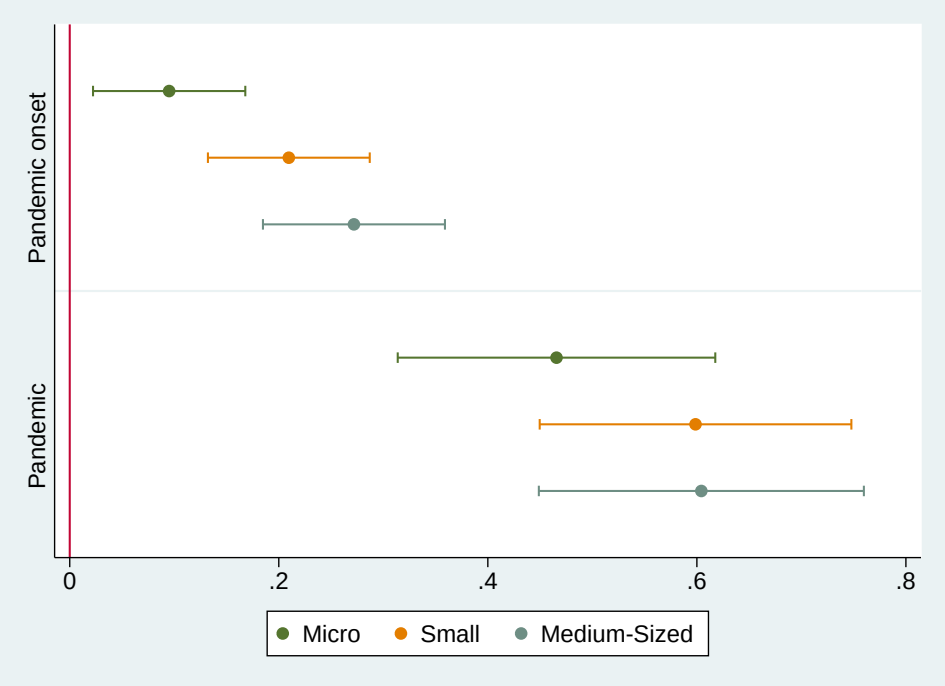
This table presents the average of composite insolvency risk indicator in each wave with respect to different countries. First column of pandemic refers to H1-2020 and thereby the onset of the pandemic. Second column of pandemic refers to H2-2020 and thereby during pandemic crisis.

Table IV: Determinants of SME insolvency risk

	Model 1	Model 2	Model 3	Model 4
Onset of the pandemic	0.249***	0.246***	0.245***	0.180***
	(0.021)	(0.021)	(0.021)	(0.024)
Pandemic	0.711***	0.709***	0.708***	0.563***
	(0.021)	(0.021)	(0.021)	(0.051)
# Employees<10		0.138***	0.125***	0.125***
		(0.016)	(0.016)	(0.016)
10 < # Employees < 50		0.004	-0.002	-0.002
		(0.013)	(0.013)	(0.013)
Turnover < 2		0.217***	0.210***	0.210***
		(0.016)	(0.017)	(0.017)
2< Turnover <10		0.082***	0.079***	0.079***
		(0.013)	(0.014)	(0.014)
Exporting firm			-0.068***	-0.068***
			(0.009)	(0.009)
Subsidiary			0.024*	0.024*
			(0.013)	(0.013)
Public Firm			0.047	0.047
			(0.038)	(0.038)
Venture Capital			-0.030	-0.029
			(0.052)	(0.052)
Construction			-0.023	-0.023
			(0.015)	(0.015)
Services			0.018	0.019
			(0.013)	(0.013)
Trade			-0.020*	-0.020*
			(0.011)	(0.011)
GDPgrowth				-0.024***
				(0.009)
Inflation				0.055***
				(0.012)
Constant	-0.113***	-0.261***	-0.216***	-0.216***
	(0.017)	(0.018)	(0.021)	(0.023)
R^2	10.5%	12.5%	12.6%	12.6%
Sample size	52475	52475	52475	52475
Time fixed effects	✓	✓	✓	✓
Country fixed effects	✓	✓	✓	✓

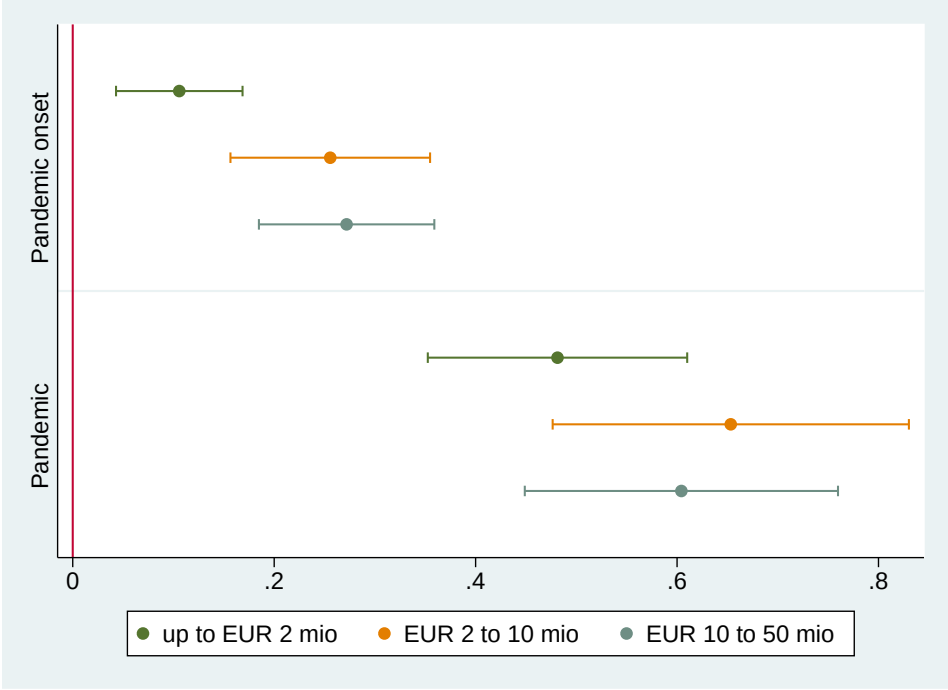
This table presents the OLS estimates for the determinants of SMEs' insolvency risk. Dependent variable is the standardized composite insolvency indicator. All specifications include country fixed effects and bi-annual time fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Three stars denote significance at 1%; two stars denote significance at 5%; one star denotes significance at 10%.

Figure 2. Insolvency risk with respect to firm size



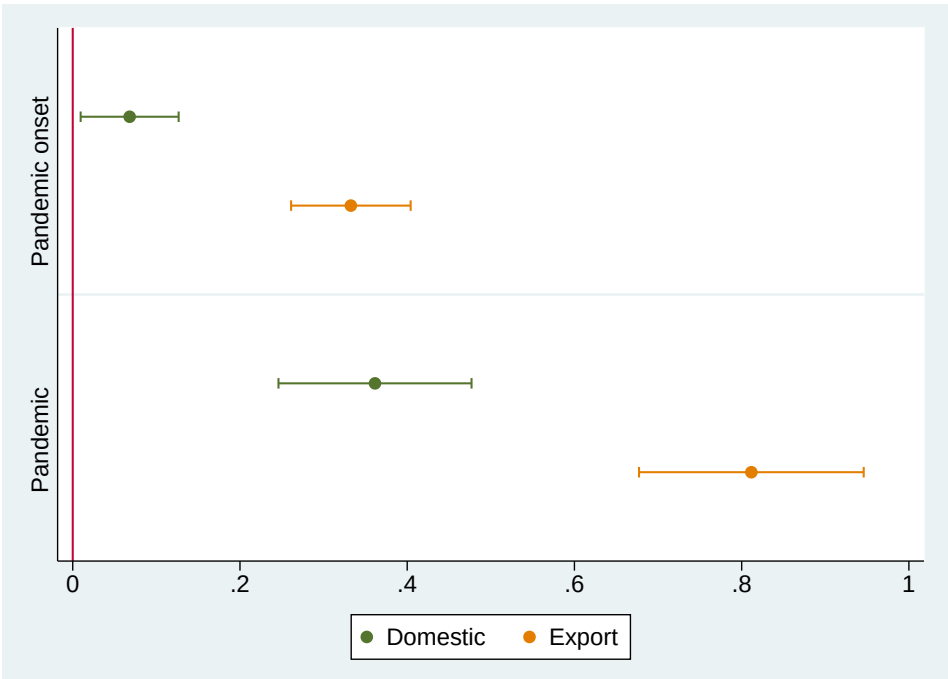
This chart presents the impact of pandemic on insolvency risk with respect to firm size. Presented results are the coefficients of onset of the pandemic and pandemic dummy variables in respective sub-sample. Micro refers to firms that have less than 10 employees, small to firms that have more than (or equal to) 10 but less than 50 employees, Medium-Sized to firms that have more than (or equal to) 50 but less than 250 employees.

Figure 3. Insolvency risk with respect to firm turnover



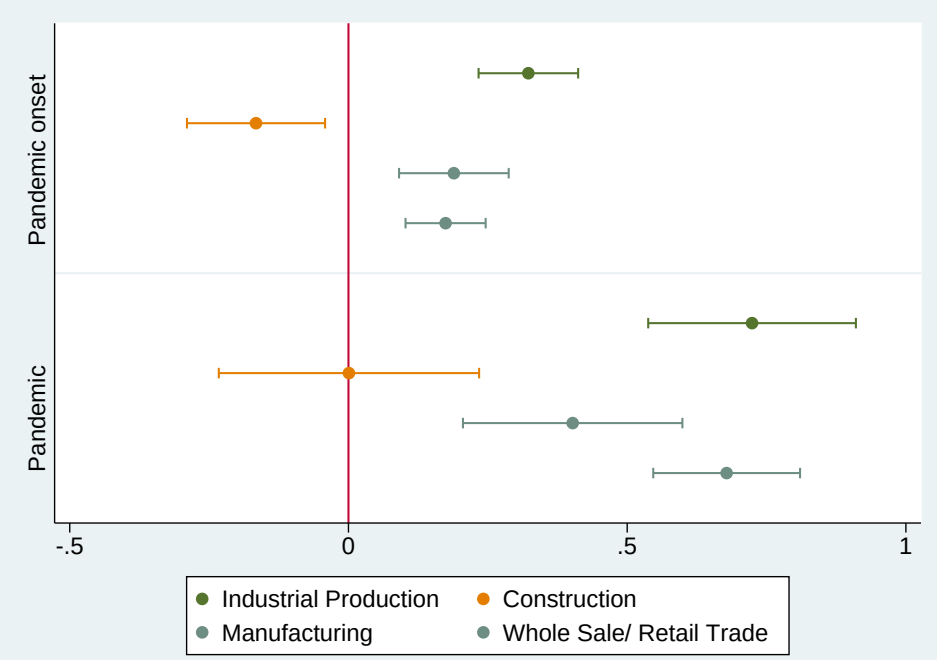
This chart presents the impact of pandemic on insolvency risk with respect to firm turnover. Presented results are the coefficients of onset of the pandemic and pandemic dummy variables in respective sub-sample. Up to EUR 2 mio refers to firms that have less EUR 2 mio turnover, EUR 2-10 mio refers to firms that have more than EUR 2 mio. but less than EUR 10 mio. turnover, EUR 10 to 50 mio refers to firms that have more than EUR 10 mio. but less than EUR 50 mio. turnover.

Figure 4. Insolvency risk differentiating for domestic and exporting firms



This chart presents the impact of pandemic on insolvency risk differentiating between domestic and exporting firms. Presented results are the coefficients of onset of the pandemic and pandemic dummy variables in respective sub-sample. Domestic refers to firms that do not export and export otherwise.

Figure 5. Insolvency risk with respect to sector



This chart presents the impact of pandemic on insolvency risk with respect to main activity of the SMEs. Presented results are the coefficients of onset of the pandemic and pandemic dummy variables in respective sub-sample.

Table V: Most pressing problem during pandemic

	Panel A: Finding Customers				Panel B: Cost of production and labor			
Onset of the pandemic	0.197***	0.146***	0.193***	0.127***	0.183***	0.172***	0.182***	0.161***
	(0.024)	(0.030)	(0.024)	(0.030)	(0.024)	(0.033)	(0.024)	(0.033)
Pandemic	0.593***	0.591***	0.447***	0.440***	0.581***	0.580***	0.506***	0.504***
	(0.050)	(0.050)	(0.053)	(0.053)	(0.050)	(0.050)	(0.053)	(0.053)
Finding customers	0.199***	0.192***	0.178***	0.168***				
	(0.009)	(0.009)	(0.009)	(0.009)				
Interaction onset of the pandemic		0.080**		0.105***				
		(0.032)		(0.032)				
Interaction pandemic			0.253***	0.263***				
			(0.033)	(0.033)				
Cost of production and labor					0.162***	0.160***	0.149***	0.147***
					(0.009)	(0.009)	(0.009)	(0.010)
Interaction onset of the pandemic						0.016		0.030
						(0.033)		(0.033)
Interaction Pandemic							0.145***	0.147***
							(0.034)	(0.034)
Constant	-0.370***	-0.366***	-0.356***	-0.351***	-0.337***	-0.337***	-0.332***	-0.330***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
R^2	13.5 %	13.5%	13.6%	13.6%	13.2%	13.2%	13.2%	13.2%
Sample size	52223	52223	52223	52223	52223	52223	52223	52223
Controls			✓				✓	
Time fixed effects			✓				✓	
Country fixed effects			✓				✓	

This table presents OLS estimates of the relationship between insolvency risk and most pressing problem of the SMEs. The dependent variable is the composite insolvency indicator. All specifications include SME specific controls, country and time fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Three stars denote significance at 1%; two stars denote significance at 5%; one star denotes significance at 10%.

Table VI: Most pressing problem during pandemic cont.

	Panel A: Competition				Panel B: Skilled staff availability			
Onset of the pandemic	0.196***	0.181***	0.197***	0.183***	0.191***	0.169***	0.191***	0.171***
	(0.024)	(0.029)	(0.024)	(0.029)	(0.024)	(0.032)	(0.024)	(0.032)
Pandemic	0.612***	0.612***	0.621***	0.620***	0.563***	0.563***	0.591***	0.590***
	(0.050)	(0.050)	(0.052)	(0.052)	(0.051)	(0.051)	(0.054)	(0.054)
Competition	0.237***	0.235***	0.239***	0.236***				
	(0.008)	(0.009)	(0.009)	(0.009)				
Interaction onset of the pandemic		0.026		0.025				
		(0.031)		(0.031)				
Interaction pandemic			-0.023	-0.020				
			(0.032)	(0.032)				
Skilled staff availability					-0.088***	-0.090***	-0.084***	-0.086***
					(0.009)	(0.009)	(0.009)	(0.009)
Interaction onset of the pandemic						0.034		0.030
						(0.033)		(0.033)
Interaction pandemic							-0.043	-0.040
							(0.033)	(0.033)
Constant	-0.377***	-0.376***	-0.378***	-0.377***	-0.149***	-0.148***	-0.152***	-0.151***
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)
R^2	13.9%	13.9%	13.9%	13.9%	12.8%	12.8%	12.8%	12.8%
Sample size	52223	52223	52223	52223	52223	52223	52223	52223
Controls			✓				✓	
Time fixed effects			✓				✓	
Country fixed effects			✓				✓	

This table presents OLS estimates of the relationship between insolvency risk and most pressing problem of the SMEs. The dependent variable is the composite insolvency indicator. All specifications include SME specific controls, country and time fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Three stars denote significance at 1%; two stars denote significance at 5%; one star denotes significance at 10%.

Table VII: Impact of insolvency risk and the pandemic on expected availability of external funding

	Bank loans		Credit line Bank overdraft		Trade Credit	
Onset of the pandemic	-0.170***	-0.186***	-0.159***	-0.173***	-0.271***	-0.277***
	(0.020)	(0.021)	(0.021)	(0.022)	(0.025)	(0.026)
Pandemic	-0.009	-0.026	0.018	-0.000	0.081	0.066
	(0.037)	(0.038)	(0.036)	(0.037)	(0.052)	(0.052)
Insolvency risk	-0.163***	-0.171***	-0.158***	-0.165***	-0.151***	-0.155***
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.005)
GDP growth	0.033***	0.034***	0.029***	0.031***	0.044***	0.046***
	(0.006)	(0.006)	(0.007)	(0.007)	(0.009)	(0.009)
Inflation	-0.038***	-0.034***	-0.024**	-0.020**	-0.007	-0.005
	(0.009)	(0.009)	(0.010)	(0.010)	(0.011)	(0.011)
Interaction onset		0.051***		0.041***		0.016
of the pandemic		(0.015)		(0.016)		(0.020)
Interaction pandemic		0.035***		0.040***		0.037**
		(0.013)		(0.013)		(0.018)
Constant	0.110***	0.106***	0.061***	0.057***	-0.015	-0.017
	(0.017)	(0.017)	(0.018)	(0.018)	(0.023)	(0.023)
R^2	10.4%	10.5%	10.5%	10.6%	11.9%	11.9%
Sample size	34236	34236	28740	28740	18153	18153
Company controls	✓		✓		✓	
Time fixed effects	✓		✓		✓	
Country fixed effects	✓		✓		✓	

This table presents OLS estimates for the determinants of the expected access to external finance. The dependent variable in column one and two is bank loans, in column three and four credit lines and bank overdraft and in column five and six trade credit. All specifications include SME specific controls, country and time fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Three stars denote significance at 1%; two stars denote significance at 5%; one star denotes significance at 10%.

Table VIII: Terms and conditions of bank loans around the pandemic

	Level of interest		Other costs		Size of the loan		Maturity of the loan		Collateral requirements	
Onset of the Pandemic	0.125***	0.137***	0.033	0.046	0.021	0.013	0.023	0.022	-0.079***	-0.061**
	(0.028)	(0.029)	(0.026)	(0.027)	(0.023)	(0.024)	(0.017)	(0.018)	(0.021)	(0.021)
Pandemic	-0.032	0.019	-0.231***	-0.175**	0.113*	0.093	0.088*	0.060	-0.221***	-0.192***
	(0.065)	(0.066)	(0.059)	(0.059)	(0.054)	(0.055)	(0.041)	(0.042)	(0.048)	(0.049)
Insolvency risk	0.101***	0.111***	0.080***	0.092***	-0.076***	-0.081***	-0.031***	-0.036***	0.077***	0.085***
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.005)	(0.003)	(0.004)	(0.004)	(0.004)
Interaction onset		-0.040*		-0.043*		0.025		0.005		-0.050***
of the pandemic		(0.019)		(0.018)		(0.016)		(0.012)		(0.015)
Interaction pandemic		-0.084***		-0.091***		0.034*		0.045**		-0.049***
		(0.018)		(0.017)		(0.016)		(0.014)		(0.014)
Constant	-0.367***	-0.362***	0.196***	0.201***	0.176***	0.174***	0.073***	0.071***	0.120***	0.123***
	(0.029)	(0.029)	(0.027)	(0.027)	(0.024)	(0.024)	(0.018)	(0.018)	(0.021)	(0.021)
Company controls		✓		✓		✓		✓		✓
Time fixed effects		✓		✓		✓		✓		✓
Country fixed effects		✓		✓		✓		✓		✓
R^2	8.9%	9.1%	5.0%	5.2%	3.5%	3.5%	2.4%	2.5%	5.4 %	5.6%
Sample size	16709	16709	16753	16753	16746	16746	16613	16613	16476	16476

This table presents OLS estimates for the determinants of the terms and conditions of bank loans around the pandemic. In column one and two dependent variable is the level of interest. In column three and four other costs related to bank loans. Column five and six, the size of the bank loan and column seven and eiqght the maturity. Finally, the last two columns refer to the collateral requirements associated with this loan. All specifications include SME specific controls, country and time fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Three stars denote significance at 1%; two stars denote significance at 5%; one star denotes significance at 10%.

Table IX: Impact of insolvency risk and onset of pandemic on expected availability of bank lending

Sample split with respect to purpose of financing	(1)	(2)
Onset of the pandemic	-0.219***	-0.241***
	(0.028)	(0.032)
Insolvency risk	-0.154***	-0.166***
	(0.005)	(0.005)
GDP growth	0.031**	0.022
	(0.014)	(0.015)
Inflation	-0.026*	-0.009
	(0.014)	(0.015)
Interaction	0.036*	0.066***
Interaction onset of the pandemic	(0.020)	(0.022)
Constant	0.125***	0.111***
	(0.026)	(0.028)
R^2	9.0%	10.6%
Sample size	17221	14353
Company controls	✓	✓
Time fixed effects	✓	✓
Country fixed effects	✓	✓

This table presents OLS estimates for the determinants of the expected access to bank lending. In column one is the subsample of SMEs that report investments in property, plant or equipment or hiring and training of employees as their reason for using bank loans during the past six months. In column two are the SMEs that report refinancing or paying off obligations and inventory and other working capital as their reason for using bank loans during the past six months. All specifications include SME specific controls, country and time fixed effects. Standard errors robust to heteroskedasticity are in parentheses. Three stars denote significance at 1%; two stars denote significance at 5%; one star denotes significance at 10%.

VI. Appendix

Table X:Variable definitions

Insolvency indicators	
General information on the type and situation of the enterprise: Question 2: Have the following company indicators decreased, remained unchanged or increased over the past six months?	
Turnover	Increased (1), Remained unchanged (2), Decreased (3), Don't Know (9)
Profit	Increased (1), Remained unchanged (2), Decreased (3), Don't Know (9)
Inventories and other working capital	Increased (1), Remained unchanged (2), Decreased (3), Don't Know (9)
Debt compared to assets	Increased (1), Remained unchanged (2), Decreased (3), Don't Know (9)
Availability of finance and market conditions: Question 11: For each of the following factors, would you say that they have improved, remained unchanged or deteriorated over the past six months?	
Your enterprise-specific outlook with respect to your sales and profitability or business plan	Increased (1), Remained unchanged (2), Decreased (3), Don't Know (9)
Your enterprise's own capital	Increased (1), Remained unchanged (2), Decreased (3), Don't Know (9)