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RESEARCH ARTICLE

The impact of government financial aid and digital tools on firm survival during the COVID-19 pandemic

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Abstract This study explores the effect of bailout capital and digital diversification by small- and medium-sized enterprises (SMEs) on their propensity to survive during and after the COVID-19 pandemic. Using a random sampling of 5469 SMEs from 16 European countries, collected by the World Bank Enterprise Survey in May 2020, January 2021, and May 2021, we conduct a two-stage estimation to examine factors that first affected the propensity of SMEs to access bailout capital, and second, factors that increased the propensity of SMEs to survive longer during and after crises. Two key findings emerge. Diversification of government financial aid and the adoption of various digital tools to leverage the effect of shock by SMEs increase their propensity to survive by sized firms. Moreover, government financial aid does not moderate the effect of digital tool adoption on the propensity to survive. Policy insights and implications are also discussed.

Plain English Summary We find that resource mobilization through government financial aid, particularly access to liquidity, significantly increases the likelihood of survival, with the effects being more pronounced for small-sized firms than medium-sized ones. Digital tool adoption matters to decrease SMEs risk of failure. However, combining government financial aid with digital tool adoption did not necessarily improve survival outcomes, possibly due to regional constraints on effectively using both resources together. This may indicate potential regional constraints for SMEs that impede the effectiveness of government support. We contribute to the literature on strategic responses to crises by SMEs, showing that while government financial aid and digital transformation are beneficial, the optimal use of these resources may depend on regional and firm-specific factors. Our insights provide valuable recommendations for research and policy to enhance SME resilience during future crises.

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1 Introduction

As a complex and interrelated crisis, the COVID-19 pandemic provides a suitable context to explore how macro-level shocks influence small- and medium-sized enterprises (SMEs) in their search for external resources (Block et al., 2021). The pandemic's economic and political ramifications presented immediate effects for firms, bringing survival concerns to the forefront (Newman et al., 2022). The availability of bailout capital during the pandemic, often through specialized government financial aid that aimed to rescue SMEs and prevent bankruptcies, job losses, and a broader economic fallout, had a direct effect on SMEs' propensity to survive (Gourinchas et al., 2020; Block et al., 2022a; Savio et al., 2024). The unique nature of the pandemic-induced crisis forced SMEs to confront the economic impact and make strategic management choices, such as investing in digital tools and technologies, applying for government financial aid, engaging with customers differently, remaining operational or selling equity, and retaining employees or starting the redundancy process. Firms could select a specific combination of digital tools from a wide range available, including online communication tools (e.g., Zoom, MS Teams, Skype), e-commerce development tools (e.g., website development, online marketplaces), social media (e.g., video platforms, digital ads, local listings), home delivery services with digital payments, customer relationship management and analytics tools (e.g., customer insight tools, business/data analytics), and employee training and hiring platforms (e.g., online training, online hiring) (Data Catalyst Institute, 2021). These strategic management and digital tool choices played a key role in determining firms' survival during and after the crisis (Belitski et al., 2022; Giones et al., 2020).

The strategic choices of SMEs, which are pivotal for regional competitiveness and economic growth (Audretsch et al., 2015), lie at the core of the debate about the purpose of the firm and how firms balance short-term and long-term interests along with shareholders' and stakeholders' objectives (Zattoni & Pugliese, 2021). While larger firms have shown more resilience to economic shocks, including the COVID-19 pandemic (Juergensen et al., 2020), SMEs are more vulnerable in times of crisis (Data Catalyst Institute, 2021; Kolasa et al., 2010; Khlystova & Kalyuzhnova, 2023) as they often lack the resources to withstand exogenous shocks (Zahra, 2021). The COVID-19 pandemic and subsequent financial and health crises have reignited this debate (Bartik et al., 2020a, 2020b; Belghitar & Khan, 2013).

In response to recent calls for a better understanding of the economic and social effects of the COVID-19 pandemic on entrepreneurs and entrepreneurship (Belitski et al., 2022), this study focuses on the survival of SMEs, incorporating their interrelated and overlapping responses to crises through adoption of specific digital tools (Data Catalyst Institute, 2021), and accessing diverse instruments of government financial aid (Atkins et al., 2022; Block et al., 2022a; Dörr et al., 2022). We pose the following research question: to what extent did diversification in government financial aid and the adoption of various digital tools by SMEs affect their propensity to survive during and after the COVID-19 pandemic?

We use longitudinal data on SMEs randomly selected across 16 Southern and Eastern European countries (SEE) in the 2019 World Bank Enterprise Survey (WBES, 2023), as well as three COVID-19 WBES follow-up surveys conducted in May 2020, December 2020/January 2021, and May/April 2021. The final random sample is stratified at the sectoral and regional levels, including 5469 SMEs, with 64% being small firms and 36% medium firms. Our interest in SMEs' survival propensity during and after the COVID-19 in the SEE was driven by the following factors. Firstly, SMEs in SEE lack resources for growth, at the same time SEE countries experience dynamic growth which makes them particularly vulnerable to external shocks compared to their Western European counterparts. Secondly, these countries often have different economic structures and formal and informal institutions compared to their Western and Northern European counterparts, which could have affected the response to the COVID-19 pandemic shock and their propensity to survive longer during the crisis. Finally, SEE countries with a lower stringency index in their COVID-19 response (Hale et al., 2021) provide a more uniform ground for analysis regarding the natural resilience and adaptability

of SMEs to external shocks. Thus, analyzing SMEs in Southern and Eastern Europe may yield valuable policy insights into how SMEs respond to various external shocks.

This study contributes to the existing literature on strategic responses to economic shocks (Bebchuk et al., 2023; Newman et al., 2022; Reilly et al., 2016) and the resource-based view (RBV) of firms (Barney, 1996, 2001; Nason & Wiklund, 2018) by demonstrating how access to different instruments of government financial aid and the diversification of digital tools (remote working, website creation, and home delivery through apps and platforms) to respond to the COVID-19 pandemic changed SMEs' propensity to survive.

While many studies have recently emerged on the role of bailout capital for SMEs' competitiveness and resilience during the crisis (Brown et al., 2021; Bertoni et al., 2023; Assefa, 2023; Miocevic & Srhoj, 2023), this study demonstrates the importance of understanding the nuanced impacts of diversification of government financial aid and digital diversification on SME survival, highlighting the significant yet complex relationships influenced by firm size, sector, and regional context. It provides insights into the effectiveness of bailout capital and digital transformation in SME survival, offering valuable recommendations for policymakers and entrepreneurs on resource mobilization and digital adoption.

Our results show that resource mobilization through government financial aid, particularly access to liquidity, significantly increases the likelihood of survival (Fairlie & Fossen, 2022a), with the effects being more pronounced for small-sized firms than medium-sized ones.

Diversification of government support significantly reduces the hazard of SME market exit by between 33.4 and 37% with the addition of at least one instrument of government financial support, and a decrease in the hazard of market exit of between 34.6 and 36% with the addition of two instruments of government support compared to no access to support. While initial diversification of government support greatly aids survival, additional forms of support do not significantly reduce exit propensity beyond the initial impact.

We also find that adopting at least one digital tool decreases the hazard of market exit by 17.9% compared to SMEs that adopted none, and that the hazard of market exit decreased by 34.9% for SMEs that adopted at least two digital tools. Access to bailout capital and digital diversification by SMEs may not complement each other in facilitating SME survival, indicating potential regional constraints for SMEs that impede the effectiveness of government support.

The rest of the paper is structured as follows. Section 2 sets the theoretical framework and develops the hypotheses. Section 3 presents the data, variables, and the empirical methodology adopted for the analysis. Section 4 discusses the results. Section 5 presents the discussion, developing theoretical, and managerial and policy implications. Finally, Section 6 concludes.

2 Theoretical framework

2.1 Government financial support, digital tools adoption, and firm survival

Government interventions can take various forms in SMEs, including direct financial assistance, tax relief, wage subsidies, and support for digital transformation. Each type of support addresses different aspects of business operations and challenges. For small firms, the diversity of these interventions can be more impactful due to their limited internal resources and the breadth of challenges they face (Storey, 1994).

Crises often lead to financial distress for SMEs. In order to survive such economic distress, SMEs need to preserve their liquidity and often turn to public funds for help. Successful SMEs signal to both small investors and larger stakeholders to attract finance (Ahlers et al., 2015). In particular, during a period of crisis, resources and resource management are crucial to gain a competitive advantage and survive (Zahra, 2021). The RBV asserts that certain tangible and intangible resources possess unique qualities that are essential for survival and maintaining a competitive advantage (Barney, 1996, 2001; Nason & Wiklund, 2018).

In the context of SMEs, which often lack the extensive resource pools of larger firms, government financial support during crises can be a critical factor in their survival and continued operation. Unlike established companies that can access strategic resources through market transactions or collaborative ventures, SMEs frequently face resource scarcity, particularly during economic downturns and exogenous shocks

such as COVID-19 (Audretsch et al., 2024a; Belitski et al., 2022).

Government financial aid provides SMEs with the necessary liquidity to manage operational costs, invest in digital transformation, and retain their workforce during crises. Globally, SMEs have appealed to their governments for financial support related to deferral of credit payments, additional liquidity, guaranteed loans, and wage subsidies to mobilize debt and public resources (Bertoni et al., 2023; Brown et al., 2021). Many countries introduced government financial aid policies during the pandemic. For example, in the USA, the Paycheck Protection Program (PPP) and the Economic Injury Disaster Loan (EIDL) program provided funds to small businesses. In Italy, the August Decree, the Relaunch Decree, and the Cure Italy Decree allocated extra funds for wage subsidy schemes and indemnities to workers during the pandemic. These measures have been associated with numerous examples of SMEs aiming to mobilize resources (Ahlers et al., 2015) to maintain sales, retain skills, and access new and existing customers, increasing their propensity to survive and grow (Juergensen et al., 2020; Kuckertz et al., 2020).

From the RBV perspective, this financial support from the government can be seen as an injection of critical resources that SMEs would otherwise struggle to obtain. Thus, government aid schemes, which included not only financial aid but also the ability to train employees and allocate resources to bid and buy new technologies in response to market structure changes, emerged as a complementary form of resource allocation during the COVID-19 pandemic (Block et al., 2022a; Miocevic & Srhoj, 2023). Enhancing the internal capabilities of SMEs through access to finance (Beck et al., 2005), such as diversifying government aid, could include multiple channels and instruments (Block et al., 2022b) and enables SMEs to build a more resilient foundation, thereby increasing their survival propensity during and after crises (Belghitar et al., 2023; Miocevic & Srhoj, 2023).

An increase in resources attracted through the government aid had provided the necessary liquidity to pay wages and retain personnel, with some SMEs even increasing hiring, training new skills to adapt to changing market needs and restructuring, adopting new digital tools and technologies, building the website and digitizing supply chains (Belghitar et al., 2023). During the COVID-19 pandemic in particular, access to government resources and direct financial aid enabled SMEs to pay wage subsidies and bonuses and to buy equipment and tools for remote working, and exceptional work compensations, when "stay at home" rules and lockdowns were enforced (Zhang et al., 2022). Other forms of government tools to support SMEs included suspension of debt payments and taxes. For instance, a study by Bartik et al. (2020a) during the COVID-19 pandemic found that small firms receiving a combination of financial aid, wage subsidies, and digital support had higher survival rates than those receiving a single type of intervention. This finding underscores the importance of a multifaceted approach in addressing the varied needs of small firms.

The RBV framework is helpful in understanding the mechanisms and incentives for strategic resource allocation and utilization to achieve competitive advantage in the short term and survive (Zahra, 2021). Government financial support during crises plays a vital role in equipping SMEs with the resources needed to navigate challenges, maintain operations, and emerge stronger, thus enhancing their overall survival prospects with the recent evidence demonstrating how public funding enabled to retain customers and employees during and after the pandemic (Bartik et al., 2020b). Based on the arguments presented, we hypothesize:

H1: Diversification of government support to SMEs increases their propensity to survive during and after crises.

Building on the RBV perspective (Barney, 2001; Nason & Wiklund, 2018), we argue that small-sized firms, unlike their medium-sized counterparts, often lack the resources to invest in additional digital infrastructure, upskilling, and training, and possess limited capabilities to undertake larger projects (Li et al., 2016; Vilhelmson & Thulin, 2016). This can reduce their competitive advantages compared to larger firms, leading many small firms to exit the market (Bloom et al., 2021). Smaller firms have more limited financial, human, and technological resources, making them more vulnerable during crises (Bartik et al., 2020b) when resources are needed to overcome their vulnerabilities and grow (Cumming & Groh, 2018; Cumming et al., 2021).

Secondly, diversification of government support may allow small-sized firms to diversify resource allocation (Audretsch & Belitski, 2024), potentially increasing the exploration activity of smaller firms as liquidity and other forms of support increase, reaching out to markets and industries previously unaffordable without financial aid for small firms. For example, greater investment would be required for digital technology purchases, training, and licensing, which are expenses for which small firms could claim funding (Block et al., 2022a). Investment in smaller firms is less likely due to their lack of liquidity (Belghitar & Khan, 2013; Belghitar et al., 2023).

Thirdly, small firms have greater flexibility with resources due to the constant reconfiguration of their internal capabilities. The variety of support available from the government may therefore allow small firms to relocate resources to match the financial aid tools and exploit them faster than medium-sized and larger firms (Audretsch & Belitski, 2021; Bartz & Winkler, 2016; Priyono et al., 2020). Small firms tend to be more flexible and adaptable than medium-sized firms. This flexibility allows them to quickly implement changes and make the most of government support, particularly in areas like digital transformation and workforce training, which may increase the returns to financial aid (Nooteboom, 1994).

Fourthly, smaller firms are more likely to accumulate debt quickly due to miscellaneous and operational costs compared to larger firms. They also face lower pressure from external shareholders seeking high payouts (Savio et al., 2024). Small-sized firms are less likely to use government funds as a substitute for dividends to pay shareholders than larger firms where shareholders have higher expectations for payouts (Davies et al., 2014).

We hypothesize:

H2: Diversification of government support to SMEs increases the propensity of small-firm survival to a greater extent than the propensity of medium-firm survival.

Firm digitalization may improve operational efficiency by integrating value chains, reducing lead times, and enhancing control over operations (Björkdahl, 2009, 2020). This integration allows SMEs to streamline processes and respond more quickly to market changes, which is crucial during crises when agility is necessary for survival. Digital tools add to firm capabilities to enable the interaction of resources, processes, and outcomes to create new value (Coreynen et al., 2017) and facilitate effective resource management, leading to better coordination and planning in both small and large SME management teams.

Secondly, an increase in the diversity of digital technologies adopted by SMEs may increase the complementarities between them and is considered a strategic resource that enables firms to interact seamlessly with their environments (Martín-Peña et al., 2019; Nason & Wiklund, 2018), and in particular during crises (Crespo et al., 2024). Diversification in digital technologies facilitates servitization, offering new business models that can help firms adapt to changing market demands during the crisis. For instance, online training platforms, e-commerce, and social media enhance customer engagement and expand market reach, critical during periods of disruption, and have been proven most efficient for leveraging costs on SMEs during the COVID-19 pandemic (Zhang, et al., 2022).

Thirdly, digital capabilities may enable SMEs to deliver services and products faster and at a lower cost, enhancing their service orientation and increasing market capture (Kühl et al., 2022). This rapid and secure data handling gives digitally advanced firms a competitive edge, particularly in markets where speed and reliability are valued (Audretsch & Belitski, 2024). The ability to access customers using various digital sources (e.g., websites, social media) and the ability to add flexibility and mobility for employees using teleworking (Long & Reuschke, 2021) increased SMEs' capacity to combine various digital tools and technologies quickly to reduce running costs and improve decision-making, further supporting operational and financial efficiency of SMEs and hence their longer survival during crises (Haefner et al., 2021). For example, the adoption of diverse technologies, such as mobile technologies, cloud computing, big data, and analytics, facilitates efficient data management and also complements other tasks in customers' engagement in person and online (Li et al., 2016). Other technologies such as real-time tracking and repositioning capabilities allow firms to manage resources more effectively, reducing intermediation costs and improving overall efficiency (Li et al., 2016), which is crucial during crises when

liquidity is paramount and there is no "cheap money" (Andrieu & Groh, 2021; Bellavitis et al., 2023).

Fourthly, the diversification of digital tools may allow SMEs to recombine external and internal knowledge more rapidly and bring new products and solutions to market faster. This is the most important during crises, as it reduces the response time to shocks (Lusch & Nambisan, 2015). An increase in the adoption of multiple technologies for various functional needs (e.g., engagement with suppliers and customers, inventory, stocking, home delivery, outsourcing) helps SMEs to increase their functionality and speed during and after a crisis, but also ideate and learn from existing technologies to reconfigure new products and services quickly, which is essential for serving present and future market segments (Matusik & Heeley, 2005). Digital diversification allows firms to increase their operational efficiency, persevere in existing markets, or switch to new markets by adopting a range of marketing and social media technologies, e-commerce platforms, online training systems, and remote working software (Data Catalyst Institute, 2021; Zhang et al., 2022). Based on the abovementioned argument, we hypothesize:

H3: Digital diversification by SMEs increases their propensity to survive during and after a crisis.

The diversification of government support to SMEs may further enhance the effect of SMEs' digital diversification increasing their propensity to survive during and after crises. This relationship can be explained by examining the joint benefits of digital diversification and government financial support to SMEs.

Prior research has shown that SMEs that are digitally advanced (Audretsch & Belitski, 2024) are more flexible and quicker to adapt to exogenous shocks and market changes. This is because they are more stable and closer to customers in maintaining customer relationships, streamlining operations, and substituting physical infrastructure and in-person interactions with digital where needed (Björkdahl, 2020). Access to a variety of government financial aid tools is critical in providing the necessary resources for SMEs to undertake digital transformations. Resources from the public sector may allow SMEs greater flexibility in decision-making and deciding what they want this finance to be used for (Holmström & Tirole, 1998). Government financial aid which comes in the form of grants, loans, and subsidies can alleviate constraints in liquidity (a) directly, by enabling SMEs to invest in digital tools and technologies such as new software and hardware, paying for website and e-commerce presence and bank transfers, and improving servitization and engagement directly (e.g., paying for tools to enable employees to work remotely, such as Zoom and MS Teams subscription fees; purchasing software; training employees) (Belitski & Liversage, 2019; Teruel et al., 2022); and (b) indirectly, facilitating stakeholder engagement and identifying needs (e.g., big data and data analytics, semantic analysis of data, scraping webpages, understanding market trends, comments and reactions, and adopting advanced technologies like artificial intelligence and analytics) (Haefner et al., 2021). The development of new digital capabilities helps SMEs to survive during crises and positions them for growth and competitiveness in the long term (Savio et al., 2024).

Finally, and most importantly, we argue that the diversification of government support will enhance the relationship between digital diversification and SME survival by addressing the specific resource constraints that hinder digital transformation in SMEs. For example, during the COVID-19 pandemic in the USA and European countries, various government programs provided financial aid that SMEs could use for technological upgrades and digital skill development (Data Catalyst Institute, 2021). This support allowed SMEs to rapidly implement digital solutions, such as remote working environments and online sales platforms, which were crucial for maintaining operations and working remotely during lockdowns (Zhang et al., 2022).

In Spain, the public guarantee programs aimed to provide liquidity to SMEs "together with a more capitalized and active banking sector, made it possible to face the enormous increase in liquidity demand and the financing needs of firms during the crisis" (Boscá et al., 2021: 12). The Accelerate Plan also in Spain included a EUR 200 million credit line to assist SMEs in acquiring digital equipment and services. Similarly, Ireland's Enterprise Ireland and Skillnet initiatives provided training and resources to support digital skills development among SMEs (Kergroach, 2021).

Thus, prior research has argued that SMEs with access to diverse government support are better able

to invest in digital tools and capabilities, leading to improved performance and higher survival rates (Bartik et al., 2020a). This could be achieved by increasing revenue-to-cost and profit-to-cost ratios by reducing expenses related to physical operations and increasing productivity in servitization through digital tools. We hypothesize:

H4: Diversification of government support to SMEs positively moderates the relationship between SME's digital diversification and their propensity to survive during and after crises.

The following section presents data and empirical strategy used to test our research hypothesis.

3 Methodology

3.1 Data and sample

Our study utilizes longitudinal data on 5469 small- and medium-sized enterprises from the World Bank Enterprise Surveys (WBES, 2023) across 16 European countries, including Bulgaria, Croatia, Cyprus, Czech Republic, Estonia, Greece, Hungary, Italy, Latvia, Lithuania, Malta, Poland, Portugal, Romania, Slovak Republic, and Slovenia.

. These countries were selected to leverage similarities in their economic structures, regulatory frameworks, digitalization efforts, and COVID-19 pandemic responses to draw more comprehensive and comparative insights from data. Firstly, all countries are members of the European Union (EU), which means they share formal institutions and common economic policies, regulations, and access to EU funding programs (European Commission, 2020). This shared regulatory environment provides a consistent framework for analysis. Second, unlike Cyprus, Greece, Italy, Malta, and Portugal, other countries in the sample are considered emerging or transitional economies within Europe, because they have undergone significant economic reforms and structural changes since the early 1990s, transitioning from centrally planned economies to market economies (EBRD, 2019) Thirdly, countries in the sample are in similar stages of digital transformation and technological adoption. They face comparable challenges in terms of digital infrastructure, share of digitally uncertain and advanced SMEs, degree of SME digitalization, and integration into the global digital economy. Fourthly, countries in the sample share similar policies in response to the COVID-19 outbreak as underlined by the values of the Stringency Index, a composite indicator developed by the Oxford Coronavirus Government Response Tracker project (Hale et al., 2021). This index assesses government actions against the pandemic shock across nine metrics, ranging from zero to a hundred, with higher values indicating stricter responses. The selected countries exhibited intermediate values on this index, which guarantees compatibility across the different policies adopted by the countries in the sample. For instance, the Stringency Index values for the countries in the sample are close to a common mean, as shown in Figure 2 in the Appendix, which compares the values of the Stringency Index for the countries of interest and the EU average (Mathieu et al., 2020). Finally, being in Eastern and Southern Europe, these countries share certain geopolitical characteristics that influence their economic policies and development strategies.

The 2019 standardized WBES sample was merged with three Enterprise surveys during the COVID-19 pandemic carried out in May 2020, December 2020/January 2021, and May/April 2021. The sample includes firms that were operational in 2019 and remained active until the first COVID-19 follow-up in May 2020. The final random sample, stratified at the sectoral and regional level, includes 5469 SMEs, with 64% being small- and 36% medium-sized firms. The firms in the study were observed at four time points: once before the pandemic in 2019, and three after the outbreak of the pandemic. This period covers the major responses to the crisis and spans at least 2 years, with three points of observation since the start of the shock. This period corresponds to the most severe lockdowns and curfews in most countries and allows for an evaluation of the immediate survival of firms after the outbreak of the event, i.e., the end of the first lockdown in May 2020, the end of the second lockdown in December 2020, and the end of the third lockdown in April 2021.

3.2 Variables

3.2.1 Dependent variable

For a detailed overview of the variables used in the empirical analysis and their summary statistics and description, please refer to Table 1.

Our dependent variable is "Survival length," which takes values from 0 to 2. It takes value 0 at the starting period (round 1—May 2020) if a firm is only observed in May 2020 and never after. In this case, it means that a firm did not survive after the first lockdown. The survival variable equals 1 if a firm is in operation at the end of round 2 (December 2020/January 2021), and equals 2 if a firm is in operation in round 3 (April/May 2021). In particular, a firm remains in the market, i.e., survives, if it never closed or closed only temporarily during the time interval. A firm is considered dead if it exits in the market and closes permanently.

Table 2 shows that starting from a sample of 5469 firms (round 1), 768 permanently closed after the first lockdown (between round 1 and round 2), while 996 firms permanently closed after the second lockdown (between round 2 and round 3). The probability that a firm survives the first lockdown was 85.96%. The conditional probability to survive the second

Table 1 Variables and definitions

Dependent variable	Definition	Mean	St. dev	Min	Max
Survival length	The variable assumes a value equal to 0 at the starting time (May 2020), equal to 1 if the firm remains in the market until December 2020, and equal to 2 if it remains until April 2021	1.53	0.72	0	2
Government support	Dummy variable equal to 1 if the firm has received government financial aid in terms of additional liquidity, deferral of credit payments, or wage subsidies, 0 otherwise	0.65	/	0	1
Diversification of government support	Ordinal variable equal to 0 if the firm has not received government any additional liquidity or wage subsidies from the government, 1 if the firm receives at least one type of above supports available, 2 if the firm received both additional liquidity and wage subsidy support	1.05	0.92	0	2
Digital diversification	Ordinal variable equals 0 if the firm has not adopted, in response to COVID-19, business online, smart working or home delivery, 1 if the firm has used at least one of these three tools, 2 if the firm adopted two of these tools, 3 if the firm adopted all the digital diversification tools	0.88	0.94	0	3
Medium size	Dummy variable equals 1 if firm is medium-sized with full-time employment between 49 and 250 employees, 0 otherwise	0.35	/	0	1
Exporting	Dummy variable equals 1 if the establishment operates in international markets, 0 otherwise	0.20	/	0	1
Website	Dummy variable equal to 1 if the establishment has a website, 0 otherwise	0.77	/	0	1
Firm age	Firm age computed as the difference between the survey year and the year the establishment starts operation	23.88	16.66	1	202
Female manager	Dummy variable equal to 1 if the top manager is female, 0 otherwise	0.18	/	0	1
Years manager experience	Years of manager experience in the sector: 1 year between 0 and 15 years of experience (baseline); 2—between 15 and 30 years of experience; 3—at least 30 years of experience	1.91	0.70	1	3
COVID-19 macro-level investments	Ratio of total governments investment, in billions USD, as a fiscal policy response to COVID-19 (IMF, 2020) in below the line measure (i.e., equity injections, asset purchases, loans, debt assumptions, including through extra-budgetary funds) per 1000 SMEs in a country i over the period since the official start of the COVID-19 pandemic until September 27th, 2021 (IMF, 2021)	1.21	3.24	0.01	11.87
GDP per capita	GDP per capita in PPP	45.25	59.62	25.73	424.27

Source: Authors using World Bank Enterprise Survey data, IMF (2021), OECD, 2020

lockdown, given that the SME is still "alive" after the first, is (5469–768-996)/(5469–768) = 78.8%. This represents a decrease of 85.96–78.8% = 7.16%. The combined likelihood of survival following the trajectory through the two lockdowns is then 67.75% (see Table 2).

3.2.2 *Independent variables*

Our independent variables focus on the diversification of government support as a means to offset the negative economic consequences of the pandemic shock. We measure diversification of government support using an ordinal variable which equals 0 if the firm has not received any additional liquidity or wage subsidies from the government, 1 if the firm received at least one type of these supports, or 2 if the firm received both additional liquidity and wage subsidies.

Table 3 shows that out of 65% of firms receiving government support, 45% received both additional liquidity and wage subsidy support (*Diversification of Government Support* = *2*). The majority of the firms of both small and medium size received two types of government support: both additional liquidity and wage subsidies (see Table 4).

Digital diversification is an ordinal variable that equals 0 if the firm has not adopted any digital response and tools to leverage the effect of the COVID-19 pandemic shock. Digital diversification equals 1 if a firm has used at least one of three digital tools to adopt—smart working (working from home), moving business online, or home delivery using apps and e-commerce platforms. Digital diversification equals 2 if the firm adopted at least two out of three digital tools. Digital diversification equals three if a firm has adopted three digital tools—smart working (working from home), moving business online, and home delivery using apps and e-commerce platforms. Table 3 illustrates that 32% of sampled firms adopted at least one digitalization tool, 17% of firms adopted at least two tools, and only 7% of firms adopted all digitization tools. The distribution of small and medium firms across the different digital tools is stable (see Table 5).

When working with survey data, there is the potential risk of reverse causality, implying that the dependent variable may influence (instead of being influenced by) some of covariates. A way to control for this is to use lags of covariates with respect to the dependent variable. To this reason, all variables in the analysis are measured in 2019, with the exception of digitalization diversification and diversification of government supports which were specific pandemic instruments of the WBES. Therefore, they were measured in the first round of COVID-19 in May 2020. Since we are interested in evaluating SME survival after the first round of data (December 2020 and May 2021), there is no reverse causality issue. These two variables—digitalization diversification and diversification of government support—are observed in May 2020 and then the effect is evaluated on the two subsequent survival outcomes in rounds 2 and 3.

The Kaplan–Meier curve in Fig. 1a, along with the log-rank test, reveals a statistically significant difference among groups receiving various forms of government support for firm survival. Observing the Kaplan–Meier survival curve in Fig. 1b, we also find that firms that diversify their digital tools have statistically higher survival probabilities, as suggested by the significant Log-Rank test (Fig. 1b).

Kaplan and Maier's non-parametric approach is based on estimating conditional probabilities at each time point when an event occurs and taking the product limit of those probabilities to estimate the survival rate at each point in time (Kaplan & Maier, 1985). Figure 1a and b show the survival curves with the *y*-axis reporting the survival probability, while the

Table 2 Survival probabilities

Time	Number of subject alive at the beginning	Firm exits	Survivor function	Std. error	95% lower CI	95% upper CI
Round of data 1 (May 2020)	5469	-	-	-	-	-
Round of data 2 (December 2020)	4701	768	0.8596	0.0047	0.8501	0.8685
Round of data 3 (May 2021)	3705	996	0.6775	0.0063	0.6649	0.6897

Source: Authors using World Bank Enterprise Survey data

Table 3 Number of firms by specific sample characteristics

Variables	Obs	Yes—a firm complies with the characteristic
Government support	5469	65%
Diversification of gov support 0	2149	40%
Diversification of gov support 1	843	15%
Diversification of gov support 2	2447	45%
Digital diversification 0	2392	44%
Digital diversification 1	1731	32%
Digital diversification 2	942	17%
Digital diversification 3	404	7%
Firm size		
Small	5469	64%
Medium	5469	36%
Exporting	5452	21%
Website	5463	77%
Female manager	5464	18%
Years manager experience		
0–15	5340	29%
15–30	5340	50%
> 30	5340	21%
Countries	*5469*	
Italy	376	7%
Poland	746	13%
Romania	465	9%
Estonia	228	4%
Czech Republic	308	6%
Hungary	497	9%
Latvia	223	4%
Lithuania	196	4%
Slovak Republic	206	4%
Slovenia	250	4%
Bulgaria	448	8%
Croatia	262	5%
Greece	386	7%
Portugal	579	11%
Cyprus	131	2%
Malta	168	3%
Sector	*5469*	
Services	719	13%
Food	1239	22%
Manufacturing	1516	28%
Machinery and equipment	1146	21%
Retail	591	11%
Metal products	157	3%
Clothes	101	2%

Source: Authors using World Bank Enterprise Survey data

Table 4 Diversification of government support by firm size

Size	Diversification of government support			
	0	1	2	Total
Small	1416	554	1528	3498
	40.48	15.84	43.68	100
Medium	733	289	919	1941
	37.76	14.89	47.35	100
Total	2149	843	2447	5439
	39.51	15.50	44.99	100

First row has *frequencies* and second row has *row percentages*

Table 5 Degree of digital diversification by firm size

Size	Digital diversification				
	0	1	2	3	Total
Small	1708	993	591	221	3513
	48.62	28.27	16.82	6.29	100
Medium	684	738	351	183	1956
	34.97	37.73	17.94	9.36	100
Total	2392	1731	942	404	5469
	43.74	31.65	17.22	7.39	100.00

First row has *frequencies* and second row has *row percentages*

x-axis reports the time horizon by each specific variable (Peto et al., 1977). It is specifically designed to handle censored data, i.e., observations for which we do not know when the event happens (for example, firms that do not experience the event or that death before the end of the study), which is common in survival analysis. The Kaplan and Meier's approach, as well as the semi-parametric method of the Cox proportional hazard model described below, are two most used techniques to deal with this data.

3.3 Control variables

We control for other firm-level characteristics, such as firm age and size, whether the firm is an exporter, having a website, having a female manager, years of managerial experience, sector controls, and country fixed effects (Audretsch et al., 2024a, 2024b; Belitski et al., 2022; Block et al., 2022a, 2022b; Kalenkoski & Pabilonia, 2022; Miocevic & Srhoj, 2023; Assefa, 2023). To avoid causality issues and ensure exogeneity to survival, these characteristics are measured in the pre-pandemic period (2019).

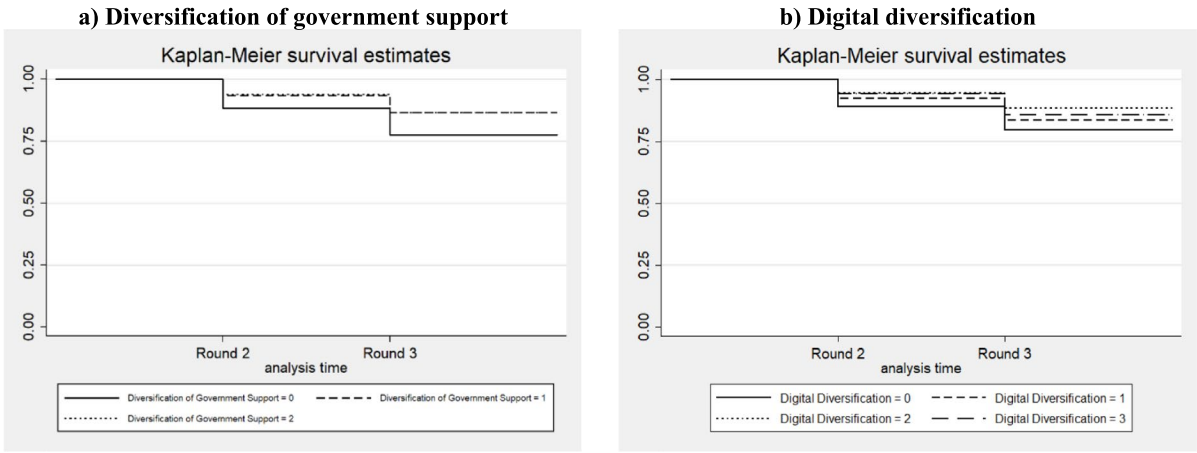

Fig. 1 Kaplan–Meier survival curves by independent variables. Source: Authors based on World Bank Enterprise Survey data

Furthermore, we cannot assume that the government policies in response to COVID-19 within each category were reasonably homogenous across sample countries. As argued in the sample selection, these countries share similar institutional and socioeconomic conditions, and their governments responded to the COVID-19 pandemic shock in very similar ways. However, we include, as an additional control for COVID-19 macro level investment, the ratio of total government investments in USD billion, related to the response to the COVID-19 pandemic (i.e., equity injections, asset purchases, loans, debt assumptions, including through extra-budgetary funds), normalized over 1000 SMEs in a country *i* over the period from the official start of the COVID-19 pandemic until September 27th, 2021 (IMF, 2021; OECD, 2020). These existing stabilizers differ across countries in their breadth and scope. Estimates included are correct as of September 27th, as governments have also taken additional measures to finalize the details of individual measures (IMF, 2021). We control for the level of economic development of a country (Chowdhury et al., 2019) using country GDP at purchasing power parity levels in 2020 (OECD, 2020). Finally, we control for sector and country-specific fixed effects.

Table 3 provides few descriptive characteristics of the sample using control variables. For example, only 21% of sampled firms are exporters, while 77% have a website, 18% have a female manager, half of the units have a manager with 15–30 years of experience, the average firm age is 24 years, and the majority operate in the Manufacturing (28%), Food (22%), and Machinery and Equipment (21%) sectors.

3.4 Estimation method

To evaluate the effect of government support diversification on the propensity to survive during and after the crisis, we control for sample selection bias. This bias can originate from the fact that some firms access government support, while others do not. Thus, observations on the propensity to survive longer can be affected for firms reporting any form of government financial support during the crisis. Following a two-stage Heckman approach (Heckman, 1979), firstly, we estimate a probit Eq. (1) where the dependent variable is access to government support (or not). Table 3 shows that 65% of the sampled firms received government support, and these firms have a higher survival probability than those that do not receive any support. Secondly, we use the predicted values for reporting access to government financial support from Eq. (1) to compute the inverse Mill's ratio for firm *i* in time t which will be used in Eq. (2). The first stage predicts the propensity to access at least one instrument of government financial support. We selected country fixed effects as instruments in the first-stage estimation, using the procedure for validity of exclusion criteria described in Wooldridge (2010). Exclusion criteria variables are only included at the first stage and will

not be used at the second stage. Our Probit model is estimated as follows:

$$Prob(GovernmentSupport = 1) = f(\beta Z) \quad (1)$$

where *Governmentsupport* is a dummy variable that equals 1 if a firm has received any form of government support, 0 otherwise; β is a vector of unknown parameters to be estimated; $\boldsymbol{Z}$ is the matrix of independent and control variables, and includes firm size, exporting, having a website, firm age, female manager, years of manager experience, and sector and country-level fixed effects as exclusion criteria. The heterogeneity in the eligibility criteria at country-level as a set of desirable and necessary for characteristics to be able to apply and access government support motivated the choice of exclusion restrictions. This choice does not affect the reliability of estimates in the second stage of analysis (survival). Using these exclusion criteria as well as additional variable which accounts for possible effects of firms' location on survival at a country level (second stage) is the average investment by government in a country to support firms' response to the COVID19 pandemic. A relevant example in using country-specific fixed effects as instruments given its heterogeneity across countries is Mauro (1995) who used time-invariant country-specific ethnolinguistic fragmentation as instrument (Mauro, 1995) or country's fixed distance from the equator as an instrument (Hall & Jones, 1999).

As a second stage, we test our hypotheses, adopting a survival analysis approach that tests how firm characteristics affect how many lockdowns a firm is able to get over (survive) and remain in the market.

The time span under investigation (May 2020–May 2021) allows us to account for the number of lockdowns a firm overcomes while remaining in the market after the initial COVID-19 pandemic shock in March 2020. To this end, we can exploit the Cox proportional hazard model (Cox, 1972), which evaluates the impact of covariates on firms' risk of exiting the market, i.e., the inverse of survival probability. The model can be specified in a semi-parametric framework as follows:

$$\lambda_i(t) = \lambda_0(t)\exp(\beta X + Mill'sratio) \quad (2)$$

where $\lambda_i(t)$ is the hazard function that measures the probability of exit for a firm i at a time t, $\lambda_0(t)$ is the baseline hazard, $\boldsymbol{X}$ is the matrix of our independent and control variables that in addition to $\boldsymbol{X}$ includes COVID-19 macro level investments and GDP at PPP to control for country characteristics and response to COVID-19; and β is a vector of unknown parameters to be estimated. In addition, to control for the sample selection issue, we extract the Mill's ratio from Eq. 1 (selection model) and include it in Eq. 2 (survival model). Finally, Eq. 2 is then augmented with a series of interaction terms to test our research hypotheses.

The semi-parametric nature of the model implies that no assumption is needed about the distribution of the baseline hazards. However, it requires the proportional hazard (PH) assumption to be satisfied. This implies that the hazards should be proportional, meaning the relative risk of exiting the market should be constant across all the survival intervals under analysis. The PH assumption can be validated through the Grambsch–Therneau test (Grambsch & Therneau, 1994), which evaluates the correlation between the Schoenfeld residuals (Schoenfeld, 1980), derived from the Cox model, and survival time. This correlation must be equal to 0 for the null hypothesis of a constant hazard function over time to be satisfied. Thus, significantly rejecting that hypothesis underlines that the potential impact of the covariates included in the model is dependent on time. In such cases, the coefficients do not have a straightforward interpretation.

4 Results

Table 6 presents the estimates of the first stage probit model (Eq. 1). The coefficients reported are the average marginal effects. We find that medium-sized firms are 3.8 percentage points ($\beta = 0.038$, $p < 0.01$) more likely than small-sized firms to receive any form of government support (Table 6). Firms that are more digitally advanced (having a website) are 4.1 percentage points ($\beta = 0.041$, $p < 0.01$) more likely to receive government support than firms that are not digitally advanced. Firms with a CEO with between 15 and 30 years of working experience are 2.9 percentage points ($\beta = 0.029$, $p < 0.01$) more likely to receive government support than firms with a CEO with less than 15 years of working experience. Firms in the machinery and equipment sector are 4.3 percentage points ($\beta = 0.043$, $p < 0.01$) more likely to receive

Table 6 Probit model for Heckman sample selection (first stage). Dependent variable: government support

	(1)
Specification	
Size	
Small	*Reference*
Medium	0.038***
	(0.013)
Firm age	−0.001
	(0.000)
Website	0.041***
	(0.015)
Manager female	−0.006
	(0.016)
Years manager experience	
0–15 years	Reference
15–30 years	0.029*
	(0.015)
> 30 years	0.025
	(0.019)
Exporting	0.020
	(0.016)
Sectors	
Service	Reference
Food	−0.003
	(0.023)
Manufacturing	0.062***
	(0.021)
Machinery and equipment	0.043*
	(0.023)
Retail	0.035
	(0.026)
Metal products	0.029
	(0.044)
Clothes	−0.119**
	(0.058)
Country fixed effects	Yes
Observations	5293

The coefficients reported are the average marginal effects

Standard errors in parenthesis; *10% significant level; **5% significant level; ***1% significant level

Source: Authors' elaboration on World Bank Enterprise Survey data

government support than firms in the service sector (reference sector), while firms in the manufacturing sector are 6.2 percentage points ($\beta = 0.062$, $p < 0.01$) more likely. Finally, great heterogeneity in access to government support is evidenced across the countries where a firm is located.

The results from the Cox proportional hazard model (second stage) defined in Eq. 2 are reported in Table 7 and coefficients estimate the probability of increasing or decreasing the risk of firm exit. If we have coefficients with negative signs, we are finding a decreasing probability of firm exit, with positive signs indicating an increasing probability of firm exit. The proportional hazard assumption (PH test) is validated for all three specifications in Table 7. It is never statistically significant, confirming that the assumption is satisfied and thus the impact of covariates is independent of time.

Our Hypothesis 1 (H1), which states that diversification of government support to SMEs increases their propensity to survive during and after crises, is supported with the parameter estimates negative and significant ($\beta = -0.440$, $\beta = -0.406$, and $\beta = -0.462$, $p < 0.01$, respectively, in specifications 1, 2, and 3 in Table 7). Focusing on columns 2 and 3 (the more extended specification), we compute hazard ratios by exponentiating the parameter estimates for diversification of government support, $\exp(-0.406) = 0.666$ and $\exp(-0.462) = 0.630$. Our results demonstrate that following an increase in government support diversification from no finance to at least one type of support (wage subsidy or liquidity), there is a decrease in the expected hazard of SMEs exiting the market by between 33.4% (1–0.666) and 37%. Interestingly, the joint use of two types of government support (liquidity and wage subsidy) does not substantially reduce the market exit propensity any further ($\beta = -0.424$, $\beta = -0.447$, $\beta = -0.441$, $p < 0.01$, respectively, in specifications 1, 2, and 3 in Table 7). This demonstrates the diminishing returns to additional types of government support compared to the use of a single instrument. In support of our H1, we also find that *COVID-19 Macro-level Investments* made by governments across the countries in our sample were effective in reducing the risk of SME market exit. An increase in the ratio of government bailout capital by one billion per 1000 SMEs during 2020–2021 is associated with a reduction in the hazard of market exit by SMEs (from $\beta = -0.022$ to $\beta = -0.023$, $p < 0.01$, in specifications 1–3 of Table 7). Computing hazard ratios by exponentiating the parameter estimates yields values from $\exp(-0.022)$ to $\exp(-0.023)$, indicating a 2.2% (1–0.978) to 2.3% (1–0.977) decrease

Table 7 Survival analysis (Cox proportional hazard model) second stage. Dependent variable: survival length

Specification	(1)	(2)	(3)
Size			
Small	*Reference*	*Reference*	*Reference*
Medium	0.078	0.066	0.009
	(0.076)	(0.104)	(0.109)
Diversification of government support = 0 (h1)	*Reference*	*Reference*	*Reference*
Diversification of government support = 1 (H1)	− 0.440***	− 0.406***	− 0.462***
	(0.112)	(0.135)	(0.153)
Diversification of government support = 2 (H1)	− 0.424***	− 0.447***	− 0.441***
	(0.077)	(0.096)	(0.108)
Digital diversification = 0 (H3)	*Reference*	*Reference*	*Reference*
Digital diversification = 1 (H3)	− 0.197**	− 0.197**	− 0.278**
	(0.079)	(0.079)	(0.126)
Digital diversification = 2 (H3)	− 0.532***	− 0.532***	− 0.430**
	(0.111)	(0.111)	(0.173)
Digital diversification = 3 (H3)	− 0.336**	− 0.336**	− 0.660**
	(0.147)	(0.147)	(0.272)
Medium # diversification of government support = 1 (H2)		− 0.101	
		(0.234)	
Medium # diversification of government support = 2 (H2)		0.063	
		(0.154)	
Medium # digital diversification = 1			0.071
			(0.165)
Medium # digital diversification = 2			0.075
			(0.229)
Medium # digital diversification = 3			0.489*
			(0.296)
Digital diversification = 1 # Diversification of government support = 1 (H4)			0.214
			(0.245)
Digital diversification = 1 # Diversification of government support = 2 (H4)			0.087
			(0.170)
Digital diversification = 2# Diversification of government support = 1 (H4)			− 0.502
			(0.409)
Digital diversification = 2 # Diversification of government support = 2 (H4)			− 0.169
			(0.232)
Digital diversification = 3 # Diversification of government support = 1 (H4)			0.125
			(0.443)
Digital diversification = 3 # Diversification of government support = 2 (H4)			0.193
			(0.318)
Years enterprise	− 0.004*	− 0.004*	− 0.004*
	(0.002)	(0.002)	(0.002)

Table 7 (continued)

Specification	(1)	(2)	(3)
Website	−0.102	−0.102	−0.103
	(0.081)	(0.081)	(0.081)
Female manager	0.162*	0.161*	0.165*
	(0.084)	(0.084)	(0.084)
Years of manager experience			
0–15 years	*Reference*	*Reference*	*Reference*
15–30 years	−0.170**	−0.170**	−0.166**
	(0.076)	(0.076)	(0.076)
> 30 years	−0.483***	−0.483***	−0.480***
	(0.112)	(0.112)	(0.112)
Exporting	−0.020	−0.020	−0.017
	(0.087)	(0.087)	(0.087)
Sectors			
Service	*Reference*	*Reference*	*Reference*
Food	0.388***	0.390***	0.399***
	(0.128)	(0.128)	(0.128)
Manufacturing	0.360***	0.361***	0.363***
	(0.127)	(0.127)	(0.127)
Machinery and equipment	0.445***	0.446***	0.448***
	(0.128)	(0.128)	(0.128)
Retail	0.081	0.082	0.083
	(0.157)	(0.157)	(0.157)
Metal products	−0.127	−0.130	−0.117
	(0.290)	(0.290)	(0.290)
Clothes	0.312	0.313	0.335
	(0.282)	(0.282)	(0.282)
COVID-19 macro-level investments	−0.023*	−0.023*	−0.022*
	(0.0130)	(0.0130)	(0.0130)
Mill's ratio	0.364*	0.363*	0.362*
	(0.193)	(0.194)	(0.194)
GDP per capita	0.001	0.001	0.001
	(0.000)	(0.000)	(0.000)
PH test (χ^2)	0.210	0.290	0.148
Observations	5267	5267	5267

The estimates reported are the coefficients which represent the parameter estimates of an increase in the expected log of the relative hazard for each one unit increase in the predictor. Standard errors in parenthesis; *10% significant level; **5% significant level; ***1% significant level

Source: Authors using World Bank Enterprise Survey data, IMF (2021), OECD, 2020

in the expected hazard of market exit by SMEs. Our Hypothesis 2, which states that diversification of government support to SMEs increases the propensity of small-firm survival to a greater extent than the propensity of medium-firm survival, is not supported. We do not find significant differences in terms of survival between small and medium firms receiving different types of government support (see Table 7, specification 2).

Our Hypothesis 3, which states that digital diversification by SMEs increases their propensity to survive during and after crises, is supported. Our results

demonstrate that increasing the digital diversification from none to at least one type of tool (remote working, establishing a website, or home delivery using e-commerce platforms) decreases the propensity of SMEs to exit the market ($\beta = -0.197$, $p < 0.01$) (Table 7, specifications 1–2). In other words, SMEs that adopt at least one digital tool decrease their hazard of market exit by 17.9% (1–0.821) compared to SMEs that adopt none. An increase in digital diversification from zero to two digital tools further decreases the propensity of SMEs' exit ($\beta = -0.532$, $p < 0.01$) (Table 7, specifications 1–2). Using the hazard ratio (0.587) decreases the hazard of market exit by 41.3% (1–0.587). Finally, an increase in digital diversification tools from zero to three digital tools decreases the propensity of SMEs' market exit ($\beta = -0.336$, $p < 0.01$) (Table 7, specifications 1–2). Using the hazard ratio (0.715) decreases the hazard of market exit by 28.5% (1–0.715). Again, as in the case of diversification of government support, we find that there is a diminishing marginal return to adopting more digital tools and that the adoption of at least two digital tools maximizes the effect of digital diversification. The survival length associated with adopting three tools may "stiffen" the effect rather than add any additional value compared to selecting at least two tools.

Our Hypothesis 4, which states that diversification of government support to SMEs positively moderates the relationship between SME's digital diversification and their propensity to survive during and after crises, is not supported. The interaction terms of government support and digital diversification are not statistically significant (Table 7, specification 3).

4.1 Other findings

Other factors that may directly increase the survival length of SMEs are firm age ($\beta = -0.004$, $p < 0.01$), sector, and the working experience of the CEO manager ($\beta = -0.170$, $p < 0.01$), while a female CEO reduces survival length (Table 7, specification 1). In particular, SMEs led by a CEO manager with at least 15 years of work experience decrease the hazard of market exit by 15.6% (1–0.844), supporting Bartz and Winkler (2016). This effect grows when an SME is led by a CEO manager with at least 30 years of work experience, which further reduces the hazard of market exit compared to a CEO with < 15 years of experience by 38.3% (1–0.617). SMEs led by a female CEO have higher hazard ratios of $\exp(0.162) = 1.176$. There is a 17.6% increase in the expected hazard of market exit relative to male CEOs, extending prior research on gender differences in managing firms in uncertainty and crises (Audretsch et al., 2022). SMEs in the food industry as well as manufacturing and machinery were more likely to exit the market than SMEs in the service sector. SMEs located in countries with different levels of economic development were equally likely to survive. Finally, Mill's ratio is positive and significant, underlying that it is correctly controlling for sample selection in the first stage.

5 Discussion

Our study extends prior research in the entrepreneurship and small business economics literature by demonstrating how SMEs changed the way firms worked during the pandemic (Belzunegui-Eraso & Erro-Garcés, 2020). In particular, this paper examines the extent to which diversification in government financial aid to SMEs within allocated bailout capital and digital diversification of services by SMEs enhances their propensity to survive during and after crises. It theorized on the effects of the diversification of government financial support and the heterogeneous responses of SMEs in terms of how the adoption of various digital tools, the maintenance of customer relationships, and access to external resources help to better understand current and future SME challenges. It also provides potential recommendations and solutions to entrepreneurs and policymakers on resource mobilization and digital strategies.

5.1 Theoretical implications

Our results contribute in several ways to the literature on the role of bailout capital for SMEs during the extended period of crisis and firm survival. Firstly, we add to the existing SME in crisis literature (Belitski et al., 2022) on the public mechanisms available to support SMEs during the extended period of crises and SME strategies related to leveraging the consequences of a shock (Belitski et al., 2022; Block et al., 2022a, 2022b; Kazembalaghi et al., 2024). We demonstrated that the hazard of market exit is decreased if SMEs favor investment

in digital tools, including moving and growing businesses online, working from home, and home delivery of goods and services using e-commerce platforms and apps, thereby extending our understanding of SMEs' responses to an extended period of crisis (Atkins et al., 2022).

Secondly, this study revises entrepreneurial and government action in response to exogenous shocks, including seeking resources and allocating financial aid in the form of liquidity, new lines of credit, or wage subsidies (e.g., Giones et al., 2020; Juergensen et al., 2020). We empirically demonstrated that SMEs who were eligible and applied for short-term government financial aid were more likely to survive longer in the market.

Below, we outline the theoretical insights and empirical takeaways we learned from this study beyond a single crisis.

Firstly, research needs to consider the impact of bailout capital. We found that SMEs that receive at least one form of government support are significantly more likely to survive crises compared to those that receive no government support. This suggests that government interventions are crucial in providing the necessary financial stability and resources for SMEs to withstand economic disruptions immediately after a shock hits.

Secondly, research needs to consider the magnitude of the impact of crises. The increase in survival propensity demonstrates that firms respond to government financial support such as wage subsidies or liquidity. However, the relationship is not linear. We demonstrate that selecting at least one tool (subsidies on wages or liquidity) is important, as providing all available tools leads to diminishing returns. Indeed, securing two types of government support does not significantly enhance survival rates beyond the effect of receiving one type of support. Moreover, our results show there are not significant differences in survival rates between SMEs of different sizes when looking at the diversification of government support. Firstly, as argued in the theoretical section, small firms often lack the internal capacity to fully utilize and absorb the diverse forms of government support effectively. The complexity and administrative burden of managing diversified support mechanisms can be overwhelming, reducing the efficiency and applicability of this support to small firms (Coad et al., 2016). Medium-sized firms, on the other hand, usually have better-established administrative procedures to take full advantage of the various diversified measures available to them.

Secondly, the benefits of receiving multiple types of government support may exhibit diminishing returns. Once a small firm receives initial critical support (e.g., liquidity to cover immediate expenses), additional types of support (e.g., technology grants or wage subsidies) may not add the same value to survival odds. For instance, liquidity for them could be of greater immediate value than wage subsidies, as they may move employees to work part-time. By contrast, medium-sized firms, with their larger scale of operations and more diversified needs, might be better positioned to leverage additional support to accumulate resources and gain competitive advantages (Zahra, 2021).

Finally, different types of government support can overlap in their benefits. For example, wage subsidies and direct financial grants both aim to alleviate immediate financial pressures; however, the value and timing of such mechanisms may differ. Small firms might experience redundancy where multiple supports do not add value beyond a certain point. Medium-sized firms, with more diversified needs, might utilize each type of support in more differentiated ways, but this does not translate into a significant increase in survival (Storey, 1994).

Furthermore, our findings highlight the critical role of selection vs. diversification of government financial aid in maintaining the business operations of SMEs during adverse conditions, as adding more financial tools does not reduce the hazard of market entry.

In addition, our results do not support the role of diversification of government support in moderating the relationship between SME's digital diversification and their propensity to survive during and after crises. Although this result is surprising, we argue it is context-specific and may be related to the socio-economic development of the countries, their institutional quality, and their market structures.

Firstly, SEE countries often face limitations in digital infrastructure. Indeed, according to the European Commission's Digital Economy and Society Index (DESI), these regions lag behind Western Europe in terms of Internet connectivity, digital skills, and the integration of digital technology into businesses (European Commission, 2022). Without robust

digital infrastructure, the benefits of digital diversification are inherently limited; even if liquidity is available to adopt more new technologies and tools, SMEs cannot fully utilize digital tools to enhance their operations. In addition, the economic and market structures in these countries are dominated by traditional industries with lower levels of digital adoption, except for Italy and the Czech Republic (EBRD, 2019). Secondly, these countries often have complex bureaucratic processes and regulatory environments that may delay and hinder the effective transition of financial support into purchasing and adopting digital tools (Audretsch et al., 2024b; Belitski et al., 2016). Furthermore, government support programs in these countries may suffer from inefficiencies in resource allocation due to corruption and lack of transparency (Transparency International, 2020) or the unequal allocation of funds to SMEs that have previously collaborated with the government or have long-standing relationships with authorities (Belitski & Grigore, 2022). In addition, public programs in this region may be fragmented and lack coordination, leading to overlapping initiatives that do not address the specific needs of SMEs effectively (European Investment Bank, 2020).

Our findings offer policy recommendations and practical implications for managers.

5.2 Policy implications

Policymakers should focus on ensuring that all SMEs have access to at least one form of financial support during crises. Given the significant impact of at least a single type of support, broadening access to government aid could enhance overall economic stability. The findings suggest that diversifying the types of support available to SMEs is more effective than simply widening access to government support.

In addition to policies focusing on supplying bailout capital to cover the current costs of SMEs, other tools such as temporary debt suspension programs could be particularly effective for survival and growth. This is because they enable shareholders to be prioritized at the expense of debtholders and employees in the short term while promoting long-term business success, as suggested by Savio et al. (2024).

Policy recommendations may include the design of public support programs beyond wage subsidies. For example, in Germany, the Federal Employment Office used exceptional work compensation, paying workers at least 60% of their basic income to retain their jobs and allow SMEs to continue operations, retaining jobs and saving businesses from leaving the market, directly affecting their propensity to survive (Taylor & Schwartz, 2020). Instead, policies could create further incentives for SMEs to adopt digital technologies, particularly focusing on helping them transition from being digitally uncertain to digitally advanced (Audretsch & Belitski, 2024). In the USA, the Paycheck Protection Program (PPP) and the Economic Injury Disaster Loan (EIDL) program provided necessary liquidity to SMEs (Fairlie & Fossen, 2022b). However, policy programs could go beyond providing liquidity. Rather than distributing specific grants or tax exemptions for investment in capability development related to the adoption and wider application of digital tools in SMEs, they could fund technologies necessary for remote working, maintaining customer engagement, and digitizing operations (Fairlie & Fossen, 2022b). Financial assistance, training, and resources aimed at digital skill development will be critical in this regard. Programs should be tailored to address the specific needs of SMEs in different industries and regions, recognizing that the impact of digital tools may vary across sectors, as some sectors may require only several digital tools, while the service and research sector, for example, may require multiple smaller and more complementary tools.

5.3 Managerial implications

Our main motivation and practical insights are in examining the effects of government financial support diversification and digital diversification on SMEs' length of survival since the beginning of the crisis.

Our findings regarding an increase in digital diversification in reducing the propensity of market exit indicate diminishing marginal returns to digital diversification by SMEs, confirming prior research on the adoption of digital tools by SMEs (Audretsch & Belitski, 2021; Li et al., 2016). While adopting two digital tools significantly enhances survival compared to just one, further adoption of digital tools does not increase the survival propensity of SMEs. This suggests that there is a threshold in the effectiveness of digital diversification and selection between available digital tools and that

their cost and time of adoption should be carefully considered.

SMEs should prioritize investing in digital tools, as even the adoption of a single digital tool substantially improves survival prospects during and after crises. The most substantial gains are observed when SMEs move from using one digital tool to using two, highlighting the importance of strategic digital investment and selection of digital technologies to adopt, extending the work of Canhoto et al. (2021) on the role of digital strategy aligning in SMEs. Given the diminishing returns to digital diversification, SMEs should focus on adopting digital tools that provide the highest impact on their operations and customer engagement. Identifying and implementing the most relevant and affordable digital tools for SMEs, tailored to their business model, will be more effective than adopting multiple tools indiscriminately. This approach could be a venue for future research on the value added by each digital tool and their complementarity (see Data Catalyst Institute, 2021).

Owner-managers of SMEs will benefit from this work by shaping the long-term objectives and potential responses to financial and other exogenous shocks beyond the COVID-19 pandemic, as our study studied the extent to which digital diversification may work and the key determinants of the length of survival since the outbreak of the crisis. SMEs that were able to mobilize additional short-term resources at the beginning of the COVID-19 pandemic and continued paying wages were more likely to survive. However, we do not find that access to liquidity, wage subsidies, and digital diversification were complementary to survival, as argued by prior research (Savio et al., 2024). The digital response to COVID by SMEs and their access to bailout capital did not provide an additional safety cushion. Our research has demonstrated that access to financial aid to eligible SMEs, whose costs are (partially or fully) supported by the government during the extended period of crisis, was not associated with the adoption of digital skills and tools.

6 Conclusion

In summary, our study presents a nuanced view of how SMEs have changed their behavior (Ahlers et al., 2015; Atkins et al., 2022), seeking to diversify government financial support and digital tools they use in response to the COVID-19 pandemic shock and increase their propensity to survive (Kalenkoski & Pabilonia, 2022; Kuckertz et al., 2020). We found that the length of SME survival in the extended period of crisis relied on the short-term focus on shareholder (government, customers) interests and job retention through access to resources (e.g., liquidity, wage subsidies). Also important was the long-term focus on competitive advantage in leading digital technologies by diversifying their digital responses with the aim of further engaging with customers and reducing operational and transaction costs (Nason & Wiklund, 2018; Zahra, 2021).

6.1 Future research

Future research is needed into the role firm size plays in the adoption of digitalization and the need for government financial aid in times of crisis. Despite the documented positive effects of short-term survival when accessing liquidity and wage subsidies, SMEs often tend to overemphasize positive returns in the near future at the risk of compromising long-term returns (Holmström, 1999; Savio et al., 2024) and are likely to spend funding on activities and stakeholders that yield short-term returns. Government financial aid, with its focus on specific aspects of business such as digitization, wage subsidies, credit lines, and liquidity for employees and R&D, may encourage SMEs to shift their strategic decision-making towards long-term planning.

Future studies could explore the depth and breadth of diversification of government financial support and the role it plays in enhancing the survival prospects of SMEs during and after crises and in particular across industries, regions, and countries, making future research more context-specific. It will also need to dig deeper into why receiving two types of government support does not significantly improve outcomes beyond receiving one type of support, and why access to more than two digital tools as a response to the COVID-19 pandemic further inhibits survival length. There is a need to unpack non-linearities in SME survival, extending what we know regarding digitization strategies and resource allocation in SMEs during the extended crisis (Audretsch et al., 2023). By providing at least one type of financial aid, governments can significantly mitigate the risks of market exit for

SMEs. However, the additional benefit of securing multiple forms of support appears limited, suggesting a need for strategic and well-coordinated support measures. These insights are crucial for policymakers aiming to bolster SME resilience in the face of economic uncertainties.

Future research might also compare and contrast a short-term orientation of SMEs' crisis management strategies, which tends to reduce resources allocated to long-term goals (Chrisman & Patel, 2012), with a long-term orientation and resource accumulation. Subsequent studies will look into the diversity of stakeholders (breadth) and intensity of collaboration with them (depth) to complement entrepreneurial finance and access stakeholders' resources to withstand, adjust, and adapt to crises.

Appendix

Table 8 Diversification of government financial support by industrial sector

Sectors	Diversification of government financial support			
	0	1	2	Total
Food	504	175	548	1227
	41.08	14.26	44.66	100
Manufacturing	553	211	744	1508
	36.67	13.99	49.34	100
Machinery and equipment	460	167	512	1139
	40.39	14.66	44.95	100
Service	300	120	299	719
	41.72	16.69	41.59	100
Retail	245	108	238	591
	41.46	18.27	40.27	100
Metal products	51	38	68	157
	32.48	24.20	43.31	100
Clothes	36	24	38	98
	36.73	24.49	38.78	100
	1.68	2.85	1.55	1.80
Total	2149	843	2447	5439
	39.51	15.50	44.99	100

The first row has frequencies (number of firms); the second row has row percentages (percentage of firms to total by sector)

Table 9 Digital diversification by industrial sector

Sectors	Digital diversification				
	0	1	2	3	Total
Food	598	419	160	62	1239
	48.26	33.82	12.91	5.00	100
Manufacturing	623	484	294	115	1516
	41.09	31.93	19.39	7.59	100
Machinery and equipment	482	387	192	85	1146
	42.06	33.77	16.75	7.42	100
Service	296	216	138	69	719
	41.17	30.04	19.19	9.60	100
Retail	276	164	98	53	591
	46.70	27.75	16.58	8.97	100
Metal products	64	43	38	12	157
	40.76	27.39	24.20	7.64	100
Clothes	53	18	22	8	101
	52.48	17.82	21.78	7.92	100
Total	2392	1731	942	404	5469
	43.74	31.65	17.22	7.39	100

The first row has frequencies (number of firms); the second row has row percentages (percentage of firms to total by sector)

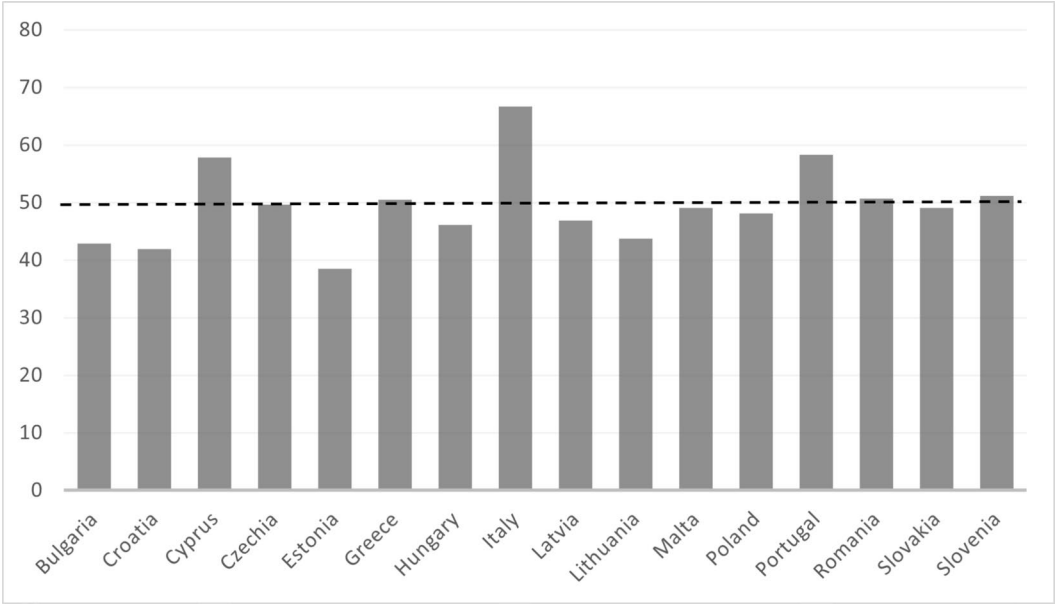

Fig. 2 Stringency Index. Note: The figure compares the 16 countries considered in the analysis with the EU average in 2020 (light grey bar). The values of the Stringency Index for the countries of interest are as follows: Italy (66.72), Poland (48.52), Romania (50.65), Estonia (38.53), Czech Republic (49.68), Hungary (46.09), Latvia (46.88), Lithuania (43.73), Slovak Republic (49.09), Slovenia (51.12), Bulgaria (42.85), Croatia (41.98), Greece (64.92), Portugal (52.89), Cyprus (57.87), and Malta (49.03). Source: Authors' elaboration on data from Mathieu et al. (2020)

Data availability The datasets analysed during the current study are available in the following repositories:

1. World Bank Enterprise Surveys repository, www.enterprisesurveys.org.

We thank the Enterprise Analysis Unit of the Development Economics Global Indicators Department of the World Bank for the data.

2. International Monetary Fund. Fiscal monitor database of country fiscal measures in response to the COVID-19 pandemic, repository: https://www.imf.org/en/Topics/imf-and-covid19/Fiscal-Policies-Database-in-Response-to-COVID-19.

3. OECD. Structural business statistics by size class and economic activity (ISIC Rev. 4), repository: https://dataexplorer.oecd.org.

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