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**FINANCIAL RESILIENCE OF MANUFACTURING
SMALL AND MEDIUM ENTERPRISES IN
PORTUGAL**

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Financial Resilience of Manufacturing Small and Medium Enterprises in Portugal

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Dedication

To God and my family.

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I am grateful to God for guiding and protecting me throughout my life, especially throughout this journey. This journey was an excellent opportunity for growth in terms of learning and academic and scientific, and self-knowledge.

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“The LORD is my Shepherd; I will lack nothing. He makes me lie down in green pastures. He leads me beside quiet waters. He refreshes my soul. He leads me in the paths of righteousness for the sake of his name”.

PSALM 23:1-3

RESUMO

Devido ao impacto da pandemia na economia global e nas Pequenas e Médias Empresas (PME) em particular, gestores e académicos têm se interessado cada vez mais em entender o que é resiliência organizacional e financeira, como se relacionam e como alcançá-las, especialmente em um ambiente de incerteza. A literatura académica considera a resiliência financeira como um dos aspetos da resiliência organizacional. A resiliência financeira é a capacidade de uma empresa em antecipar, planejar, responder e adaptar-se às mudanças graduais ou a choques abruptos, a fim de sobreviver e prosperar, por meio da adoção de políticas para diminuir os défices orçamentais, acesso a recursos financeiros para prevenir dificuldades ou para aproveitar oportunidades de investimento.

Em geral, as PME operam com recursos limitados, o que pode intensificar os obstáculos frente a circunstâncias adversas. Muitas destas empresas apresentam sistemas administrativos reduzidos, planeamento inadequado, e necessidade de recorrer a fontes alternativas de recursos para sobreviver a eventos disruptivos. Nesse sentido, esta dissertação teve como objetivo contribuir com discussão teórica e empírica sobre a resiliência financeira das PME no setor de indústrias transformadoras em Portugal.

Para a discussão teórica, foi realizado um mapeamento científico para explorar a produção científica internacional sobre resiliência, a fim de fornecer uma visão geral do estado da arte, com auxílio dos softwares Bibliometrix e VOSviewer.

Em relação à parte empírica, este estudo desenvolveu modelo quantitativo com análise de regressão logística para testar hipóteses e examinar a correlação entre características das PME e resiliência financeira usando dados secundários contabilísticos extraídos da base de dados SABI, referente aos anos de 2006 a 2021. A amostra final foi composta por 1.398 empresas do setor da indústria transformadora portuguesa.

Em resumo, a análise dos resultados da regressão logística sugere que para cada aumento de unidade na variável caixa (disponibilidade financeira), a razão de chance (odds ratio) da PME da amostra pertencer à categoria resiliente aumenta cerca de 28,8 vezes. Em relação ao tamanho da empresa, a cada aumento de unidade nessa variável, a razão de chance (odds ratio) da PME pertencer à categoria de empresas resilientes aumenta em aproximadamente 35,1%. Comparando o impacto das duas crises, os resultados sugerem que as razões de chance de uma PME pertencer à categoria resiliente foram menores durante a crise pandémica em comparação com a crise financeira de 2008-2011.

Palavras-chave: PME; Resiliência Financeira; Performance Financeira; ROA; Crise Covid

ABSTRACT

Due to the impact of the pandemic on the global economy and Small and Medium Enterprises (SMEs) in particular, managers and researchers have been interested in understanding what organizational and financial resilience is, how they are related, and how to achieve such desirable features, especially within an uncertainty environment. Academic literature considers financial resilience as one of the aspects of organizational resilience. It refers to the capacity to anticipate, plan for, respond to, and adapt to gradual change and abrupt, unexpected shocks to survive and thrive by adopting policies to decrease budget deficits and acquire financial resources to prevent or take advantage of uncertain events and take investment opportunities.

In general, SMEs' resource is scarce, for this reason they may have more difficulties in anticipating, and they generally have smaller administrative systems when it comes to planning, and therefore may need to seek other sources to resist and cope with disruptive event. In this sense, this dissertation aimed to provide both theoretical discussion and empirical evidence on SME financial resilience in the manufacturing sector in Portugal.

For the theoretical discussion of this topic, a science mapping was carried out to explore the international scientific production on resilience to provide an overview of the state-of-the-art using the Bibliometrix and the VOSviewer software.

Regarding the empirical part, this study applied a quantitative research design with logistic regression analysis to test the hypothesis and examine the correlation between SME characteristics and financial resilience using secondary account-based data extracted from the SABI database from 2006 to 2021. The final sample comprised 1,398 firms from the Portuguese manufacturing industry sector.

In summary, the logistic regression analysis suggested that for each unit increase in the variable cash, the chance that SME in the sample belongs to the resilient category increases about 28.8 times. Regarding firm size, with each unit increase in this variable, the chance of the SME belonging to the category of resilient companies increases by approximately 35.1%. Concerning both crises, results suggest that the chances of an SME belonging to the resilient category were lower during the pandemic than during the financial crisis of 2008-2011.

Keywords: SME; Financial Resilience; Financial performance; ROA; Covid crisis.

LIST OF ACRONYMS

AIC	Akaike Information Criterion
BIC	Bayesian Information Criterion
CEO	Chief Executive Officer
EC	European Commission
ESG	Environmental, Social and Corporate Governance
EU	European Union
GDP	Gross Domestic Product
GLMM	Generalized Linear Mixed Model
HRM	Human Resource Management
IFRS	International Financial Reporting Standards
JIF	Journal Impact Factor
NACE	Classification of Economic Activities in the European Community
ORs	Odds Ratios
PORDATA	Portugal database
PsyCap	Psychological Capital
RBV	Resource-Based View
ROA	Return on Assets
SABI	Iberian Balance Sheet Analysis System
SCI	Scientific Citation Index
SME	Small and Medium Enterprises
SSCI	Social Sciences Citation Index
UK	United Kingdom
USA	United States of America
VIF	Variance Inflation Factor
WoS	Web of Science

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INTRODUCTION

The outbreak of COVID-19 has impacted the global economy and raised questions about how firms should better face these challenges and remain resilient in extreme and multifaceted uncertainty. Preparing for uncertainty, particularly over long-time horizons, is much more complex than preparing for particular risk events, as it means considering uncertainties (Huber et al., 2021). Due to the impact of the pandemic on the global economy and Small and Medium Enterprises (SMEs) in particular, the concept of resilience has experienced a renaissance (Radic et al., 2022).

For this reason, managers and researchers have increasingly been interested in understanding what organizational and financial resilience is, how they are related, and how to achieve such desirable features, especially within an uncertain environment. Considering this, the literature on organizational resilience studies has increased in the last three years, mainly due to the need to understand how companies can face crises and disruptions, survive, and keep growing and maintaining successful businesses.

According to the academic literature, organizational resilience involves an organization's ability to anticipate, respond, and recover from disruptions. Given this topic's importance, researchers have studied it from several perspectives, such as resources, organizational structures, practices, or systems that may impact firm resilience, including the role of resource slack for preventing and anticipating unexpected events (Iborra et al., 2020).

Financial resilience is one of the aspects of organizational resilience. It refers to the capacity to anticipate and adapt to gradual change and abrupt, unexpected shocks to survive and thrive by adopting policies to decrease budget deficits (Sreenivasan & Suresh, 2023) and acquire financial resources on time in order to prevent or take advantage of uncertain events and take investment opportunities (Sahebi et al., 2022). It also includes elaborating and implementing a complex of managerial decisions aimed at preventing and overcoming the reduction of enterprise value and minimizing negative consequences on the enterprise (Beşliu et al., 2021).

As pointed out by the literature, firms should pay particular attention to antecedents that improve ability and may help firms to face disruptive events (Iborra et al., 2020). Additionally, there need to be more studies focusing on financial vulnerability businesses in the event of the pandemic outbreak to capture the potential severity of these consequences in financial terms and on an aggregated level (Wieczorek-Kosmala, 2022).

According to the literature, one of the abilities to respond flexibly to any shock the organization faces is the availability of financial resources. It is also referred to available slack or as financial slack. Financial slack is related to a stock of cash and cash equivalents held by an organization ready to be used (Wieczorek-Kosmala, 2022).

The COVID-19 pandemic posed an existential threat to European SMEs' financial resilience with significant consequences for the European economy (Kaya, 2022). In general, SMEs' resource is scarce. For this reason, they may have more difficulties in anticipating. They generally have smaller administrative systems when it comes to planning, and therefore may need to seek other sources to resist and cope with disruptive event (Iborra et al., 2020).

Considering this, SMEs have significant difficulties recovering their financial health after the pandemic devastated them (Sreenivasan & Suresh, 2023). As SMEs have been hit particularly hard by the pandemic, these trends become even more crucial and are closely monitored by European policymakers (Kaya, 2022).

SMEs are defined as "companies that employ less than 250 people and whose annual turnover does not exceed 50 million euros or whose annual balance sheet total does not exceed 43 million euros", according to Article 2 of Recommendation No. 2003/361/EC of the European Commission. Considered the backbone of the European economy, as referred to by the European Investment Bank (2020), SMEs represent about two-thirds of overall employment. They contribute over 55% of the overall value added to the non-financial business economy. In Portugal, according to the statistical database available on the Central Balance Sheet (Bank of Portugal, 2021), in 2020, there were 483,760 companies, of which 482,515 corresponded to micro, small, and medium-sized companies, about

99.7%. In 2020, according to this database, these companies obtained 212,465 million Euros in business volume and employed 2.2 million people in Portugal.

Considering this magnitude and the relevance of these companies to the economy and the challenges faced during the pandemic, it is important to study the determinants of SME survival, particularly during times of crisis. In addition to difficulties and challenges, crisis can also offer opportunities. Despite devastating impacts on economies and societies, they also open up an opportunity space for strategic renewal (Wenzel et al., 2021).

In the context of the pandemic and considering its social and economic effects, more recent research has been dedicated to investigating the impact of COVID-19 on firm performance. Many of these studies have highlighted various challenges businesses face amid pandemics. However, there still needs to be empirical clarity regarding the current impacts of COVID-19 on business continuity and business resilience (X. Chen et al., 2021). Several perspectives and nuances can be analyzed to understand the effects on the firm profitability.

Analysing factors that impact companies' performance is not a recent study topic. Due to the multidisciplinary complexity and uncertainties associated with the particularity of each entity, there is still much to explore in this vast field of knowledge, especially in the context of SMEs. Due to the reality caused by the COVID-19 crisis, it is important to investigate which firm characteristics may have influenced SMEs' financial resilience during this crisis. As mentioned by Hermundsdottir et al. (2022), COVID-19 has significantly impacted the manufacturing industry, and manufacturers have responded to the crisis in different ways. Thus, analyzing and understanding why some firms resist a systematic unexpected event like the pandemic better than others is important.

Although the academic literature on organizational resilience has increased in the last three years, given the importance of this topic, recent academic studies have highlighted the need for further investigation. There needs to be more existing literature on providing an approach to measure financial resilience, argue Sahebi et al. (2022). Although previous studies have developed an analytical framework to measure financial resilience and provided evidence of the significant role of resources using international case studies, there are few quantitative studies on the impact of resources on financial resilience (Lee & Chen, 2022). Additionally,

there is a strong need to investigate the financial resilience that can trigger an industry-wide recovery in times of national or global crisis (Sundarakani & Onyia, 2021).

Based on the academic literature debates, the main reason for this kind of gap topic may be explained because it is challenging to quantify resilience, and many different constructs have been applied in the academic research. Thus, there is a need in more theoretical and empirical discussion to improve the exploration of the concepts and variables that would robustly determine financial resilience across various industries.

In this sense and motivated by the gaps pointed out by the literature, this study aimed to provide both theoretical discussion and empirical evidence on SME financial resilience. Thus, firstly for the theoretical discussion of this topic, a science mapping was carried out in order to explore the international scientific production on resilience to provide an overview of the state-of-the-art and improve debates on organizational and financial resilience using bibliometric techniques. The main objective of this part was to understand how the theme evolved and identify gaps and the most recent and relevant discussions within the scope of the purpose of this theme to subsidize the literature review. The second objective was to provide empirical evidence on SME financial resilience in the manufacturing sector in Portugal, based on the gaps identified in the science mapping and grounded by the relevant literature. The objective of the empirical part was to investigate specific firm characteristics that may explain SME financial resilience in the manufacturing sector in Portugal from 2005 to 2021.

In order to achieve the science mapping objectives, the following research questions were proposed:

- What are the main evolutionary sample characteristics, especially concerning the number of published articles, countries, journals, the most relevant authors, articles, and trend topics?
- What are the main characteristics related to the conceptual structure in this bibliographic sample?

Regarding the empirical part, the following research questions were proposed to achieve the objectives:

- What is the relationship between financial slack, operational leverage, internationalization, company size and age on SMEs' financial resilience in the manufacturing sector in Portugal?
- What is the relationship between the financial crisis (2008-2011) and the pandemic crisis (2020-2021) on the SMEs' financial resilience in the manufacturing sector in Portugal?

To answer the research questions related to the science mapping section, the methodology included bibliometric techniques in bibliometric metadata extracted from the Web of Science. One of the techniques applied in this study included a cluster analysis of the co-occurrence of terms in the sample to identify the main lines of research on this subject, gaps, and research directions. For data analyses, the Bibliometrix and the VOSviewer software were applied.

In relation to the methodology of the empirical section, a quantitative research design with logistic regression analysis was applied to test the hypothesis and examine the correlation between SME characteristics and financial resilience. For this purpose, a set of financial data extracted from the SABI database was used. Regarding the statistical analysis, a Generalized Linear Mixed Model (GLMM) was employed to explore the relationship between the variables and SMEs' financial resilience using the software R.

The development of this research is highly relevant and current, considering the significant and indispensable role of SMEs in the economic development of a country (Kaberia et al., 2021). Within the European Union, in 2020, SMEs in the non-financial sector accounted for 99.8% of member states' companies. These companies generated about 65% of total employment and 53% of the value-added, according to The Annual Report on European SMEs (2020/2021).

This study contributes by providing a discussion of organizational and financial resilience theoretical and empirical approach. The theoretical discussions related to this topic may contribute to a better understanding and shed light on financial resilience definitions and developing more solid constructs. The maturation of theoretical bases may contribute to the development of empirical research that can robustly assess the financial resilience of companies to add value and enable the development of capabilities that may contribute to their resilience, especially when facing disruptive situations.

Regarding the empirical contributions, this study aims to provide insights into SMEs' financial resilience during the Covid crisis period, especially in understanding how Portuguese SMEs manage resources and strategies and provide insights for possible future crisis. This study is also expected to provide insights to academic researchers and public policymakers, especially into how to stimulate SMEs' resilience in crisis period.

This study is organized as follows. The first part is dedicated to the science mapping analysis. Then, the literature review, followed by the methodology, results analysis, and conclusion.

PART 1 - SCIENCE MAPPING

This section aims to explore the international scientific production on resilience to provide an overview of the state-of-the-art within the scope of scientific articles indexed in the Web of Science (WoS) bibliographic database¹, in the knowledge areas of “Business”, “Business and Finance”, and “Management”. For this purpose, this first chapter is structured into two main parts. The first briefly contextualizes the relevance of using science mapping techniques. Then, the scientometrics analysis techniques used and the workflow process, the results, and respective analyzes will be described, and, finally, the main findings that will guide the development of the main parts of this study.

1.1 The purpose and relevance of science mapping

The literature attributes the origin of the popularization of the term resilience to Holling’s publication in 1973 in a study on ecological environments (Bhamra et al., 2011; Demiroz & Haase, 2019; R. Chen et al., 2021; Hussen Saad et al., 2021). In that context, resilience refers to the ability of an ecosystem to recover to its previous state after being damaged. “Resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and still persist” (Holling, 1973, p. 17).

The term resilience is used in various knowledge fields, and its concept is both multidisciplinary and multifaceted (Bhamra et al., 2011; Kativhu et al., 2018; Tolner et al., 2021). Although the context of the term may change, across all of these fields, the concept of resilience is closely related to the capability and ability of an element to return to a stable state after a disruption (Bhamra et al., 2011). In the organizational resilience field, it is defined as the ability of a business to adapt to disruptions that threaten existence and survival (Kativhu et al., 2018;

¹ Retrieved reference date: February 11, 23

Soufi et al., 2021), and also the ability to drive growth in a crisis period (R. Chen et al., 2021).

Although several studies have already been developed in this area, even now, there is no unified definition of resilience in the business and management field, and it is necessary to take stock of current knowledge and structure them to lay the foundation in this field (Saad et al., 2021). It occurs mainly because scholars have interpreted the concept of organizational resilience from different perspectives, and there is no universally accepted standard for the study of the structure, its influencing factors, and its measurement (Kativhu et al., 2018; R. Chen et al., 2021). In this sense and considering the motivation to understand the general context in which the main debate of this subject is inserted, within the scope of business, finance, and management fields, this chapter was developed to provide an overview of the state-of-the-art in a broader context, before delving into the specific questions about financial resilience.

As academic knowledge is expanding exponentially (Linnenluecke et al., 2020) and it is becoming increasingly unfeasible to remain current with everything that is being published (Aria & Cuccurullo, 2017), science mapping has become important to researchers conduct a more assertive and efficient research strategy. Thus, the main objective is mapping the studies to understand how research have been developed in this field, to identify the most relevant studies and approaches, to map the conceptual structure, and to look for insights and directions to conduct the development of the literature review and the empirical sections of this dissertation. For this purpose, the software VOSviewer (van Eck & Waltman, 2010) and the Bibliometrix (Aria & Cuccurullo, 2017) were applied in this section to visualize and explore the main characteristics of the bibliographic data sample based on performance analysis and science mapping techniques.

Science mapping is defined as a rigorous method for exploring and analyzing large volumes of scientific data to provide an overview of state-of-the-art on a given topic (Donthu et al., 2021). The literature argues that this scientific research approach has become popular (Donthu et al., 2021; van Eck & Waltman, 2014) due to the growing number of academic publications at a rapid pace and in the face of need for the researcher to remain current with what has being published

(Aria & Cuccurullo, 2017) and, due to advances in information technologies tools (Pessin et al., 2022).

The use of bibliometric techniques have been adopted to map the subjects with complex discussions, especially at the beginning of the research, to support scientific writing (Pessin et al., 2022). It may be useful for visualization of the interdisciplinary nature of research activities at various levels of analysis (Glänzel & Debackere, 2022). In addition, it may serve as a starting point for other review techniques in advancing theory and practice (Mukherjee et al., 2022) and identify gaps and may result in new future research directions (Donthu et al., 2021; Pessin et al., 2022).

In addition to the arguments presented by the literature, scientific knowledge, even though specific it may be, does not arise in isolation, it is part of a pre-existing context, often the result of the development of academic and socio-economic debates. In this sense, these science mapping techniques were applied in this study, considering their importance in understanding the knowledge field from the general context to understand the advancement of scientific discussions and considering the economic and social relevance of the theme related to business resilience, especially in crisis periods. Thus, the next subitems present the strategy used for the bibliometric workflow development and the analysis of the results.

1.2 Science mapping techniques

The bibliometric analysis manifests across two techniques categories, performance analysis and science mapping. The performance analysis accounts for the contributions of research constituents, whereas science mapping focuses on the relationships between research constituents (Donthu et al., 2021). The results of performance analysis and science mapping may also serve as a starting point for other review techniques in advancing theory and practice (Mukherjee et al., 2022) and, if well done, can help build new knowledge bases for advancing a research field in many ways, such as identify gaps and result in new ideas for investigation (Donthu et al., 2021). In this sense, and following a

similar approach used by (Pimentel et al., 2023), the techniques used in this section aim to answer the following questions based on the main studies on “resilience” issues within the WoS’ knowledge areas of “Business”, “Business and Finance”, and “Management”.

- What are the main evolutionary sample characteristics, especially concerning the number of published articles, countries, journals, the most relevant authors, articles, and trend topics?

This question aims to provide an overview of the main studies on “resilience” issues based on bibliometrics performance analysis and its discussion to understand its main aspects.

- What are the main characteristics related to the conceptual structure in this bibliographic sample?

At this stage, a cluster analysis will be carried out to the co-occurrence of terms in the sample to identify the main lines of research on this subject from a broad perspective to try to perceive possible gaps and research directions.

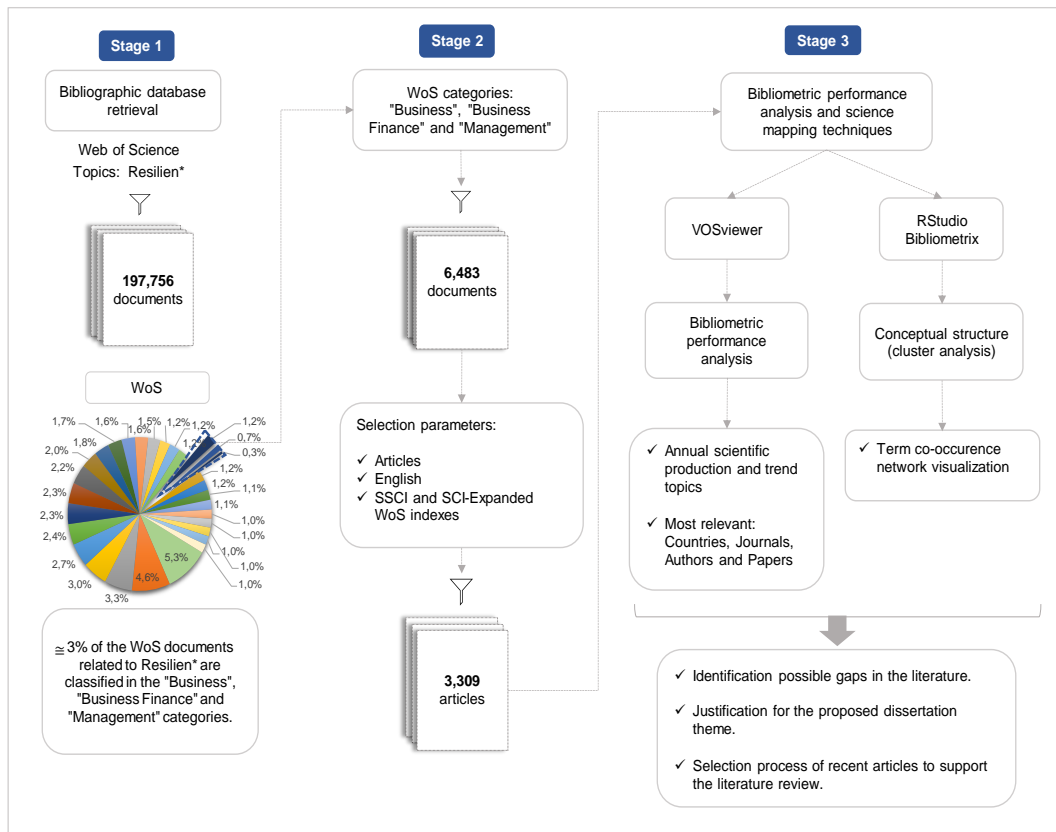
1.3 Bibliographic sample selection process and workflow description

The literature recommends general workflow guidelines for science mapping research with bibliometric methods (Aria & Cuccurullo, 2017; Zupic & Čater, 2015). After the study design definition, it usually includes the following steps: data collection, analysis, visualization, and its interpretation. In this sense, the research strategy adopted in this study considered these main steps in its workflow: the WoS bibliographic database retrieval, delimitation of documents based on WoS knowledge categories, performance analysis, and the conceptual structure analysis based on the term co-occurrence.

Figure 1 shows the science mapping workflow. The first stage comprises the theme delimitation, research parameters and database choice, and systematic metadata retrieval. As this study aimed to conduct a science mapping on organizational business resilience in a more comprehensive way, the start point was to select in the Web of Science Core Collection, the “topic” field, considering

it searches terms within the title, abstract, author keywords, and keywords plus. Thus, in this first parameter filter, “resilien*” was the search term applied. The strategy for using the term “resilien*” is justified considering that it is related to both root words “resilience” and “resilient”. As result of this first stage, the WoS returned 197,756 documents published from 1909 to 2023 in all WoS knowledge categories.

Figure 1 - Science mapping workflow



From this first stage of the research, although still very comprehensive and without any delimitation, it is possible to observe that the term “resilien*” is not a recent topic and that, due to the multidisciplinary nature related to its concept and the various applicability, it has been much explored in various areas of research. In this initial stage of document filtering, the results also revealed the main research areas (WoS Categories) in proportion to the scientific production related to this key term: Environmental Sciences (5.3%); Engineering Electrical Electronic (4.6%); Environmental Studies (3.3%); Ecology (3.0%); and Psychiatry (2.7%).

Next, for the document's selection process continuity, the strategy used in the second stage was to filter documents considering the knowledge areas area (WoS categories) related to this research project, namely, "Business", "Business Finance", and "Management". With this parameter, the database returned 6,483 documents published from 1970 to 2023. This preliminary result revealed that about 3% of all documents related to the term "resilience" are indexed in these WoS categories.

Then, the following selection parameters were also applied in this step: "English" for language, and both WoS Indexes were considered: Social Sciences Citation Index (SSCI) and Science Citation Index Expanded (SCI-Expanded). Following these parameters, the database returned 3,309 documents (articles and early access) published from 1989 to 2023. Then, the respective metadata were exported in the tab-delimited file format as it is required to run in the VOSviewer software and the BibTex format to the Bibliometrix.

The third stage consisted of the performance analysis using the Bibliometrix and the science mapping through the conceptual structure analysis based on the term co-occurrence to explore the scientific production using the VOSviewer. For this proposal, it was necessary to convert the files in RStudio to enable the visualization of metadata through Bibliometrix.

The following subsections present the performance analysis and science mapping on thematic areas of scientific research developed on resilience studies within this bibliographical sample.

1.4 Scientific production analysis

1.4.1 *Overview of scientific production*

This section aims to provide an overview of the main studies on "resilience" issues based on bibliometrics performance analysis and its discussion to understand its main aspects. This step was designed to answer the question related to the main evolutionary sample characteristics, especially concerning the

number of published articles, countries, journals, the most relevant authors, the most relevant articles, and trend topics.

Annual scientific production

According to Abramo et al. (2022), the health of any scientific discipline depends on continual re-evaluation of the state of the art. In this sense, the main advantage of bibliometric analysis is that it assists researchers in observing historical changes in the characteristics of publications based on analyses conducted using sample bibliographic data (Chang et al., 2015).

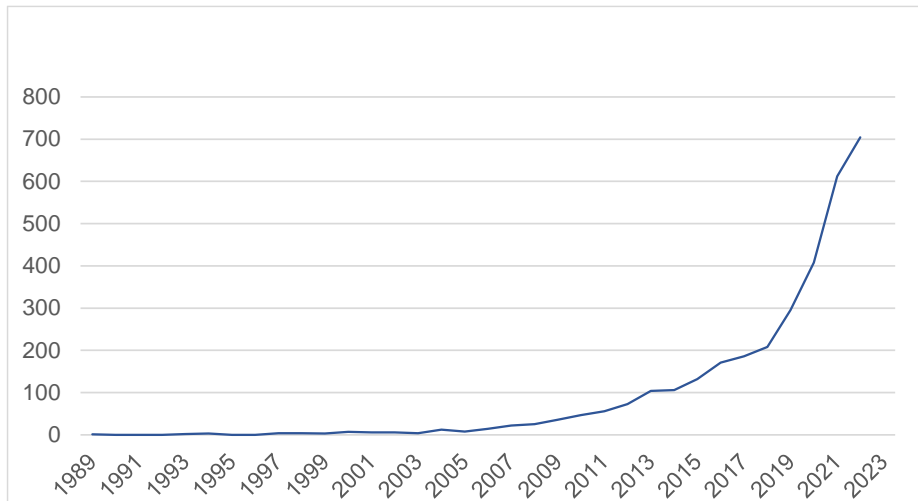
This type of analysis may lead the researcher to broaden the range of perceptions about the subject, identify gaps and be able to remodel approaches and concepts hitherto addressed. Hence the importance of broadening the temporal and spatial vision to seek specialization in a given line of research. For this reason, in this study, it was decided to keep the entire time series of the articles in this sample in this comprehensive analysis of this set of 3,309 articles to be able to understand the evolution of the approaches discussed on resilience in the “business”, “business and finance” and “management” knowledge fields, over the period from 1989 to 2023.

From the analysis of the main debates in the literature on this subject, it was possible to observe that after decades of being preoccupied with the financial benefits of social and environmental business practices, researchers are starting to turn their attention to resilience-related benefits (DesJardine et al., 2019). Recently, despite fragmented literature on definitions, measurements, and variables influencing the concept (Saad et al., 2021), resilience has gained new momentum in organization studies (Hillmann & Guenther, 2021).

In fact, from 1989 to 2023, the number of scientific articles indexed in the WoS on resilience in business, finance, and management has grown significantly, especially after the global financial crisis of 2007-2008. From this perspective, 2008 can be considered a turning point in developing organizational resilience research (Saad et al., 2021; Soufi et al., 2021). Resilience is an essential skill for companies and individuals to possess to survive and thrive in today’s uncertain world. The increasing production of scientific articles on this topic in this sample of 34 years is a testament to the importance of resilience in the business world.

Nowadays, debates on this topic are of great interest due to the effects caused by the current Covid-19 pandemic (Tolner et al., 2021). The analysis of the annual scientific production of this sample over this period revealed that about 54% of the articles were published from 2020, as shown in Figure 2. Most of these articles discussed resilience strategies that companies can adopt during crisis pandemic.

Figure 2 - Annual scientific production



Although most of the recent debates are related to economic disruptions and the pandemic crisis, over the years, it was possible to observe a range of other issues related to the survival and performance of companies have also been considered in the scope of research on organizational resilience, both internally and externally to the company. Organizational resilience research integrates some established research and practice areas, including risk management, business continuity, disaster management, operations management, engineering and safety, leadership, and change management (Brown et al., 2017).

The debates are multivariate and range, for example, from issues related to human resource management, characteristics of managers, characteristics of companies, passing through natural disasters, terrorism, wars, and other aspects that can compromise economic stability and consequently can translate into becoming a threat to the stability and even the survival of organizations.

Additionally, the growing awareness of the impact of natural disasters such as hurricanes, floods, earthquakes, and fires on business has contributed to the rise of scholarly articles on “resilience” in business, finance, and management.

Beyond that, increased awareness of environmental risks and growing pressure on companies to adopt more effective and resilient risk management practices have also contributed to the rise of this topic research.

Over the 34 years of this bibliographic data sample, the main topics addressed can be summarized in four main moments:

1989 - 2000 (24 articles):

Initially, from 1989 to 2000 (24 articles), the main topics discussed were the resilience of military expenditures (Demasi & Lorie, 1989) and the importance of motivation and empowerment for career development (London, 1993). In addition, the importance of leadership for organizational health (Waterman et al., 1994) and the need to improve learning capacity in high-risk environments were also studied (Weick, 1993). These topics were important for understanding the behavior of markets and businesses, and for developing strategies to deal with changes and crises.

2001 - 2007 (72 articles):

Between 2001 and 2007, the theme “resilience” was widely discussed. The topic approach included psychological capital (Luthans et al., 2007), supply chain resilience (Craighead et al., 2007; Sheffi & Rice, 2005), and environmental change (Lengnick-Hall & Beck, 2005). In addition, topics such as the business value of health management, the relationship between diversity and resilience, the role of quantity in organizational breakdown were discussed. Regarding industries, articles also discussed supply chain disruptions, the effects of competition and diversification on supply chains, and support for career development. In short, the analysis suggests that the annual scientific production in this period comprehensively addressed the theme of resilience from various perspectives on how organizations can use resilience to become more competitive, improve performance and satisfaction, and increase their ability to deal with disasters.

2008 - 2019 (1439 articles):

From 2008 to 2019, about 43% of the scientific production. Based on the analysis, the 2007 financial crisis was one of the main events that stimulated the scientific production of academic articles on resilience in business, finance, and

management in this period. The main debates include financial crisis and issues related to how organizations face adversities (DesJardine et al., 2019; Powley, 2009; Williams et al., 2017), several aspects related to supply chain resilience (Brandon-Jones et al., 2014; Juttner & Maklan, 2011; Pettit et al., 2010; Ponomarov & Holcomb, 2009), psychological capital (Avey et al., 2011; Luthans et al., 2008), and capacity for organizational resilience through strategic human resource management (Lengnick-Hall et al., 2011). Other topics were also debated during this period, such as those related to dynamic capabilities for facing natural disasters (Martinelli et al., 2018), corporate social responsibility (Skarmeas & Leonidou, 2013), and risk management (Parker & Ameen, 2018).

2020 - 2023 (1774 articles):

About 54% of the articles in this sample were published between 2020 and 2023, revealing that the COVID-19 pandemic influenced business and the academic community to understand how companies can face crises and other disruptions. Although the subjects and approaches of this article set are different, the analysis suggests that, in general, the pandemic has influenced especially issues related to the impact of the pandemic on the tourism industry (Sigala, 2020), personal resilience related to the COVID-19 anxiety in front-line nurses (Labrague & De los Santos, 2020), psychological resilience (Zheng et al., 2021), supply chain (Belhadi et al., 2021; Sarkis, 2021; van Hoek, 2020), firm performance (Cowling et al., 2020; Ding et al., 2021).

Despite the increase in academic research on business resilience in recent years, little resilience research has focused on the context of SMEs in developing countries, which is surprising given the contribution made by these businesses (Saad et al., 2021). The Covid-19 pandemic has caused a resurgence of the idea of resilience, especially regarding SMEs and the global economy (Radic et al., 2022).

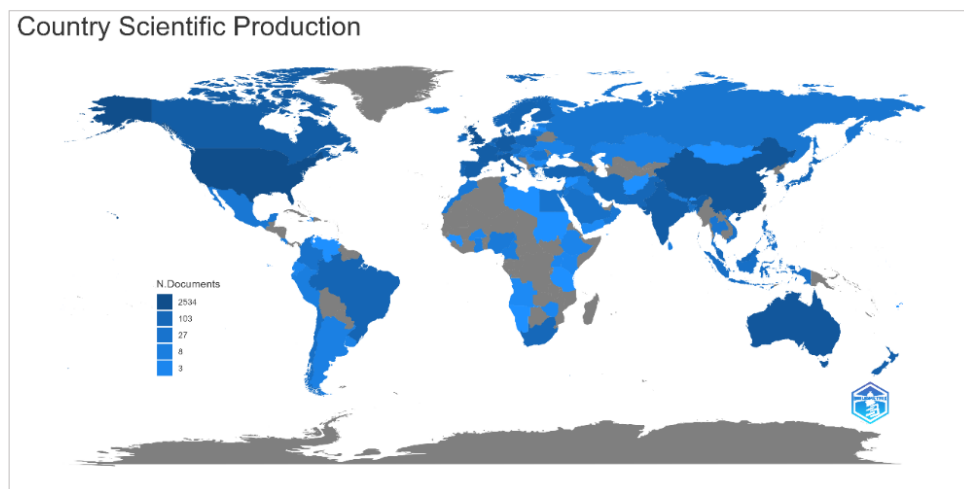
Countries

The world has encountered numerous challenges in the past. However, in the last thirty years, the issues of natural disasters, epidemics, and wars have impeded many countries' developmental operations and economic activities

(Sundarakani & Onyia, 2021). For this reason, organizational resilience has attracted widespread attention in the management as an indispensable element for successful organizational response to crises, especially after worldwide shock events (Zhang et al., 2022). Exploring academic production worldwide may be an interesting strategy to identify possible gaps and provide future directions.

According to Al-Jamimi et al. (2022), scientific leadership can be easily indicated from papers published by a country, and these indicators allow researchers to assist in forecasting future research directions through those identified leaders. In this sense, the analysis of bibliographic metadata was conducted to verify the academic productions worldwide, based on the authors' and co-authors' affiliations frequency distribution. Results indicated that the 3,309 articles in this sample under analysis were developed by academics affiliated with institutions in 86 countries. Figure 3 indicates the distribution of scientific research production by country on resilience within the business, finance, and management knowledge area.

Figure 3 - Country scientific production



Under this perspective, Table 1 presents a list of the 20 main countries in which resilience research has been undertaken under this sample analysis.

The USA is at the top position by contributing 727 (22%) publications, followed by the UK with 408 (12%), China with 268 (8%), Australia with 218 (7%), Italy with 150 (5%), Canada 118 (4%), India 99 (3%), Spain 97 (3%) and France 92 (3%). The scientific production of these ten countries corresponds to (about 70%) of the analyzed sample. Most countries on the list of scientific production

concentrated on developed economies. This result is in accordance with other studies (Linnenluecke, 2017; Saad et al., 2021).

Table 1 - Top 20 countries scientific production

Country	Articles	%
USA	727	22%
United Kingdom	408	12%
China	268	8%
Australia	218	7%
Italy	150	5%
Germany	147	4%
Canada	118	4%
India	99	3%
Spain	97	3%
France	92	3%
Netherlands	81	2%
New Zealand	80	2%
Brazil	43	1%
Sweden	43	1%
Portugal	40	1%
Korea	37	1%
Denmark	36	1%
Turkey	36	1%
Norway	32	1%
Finland	31	1%

Journals

Some bibliometric indicators have been used to look at journals in which papers have been published because journals with a high citation impact are frequently reputable journals with an international focus and which publish higher-quality research (Al-Jamimi et al., 2022).

The analysis revealed that the 3,309 articles were published in 368 journals, in a wide range of journals spreading from 2021 JIF quartile Q1 to Q4 rank, according to Table 2.

Table 2 - Journals 2021 JIF quartile ranking

2021 JIF Quartile	Journals	Articles	(%)
Q1	87	1182	36%
Q2	91	889	27%
Q3	89	629	19%
Q4	86	585	18%
N/A*	15	24	1%
	368	3309	

Source: Elaborated based on WoS and Clarivate database.

Table 3 illustrates the distribution of the top 20 Journals published the most within the scope of the sample and the respective Journal impact factor for 2021, according to Clarivate.

Table 3 - Journals that published the most within the scope of the sample.

Source	2021 JIF Quartile	Articles	%
Disaster Prevention and Management	Q4	161	5%
Technological Forecasting and Social Change	Q1	85	3%
Journal of Nursing Management	Q2	79	2%
Journal of Business Research	Q1	73	2%
Journal of Contingencies and Crisis Management	Q3	73	2%
International Journal of Logistics Management	Q2	67	2%
IEEE Transactions on Engineering Management	Q1	63	2%
Supply Chain Management-An International Journal	Q1	63	2%
European Journal of Operational Research	Q1	54	2%
International Journal of Oper. & Prod. Management	Q1	53	2%
Tourism Management	Q1	44	1%
Business Strategy and the Environment	Q1	40	1%
International Journal of Physical Dist. & Log. Management	Q1	39	1%
International Journal of Logistics-Research and Applications	Q2	35	1%
Finance Research Letters	Q1	31	1%
International Journal of Contemporary Hosp. Management	Q1	29	1%
International Journal of Human Resource Management	Q2	29	1%
Tourism Management Perspectives	Q1	29	1%
Engineering Construction and Architectural Management	Q3	28	1%
Socio-Economic Planning Sciences	Q2	28	1%

The most preferred journal by authors for their research papers was the *Disaster Prevention and Management*, with 161 articles (5%). This journal publishes articles related to disaster risk reduction and management in the fields of business, management and accounting, policy and law, and environmental studies. The second is *Technological Forecasting and Social Change*, with 85 articles (3%). This journal publishes papers related to social, environmental, and technological factors. Then, the *Journal of Nursing Management* with 79 (2%), and the *Journal of Business Research* with 73 (2%). The analysis of these main journals that published academic articles on “resilience” in business, finance and management is quite diverse, and some of them have high impact rates, which indicates that the articles published in these journals are relevant to the area.

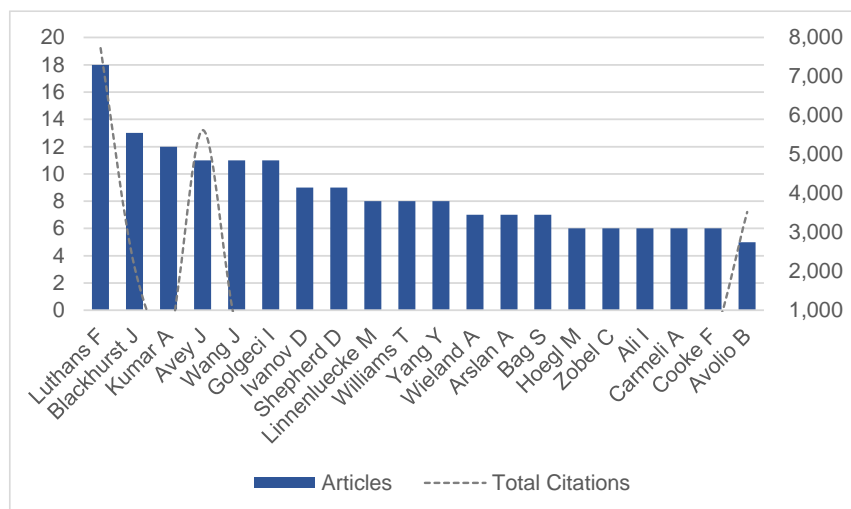
From the major journals that published academic articles on “resilience” in business, finance, and management few of them are specialized in in accounting and finance. Only the *Journal of Finance*, the *Accounting Research*, and the

Accounting, Organizations and Society figure in the top 20 published journals. This may indicate a research gap in this area, as accounting and finance are extremely important for managing and developing of resilient companies.

Most relevant authors

The scientometrics literature argues that publication counts (productivity) and received citations (the impact of an individual paper) remained the dominant indicators for measuring scientific performance (Al-Jamimi et al., 2022; Gagolewski et al., 2022). Thus, it is important to analyze the most relevant authors to understand what has been studied, the approaches of the main authors, and the maturing process of the respective ideas over the years and their context to identify possible insights (Pimentel et al., 2023). In this sense, Figure 4 shows the authors who have published more than seven articles on resilience studies and highlights the number of total citations.

Figure 4 - Most relevant authors



The analysis revealed that the most productive author in this sample is Fred Luthans (18 articles). He is also this sample’s most cited author (7,729 citations). The main contribution of Fred Luthans’ articles is the concept of Psychological Capital (PsyCap), defined as an individual’s positive psychological state of development composed of hope, self-efficacy, resiliency, and optimism (Luthans et al., 2007). His most cited article is “Positive psychological capital: measurement and relationship with performance and satisfaction related to the relationship between positive psychological capital and employee performance

and satisfaction”. In this article, Luthans et al. (2007) provides evidence that positive psychological capital is an effective tool for predicting work performance and satisfaction.

The second most productive author is Jennifer Blackhurst (13 articles). In general, her articles focus on the effects of supply chain disruptions and how to anticipate and manage these disruptions to maintain business continuity. One of her most relevant articles is “Firm’s resilience to supply chain disruptions: scale development and empirical examination”. In this article, Ambulkar et al. (2015) argue that firms need to have a certain level of resilience to supply chain disruptions in order to be successful. This resilience is achieved through the ability to reconfigure resources or having a risk management resource infrastructure.

The third most productive author in the sample is Anil Kumar (12 articles). The main contribution is related to strategies and frameworks to enhance the resilience of perishable product supply chains in the context of the COVID-19 outbreak. Then, James Avey (11 articles) was the fourth most productive author and the second most cited. His central theme is in the field of psychological capital to analyze, for example, its impact on employee attitudes and performance. His most cited article was in co-authorship with Fred Luthans mentioned above.

Finally, the fifth most productive was Jie Huang (10 articles). In general, some studies developed by this author were related to the potential of the digital economy to facilitate sustainable development in the post-pandemic environment, the efficiency of financial markets in the face of the COVID-19 pandemic, and the role of social networks in helping small businesses become more resilient. In addition to the most productive authors, it is worth highlighting Bruce Avolio (5 articles), one of the most cited authors (3,526). His studies are on psychological capital, and he also developed research in co-authorship with Fred Luthans.

1.4.2 Conceptual structure

Keyword co-occurrence analysis is a co-word analysis method that identifies thematic relationships in a specific field by calculating the occurrence frequency of keywords and analyzing the connection strength between different keywords (Zhang et al., 2022).

A term co-occurrence map based on text data was created in the VOSviewer, considering terms extracted from the title and abstract fields by binary counting with five as the minimum number of occurrences of a term. In this stage, the first action consisted of the data cleaning by excluding general research terms such as hypotheses, research methodology, sample, student, systematic review, etc. Names of countries and other terms not necessarily related to the key concepts on this knowledge field were excluded, such as 21st century, allocation, months, average, calculation, etc. The process terms cleaning covered six cleaning cycles resulting in a sample data containing 541 terms categorized in five clusters, as shown in Figure 2.

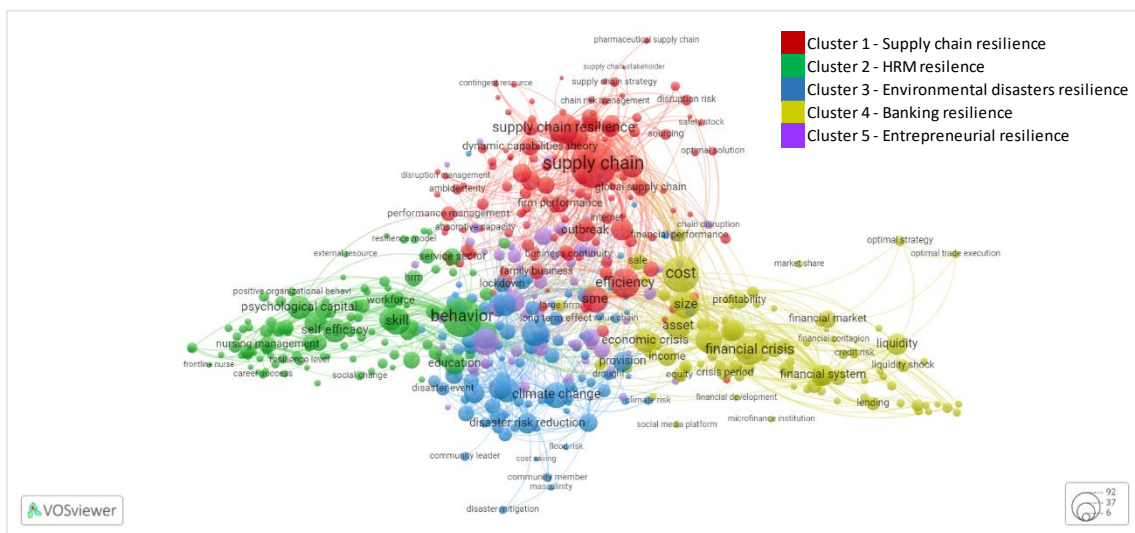
As mentioned before, the VOSviewer was applied in this study. It is a free bibliometric visualization software developed by van Eck & Waltman (2010), wherewith it is possible to construct and visualize a large number of bibliographic items making it possible to develop science mapping studies using various techniques of bibliometric analysis. In this study, the VOSviewer was used to map the scientific production on business resilience and provide an overview of this field, exploring its conceptual structure through the term co-occurrence analysis. The co-occurrence term analysis pertains to the conceptual interactions among research constituents, and it is based on the number of publications in which both terms, individual words or multiple words, occur together in the title and abstract in a considered sample of bibliographic data (Donthu et al., 2021; van Eck & Waltman, 2014).

This techniques analysis allows to explore the relationships between topics in a research field focusing on the content of the publication, and it assumes that words that frequently appear together have a thematic relationship with one another (Donthu et al., 2021) and uncover relationships among terms or concept

in a set of documents wherein it converges into a cluster under a common theme (Khare & Jain, 2022; Mukherjee et al., 2022).

In this sense, a co-occurrence network visualization map was created in the VOSviewer based on text data, considering the minimum number of five occurrences of a term, as shown in Figure 2. After cleaning the data extracted from VOSviewer and analyzing the generated map, the analysis of the co-occurrence of the 541 terms revealed the conceptual structure of the sample is composed of five clusters that suggest address mainly the following aspects: Supply chain resilience (cluster 1 in red – 143 items); Human resource management resilience (cluster 2 in green – 120 items); Environmental disasters resilience (cluster 3 in blue – 103 items); Banking resilience (cluster 4 in yellow – 99 items); Entrepreneurial resilience (cluster 5 in purple – 76 items).

Figure 5 - Co-occurrence network visualization on resilience studies



This science mapping analysis revealed vast literature on resilience within business, management, and finance. The sample cluster analysis demonstrates that most academic research has been conducted in various approaches and contexts, including industries, consumers, human resource management, financial services, healthcare, and insurance. In general, research has shown three key factors that contribute to a company’s resilience: its culture, the strength of its brand name, and the quality of its leadership.

Overall, the analysis of co-occurrences revealed five distinct clusters that offer insight into how academic literature conceptualizes current research topics

related to resilience within the areas of business, management, and finance is vast. Each cluster provided an understanding of the current gaps in research and a view into future directions on resilience research.

Understanding these connections is essential for developing better strategies for managing and responding to disruptions in today's globalized world. These studies have identified five clusters that may serve as a starting point for further exploration into how various aspects of resilience interact. With further investigation, this type of research could lead to more effective management strategies and improved levels of resilience.

The next paragraphs describe main aspects of each cluster:

Cluster 1 - Supply chain resilience (shown in red)

This cluster discusses various topics related to increasing resiliency within complex global supply chains, such as strategic decision-making, risk management, and implementing new technologies. Supply chain resilience is a key component of an organization's ability to effectively respond and recover from disruptions. It involves the capacity to proactively identify, assess, and mitigate supply chain risks while simultaneously responding quickly and efficiently to shocks that occur.

Moreover, cluster 1 shows several subtopics that could help understand how SMEs are affected by supply chain disruption incidents, such as natural disasters or pandemics. It included topics related to managing multiple sources of uncertainty, evaluating and identifying risk factors associated with supply chain resilience, and analyzing cost-benefit tradeoffs for effective risk mitigation strategies.

Cluster 2 - HRM Resilience (shown in green)

In this cluster, the most relevant debates seem focused on human capital, and the terms are related to human aspects and characteristics or variables that may explain business resilience in this research field. Human Resource Management (HRM) resilience is an important factor that significantly impact a company's success. It involves employees' behavior, skill, and self-efficacy to cope with changes, challenges, and crises. It requires employees to be proactive in their

approach to any situation and encourages them to take full responsibility for their actions.

Cluster 3 - Environmental disasters resilience (shown in blue)

The most relevant debates focused on environmental issues. Resilience in this context refers to the ability to prepare and respond effectively to natural disasters. It involves both proactive measures taken in advance of an event and reactive strategies that are employed when disaster strikes.

Cluster 4 – Financial and banking resilience (shown in yellow)

This cluster helps to draw a picture of how the economic and financial crises have impacted different aspects of the economy, such as costs, capital structure, liquidity, and regulations. It also points to how these factors have affected the banking sector, which has been central to these events. Articles in this cluster shows how these economic and financial events have deeply impacted different aspects of the global economy.

Literature refers to resilience in this context as the ability of a banking or financial institution to withstand, recover from and adapt to shocks. It enables an institution to remain profitable despite external economic pressures and internal management issues. Banks and other financial institutions are increasingly aware that they must be resilient to stay competitive in today's rapidly changing global markets.

This fourth cluster provides insight into the current state of the global economy following periods of financial and economic crises. It also highlights the importance of understanding cost, capital structure, liquidity, and regulation to help businesses build resilience and be better prepared for future disruptions.

Cluster 5 - Entrepreneurial resilience (shown in purple)

In cluster 5, most debates focus on entrepreneurial vision companies and their resilience in crisis moments under different approaches. Entrepreneurial resilience involves the ability to keep going despite setbacks and challenges, learn from experience, and stay focused on the goal. Some studies aimed to understand small firm growth and success factors during COVID-19, supply chain resilience, resilient entrepreneurs' features, and other aspects related to

innovation, ecosystems, sustainable development, and business practices that may help firms face unexpected disruption. Other debates were studied, such as gender issues, ethics, network, and team performance.

1.5 Main findings

The science mapping analysis provided a comprehensive understanding of the main issues related to resilience within the knowledge areas of business, finance, and management.

Although the tendency for academic research on organizational resilience has grown considerably, especially after the 2008 financial crisis and the crisis caused by the pandemic, there still needs to be a gap in quantitative research, especially concerning financial resilience, including SMEs. It was also possible to observe the research gap about accounting aspects and the importance of accounting in the firm's resilience.

This science mapping provided the motivation to develop this master's thesis on SMEs' financial resilience. Furthermore, the insights obtained from this analysis inspired the following literature review and, consequently, the development of the empirical part of this study.

PART 2 - LITERATURE REVIEW

2.1 Concepts and underlying theory

The concepts of organizational resilience and financial resilience are related. In a broad context, academic literature defines organizational resilience as an organization's ability to anticipate potential threats, cope effectively with adverse events, and adapt to changing conditions (Duchek, 2020).

One of the approaches of organizational resilience studies is from the financial perspective. Most financial resilience studies focus on the financial management viewpoint linking the role of organizational resources, such as the financial slack, in conducting firms in a stable financial condition against shocks (Barbera et al., 2020; Lee & Chen, 2022).

In this sense, and under the assumption that financial resilience presupposes organizational resilience, this section will present firstly the organizational resilience aspects, followed by the concepts regarding financial resilience. Then, the underlying theory in which this work is grounded.

2.1.1 *Organizational resilience*

The concept of resilience varies significantly across research knowledge areas and their perspectives. It is considered a multifaceted and multidisciplinary concept employed in various disciplines (Saad et al., 2021), and it has experienced a renaissance due to the impact of the COVID-19 pandemic on the global economy (Radic et al., 2022). Etymologically, resilience originates from the Latin term *resilire*, which denotes a capacity to rebound or bounce back, and it refers to the elastic deformation of a material that restores its original configuration after experiencing external force (Radic et al., 2022).

As referred by the literature, the term resilience became popularized after Holling's publication in 1973 in a study on ecological environments (Demiroz &

Haase, 2019; Saad et al., 2021). Within the context of ecological studies, the term resilience denotes the capacity of an ecosystem to recuperate its previous condition after undergoing any form of damage. As defined by Holling (1973, p. 17), “resilience determines the persistence of relationships within a system and is a measure of the ability of these systems to absorb changes of state variables, driving variables, and parameters, and persist”.

According to Alexander (2013), although there is no doubt that the scientific concept of the term resilience was popularized from Holing’s publication, he was not the first in that field to use the term as it had been in use some years earlier. Furthermore, in a study on the word’s etymology, Alexander (2013) presented a brief historical example of different uses of the word. It showed that the concept of resilience has a long history of multiple, interconnected meanings in art, literature, law, science, and engineering. Indeed, the term resilience is utilized in several knowledge domains, and its underlying concept is characterized by its multidisciplinary and multifaceted nature (Kativhu et al., 2018; Tolner et al., 2021).

Within engineering and physical science, resilience refers the return to the original state after specific disruptions. However, in other disciplines, such as psychology, resilience focuses on organizations’ adaption amid continuing and unfolding disruptions (Saad et al., 2021). Across various disciplines, the notion of resilience may change in context; nevertheless, it is fundamentally interconnected with the capacity and aptitude of a component to revert to a stable condition post-disruption.

In the organizational resilience context, it is considered as the ability of a business to adapt to disruptions that threaten existence and survive (Kativhu et al., 2018; Soufi et al., 2021) and also the ability to grow during a time of adversity (R. Chen et al., 2021). The concept of organizational resilience has been increasingly studied in recent years (Hillmann & Guenther, 2021; Saad et al., 2021) because it has been considered a crucial factor for organizational success and sustainability.

Resilience is also considered an organization’s ability to anticipate, prepare for, and adjust to varying circumstances, including disruptions to its operations, processes, and resources. The process includes the proficiency to recognize, evaluate, and govern potential hazards and the aptitude to recuperate fast and

efficiently. It is referred to by the literature as an advantageous attribute for an organization and its members to effectively manage diverse forms of adversity (Linnenluecke, 2017).

Organizational resilience comprises the capacity to assimilate and adjust to disturbances (Hillmann & Guenther, 2021) through the establishment of organizational frameworks, procedures, and mechanisms that are flexible and able to promptly and efficiently react to evolving circumstances and conditions (DesJardine et al., 2019). In addition, it also involves developing the capacity to learn from disruptions and develop new strategies (Pal et al., 2014) and approaches to better manage them in the future.

Although the concept of resilience is considered promising within the business and management knowledge area (Hillmann & Guenther, 2021), some researchers have expressed their reservations towards the concept, emphasizing its ambiguity and lack of clarity in terms of agreement about the nature and fundamentals of organizational resilience (Sevilla et al., 2023).

This lack of consensus about what resilience means and which elements it construct contains (Duchek, 2020) hinders the development of empirical research on organizational resilience, keeping this research theme sparse in terms of valid measurement scale (Hillmann & Guenther, 2021).

In a systematic review of influential publications on resilience in business and management research, Linnenluecke (2017) identified five research perspectives that view resilience as organizational responses to external threats, organizational reliability, employee strengths, the adaptability of business models, or design principles that reduce supply chain vulnerabilities and disruptions. According to this author, resilience has been conceptualized quite differently across studies, and the conceptual similarities and differences among these lines of research have not yet to be explored. Additionally, each research perspective has considered its conceptualizations and measures of resilience (Duchek, 2020), which is one of the reasons that contribute to researchers criticizing the concept for being fuzzy. It may reduce the significance of the concept for practice and research (Hillmann & Guenther, 2021).

The development of conceptualizations and challenges related to organizational resilience were studied by (Hillmann & Guenther, 2021), and some of these challenges are highlighted as follows:

Organizational resilience is defined in many ways, for example as a capability, capacity, characteristic, outcome, process, behaviour, strategy or approach, type of performance. Resilience is studied in relation to several events.

Another confusion about the concept evolves around whether resilience is a single or multi-level concept. The literature has constructed resilience at different levels or emphasized that organizational resilience is achieved at collective levels.

Regarding to capability-based understandings, the question arises whether there are common pathways to resilience, whether resilience is equifinal to the organization or if resilience exhibits both aspects.

It is discussed whether resilience is a strategic or an operational-level aspect. (Hillmann & Guenther, 2021, pp. 8-9)

All these challenges need to be explored to improve quantitative research in the business and management knowledge area. The importance in this kind of discussion may help to understand and better define organizational resilience to improve research approaches and constructs to develop knowledge related to factors that may contribute to knowing what an organization can or must do to maximize the probability of keep operating in the near future (Sevilla et al., 2023). In this sense and to determine the relevance of the resilience concept for organizations and businesses, some authors have been proposing some frameworks and empirical approaches which have been improving the discussions related to the main challenges, such as those pointed out by (Hillmann & Guenther, 2021).

Regarding the challenges related to definitions of issues on organizational resilience, Duchek (2020) proposed a conceptual framework based on an overview of the different resilience stages and capabilities, their relationships, and interactions. In this study, Duchek (2020) discussed three successive stages of resilience: anticipation, coping, and adaptation which are composed of different underlying individual components, such as prior knowledge base resource availability, to form the meta-capability named 'organizational resilience'. The author concluded that organizations must possess proactive capabilities, reactive capabilities, and cognitive and behavioural components to withstand unexpected events. In line with this, according to Madani and Parast (2023), the ontology of resilience should be modified to include different components of resilience, such as capacities, activities, and measures. Additionally, the authors highlighted the

role of innovation in resilience management by providing learning capabilities to improve firm resilience.

Another challenge Hillmann and Guenther (2021) identified refers to resilience is studied in relation to several events, such as financial crises, pandemic, terrorism, extreme weather events, data loss, and fire. According to these authors, a clear resilience definition should include common aspects of resilience and context-specific aspects to better understand the kind of resilience the researcher is investigating.

Regarding this aspect, after the pandemic crisis, the number of resilience studies has been increasing to explore the impact of the COVID pandemic on firms. For example, Shafi et al. (2020) studied the impact of the pandemic crisis on 184 SMEs operating in Pakistan. Using an online questionnaire, the authors found that most of the participating firms had been severely affected and were facing several issues such as financial, supply chain disruption, decrease in demand, and reduction in sales and profit, among others. The results suggested that over 83% of SMEs were neither prepared nor had any plan to handle such a situation. In addition, more than two-thirds of SMEs reported that they could not survive if the lockdown lasted more than two months. Based on their findings, Shafi et al. (2020) proposed policy measures to help SMEs ease their sufferings. These have been divided into four categories: protection of employees and information accuracy, boost economy, income and employment support for SMEs, and planning and resilience capability.

In relation to the discussion if resilience is a single or multilevel concept, Raetze et al. (2021) studied resilience and how it functions at three different levels of analysis: individual, team, and organizational levels. The authors highlighted that the individual level of analysis is the most popular in organizational resilience research, with more than two-thirds of the included articles considering individuals operating in a broad range of occupations with emphasis on occupational groups that are frequently confronted with acute forms of stress and traumatic events, especially military members, and social workers. However, according to Raetze et al. (2021), as resilience is also relevant in employment contexts with less acute forms of stress, work has increasingly focused on individuals operating in “normal” business organizations, such as employees,

entrepreneurs, and leaders. As result, Raetze et al. (2021) emphasized the need for greater conceptual clarity and more sophisticated empirical designs in future research on resilience in organizations and the need of future research to adopt a multilevel approach when studying resilience at work to develop a better and more harmonized understanding of this complex construct.

Regarding the grounded theory, most studies are based on the resource-based view or the dynamic capability theory, such as Lee and Chen (2022) that investigated the relationship between an organization's financial resilience and its financial, human, and political resources using the framework of the resource-based view theory. In the dynamic capability theory, some studies investigated the impact of financial slack in extreme contexts to ensure resilience (Wieczorek-Kosmala, 2022).

In relation to the discussion of whether resilience is a strategic or an operational-level aspect, according to Hillmann and Guenther (2021), some authors argue that resilience is only achieved through the alignment of both levels. Including the need to develop a mature digital strategy to improve their resilience (Forliano et al., 2023).

Additionally, concerning the SME context, according to Gianiodis et al. (2022), there is a need to develop a theoretically grounded concept of resilience for small businesses because such businesses are resource-constrained and are managed and operated by the owner-manager.

In summary, based on the concepts highlighted in the literature, organizational resilience is a complex concept that necessitates an all-encompassing comprehension of the surroundings and the ability to predict, equip for, and conform to dynamic circumstances. In addition, it is worth emphasizing that it requires knowledge and ability to manage resources, personnel, culture, leadership, and risk to remain resilient.

2.1.2 *Financial resilience*

As mentioned in the previous section, financial resilience is one of the aspects of organizational resilience studied in the academic literature from different perspectives, such as related to government responses to financial shocks (Barbera et al., 2017; Lee & Chen, 2022); banking sector (Danisman et al., 2021); financial inclusion (Hamid et al., 2023); supply chain (Gupta et al., 2023), SME (Iborra et al., 2020).

In the public financial management literature, financial resilience is defined as the ability of government organizations to resist and withstand external shocks in the short and long term (Barbera et al., 2017; Lee & Chen, 2022). In the banking context, financial resilience refers to the ability of a financial institution to control its relevant risks (Danisman et al., 2021). Within the context of financial inclusion studies, financial resilience is considered as the ability of individuals to rely on their resources during adverse shock, including some practices, such as keeping control of money, taking care of expenditures, having a financial cushion, handling financial shortfall, having financial planning (Hamid et al., 2023).

In the business context, according to Sreenivasan and Suresh (2023), organizational resilience is viewed as financial resilience when an organization experiences shocks and their financial stability helps them to withstand and recover from crises. Academia has considered diverse meanings of financial resilience, such as corporate management technique (Sreenivasan & Suresh, 2023) and management strategy in business to be adaptive in their operating environment (Nkundabanyanga et al., 2020).

According to the literature, financial resilience is the capacity to anticipate, plan for, respond to, and adapt to gradual change and abrupt unexpected shocks to survive and thrive by adopting policies to decrease budget deficits (Sreenivasan & Suresh, 2023). It is also considered the ability to acquire financial resources in a timely manner in order to prevent or take advantage of uncertain events and take investment opportunities (Sahebi et al., 2022). According to Wolf and Karszes (2023), financial resilience is the capacity over time of a business to

avoid financial distress in the face of revenue or cost volatility and/or recover from any distress.

Additionally, financial resilience in the context of enterprise value management refers to the creation of a system of principles and methods, the elaboration and implementation of a complex of managerial decisions aimed at preventing and overcoming the reduction of enterprise value, as well as minimizing negative consequences on the enterprise (Beşliu et al., 2021). According to Sahebi et al. (2022), this concept focuses on how a firm efficiently uses the remaining financial resources to improve competitive advantages or invest in maintenance and reconstruction to accelerate recovery in adversity times.

Since the 2008 financial crisis, financial resiliency has gradually become a crucial tool employed by supply chains worldwide (Sahebi et al., 2022). As highlighted in the literature, seeking financial resilience may offer risk management benefits (Nkundabanyanga et al., 2020), maintain efficient financial strategies and stable business operations (Sundarakani & Onyia, 2021), mitigate the negative impact of environmental uncertainty and financial limitations on business success and survival (Sahebi et al., 2022).

According to the literature, some features are crucial for firms to achieve financial resilience, such as slack resources and the availability of financial resources (Wieczorek-Kosmala, 2022), safety stocks (Xu et al., 2020), internationalization strategy (Martins et al., 2022), online sales (Forson et al., 2022), environmental, social, and governance practices (C. D. Chen et al., 2022), innovation (Roper & Turner, 2020), and managerial ability (H. T. Nguyen et al. 2023; Kumar & Zbib, 2022).

Regarding the slack of resources, including excess resources and stock, there is a discussion in the literature about the cost of maintaining them. Nevertheless, it is imperative to possess slack resources to assimilate the effects of the disturbance and potentially foster the development of absorptive resilience, which denotes the ability to veer away from predetermined procedures, merge resources, and instigate internal modifications to accommodate diverse circumstances (Conz et al., 2023). In addition, as emphasized by these authors, how firms respond to and display resilience in coping with a crisis's uncertainty

varies according to the entrepreneurial attitude of the entrepreneur and the typology of slack resource leveraged (financial, human, and technological).

As explained by Conz et al. (2023), the financial slack improves firm performance and helps avoid the high level of debts and to face and recover in unexpected situations. Human resources slack refers to the excess of employees, including redundancy of employees with relatively high expertise. Technological slack refers to the pool of technological resources in an organization that exceeds the minimum necessary to produce a given output level.

Financial slack is the most common type of organizational slack considered in the seminal and recent research, which refers to the level of financial assets available to an organization, such as cash on hand, that can be deployed easily (Tognazzo et al., 2016). Additionally, according to Wieczorek-Kosmala (2022), cash-driven resilience capabilities are demonstrated by companies that hold cash resources and are able to source the buffer of cash resources over time.

Discussions on the importance of financial slack within SMEs are relevant due to several factors. One of them refers to resource scarcity, may have more difficulties in anticipating, and generally have smaller administrative systems when it comes to planning, and therefore may need to seek other sources to resist and cope with disruption event (Iborra et al., 2020).

In relation to the hole of stocks to financial resilience, researchers have been studying the impact of the pandemic on supply. For example, Xu et al. (2020) investigated the impacts of the pandemic on global supply chains and concluded that the pandemic had caused unprecedented disruptions throughout all their stages with major turbulences in manufacturing, processing, transport, and logistics, as well as significant shifts in demand. According to Xu et al. (2020), enhancing supply chain resilience is the main key driver to reducing vulnerability in disruptive times, and they suggested some actions to mitigate the risks, such as relocations; developing contingency plans; collaborating with suppliers, customers, and other stakeholders; invest in digital technologies and data analytics to improve supply chain visibility and responsiveness; diversify the supplier base and reducing dependence.

Another firm characteristic that contributes to financial resilience is the internationalization strategy. The strategy of early internationalization helps to increase competitiveness, facilitating access to new product ideas, innovation, and technology. It is also fundamental to ensuring the survival and growth of enterprises (Martins et al., 2022).

Adopt sales online is considered another strategy for achieving financial resilience. According to Forson et al. (2022), may positively impact the financial resilience of an enterprise, improving sales and cash flow. Other benefits include providing products and services conveniently, pricing, and the ability to target diverse demographics.

Concerning Environment, Social, and Governance (ESG) issues, the current COVID-19 crisis has emphasized the relationship between a company's ESG strategy and its ability to achieve long-term economic prosperity (C. D. Chen et al., 2022). According to C. D. Chen et al. (2022), ESG performance can improve future resilience and create crisis-resilient value during the pandemic.

The literature has pointed out that the innovation is considered another key driver to financial resilience. In the study developed by Roper and Turner (2020), the evidence suggested that where firms can sustain R&D and innovation investments, they showed better survival chances, stronger growth, and higher profitability.

Managerial ability is another firm characteristic discussed in the literature related to financial resilience. The availability of resources alone is not enough. Managers must have managerial skills to manage available resources as efficiently as possible. Managerial ability refers to the skills, knowledge, and expertise a CEO or manager possesses to effectively manage and lead a company (Kumar & Zbib, 2022). According to empirical results, firms with better CEO managerial ability were more resilient and had higher profitability than their counterparts during the pandemic.

In line with this result, H. T. Nguyen et al. (2023) found that firms led by higher managerial ability exhibit lower stock return volatility, higher operating performance, and lower levels of default risk amid the pandemic. These authors also found that the effect of managerial competency on corporate resiliency was

more pronounced among firms with high exposure to COVID-19. In addition, according to H. T. Nguyen et al. (2023), firms led by high managerial competency management were associated with higher stock liquidity. They were less likely to exhibit employment, healthcare, safety, and consumer protection-related violations amid the pandemic.

In summary, according to the academic literature, for SME achieve financial resilience it is necessary resources available and managerial ability to manage all resources efficiently and in an adaptative manner to face any disturbance and remain successful in challenging circumstances.

2.1.3 The underlying theory

The theoretical bases most common that underlie studies on financial resilience is the Resource-Based View theory (RBV). According to Hillmann (2021), resilience studies provide a different explanation of why companies survive and remain successful, which contributes to theoretical debates on the resource-based view and dynamic capabilities.

Researchers have been studying the relationship between an organization's financial resilience and financial, human, and political resources using the resource-based view theory (Lee & Chen, 2022). The relevance of studying financial resilience under this theory may be justified because the availability of resources is a key factor in ensuring resilience, argue Leuridan and Demil (2022). Additionally, the resource-based view can be considered a starting point for examining the drivers of business success in periods of recession (Tognazzo et al., 2016).

Literature defines the RBV as a business management theory that examines markets with firm resource heterogeneity and imperfect resource mobility to determine the sources of competitive and sustained competitive advantages (J. Barney, 1991). This theory examines the link between a firm's characteristics and competitive advantages (Cruz & Haugan, 2019). In general, the RBV literature studies suggest that multiple resources, such as a practical compound of managerial skills and redundant resources can drive successful outcomes (Lee

& Chen, 2022). In this sense, according to Sheffi and Rice (2005), a mechanism for achieving firm resilience is building redundancy of resources, such as unused capacity and multiple sourcing.

This theoretical perspective justifies how an organization’s competitive advantage can be achieved by possessing various assets and resources (financial, physical, human, technological, organizational and reputational for resilience development (Pal et al., 2014). In addition, slack resources are important in generating opportunities for profit under challenging environmental conditions (Tognazzo et al., 2016). Regarding this, resource slack may contribute to managerial decisions for a stable system, leading to more resilient organizations during disruptions, which supports the importance of building resources to prepare for uncertainties (Lee & Chen, 2022). Table 4 was elaborated based on R. Chen et al. (2021), and it summarizes the main views and perspectives related to the organizational resilience theory.

Table 4 - OR definitions based on theoretical views and perspectives.

Views	Perspectives	Concept	Authors
Dynamic View	Capability Perspective	Organizational resilience is the ability of an organization to anticipate, respond effectively, learn from, and adjust its structure to prevent disruptions, to survive, adapt, recover, and even thrive in the face of unexpected and catastrophic events and turbulent environments.	Duchek et al. (2020) Ma et al. (2018) Koronis and Ponis (2018) Annarelli and Nonino (2016) Kim et al. (2016)
	Process Perspective	Organizational resilience is a dynamic process of responding to changes in the external environment, deploying resources, developing cognitive and behavioral competencies, and recovering from traumatic events, encompassing typological and quantitative dimensions.	Ishak and Williams (2018) McCarty et al. (2017) Lengnick-Hall and Beck (2009) Allen and Toder (2004)
Static View	Functional Perspective	Organizational resilience is understood as a combination of robustness, redundancy, adequacy, and rapidity in functioning, as well as an organization’s awareness of its situation, management of critical weaknesses, and ability to adapt to complex and dynamic environments.	Wicker et al. (2013) McManus et al. (2008)
	Results Perspective	Organizational resilience results from both relational and financial reserves, as well as structures that are a source of resilience for collective perceived power, enabling organizations to maintain their relational reserves and survive and recover from unexpected events and chaotic changes.	Sincorá et al. (2008) Gittell et al. (2006) Weick (1996)

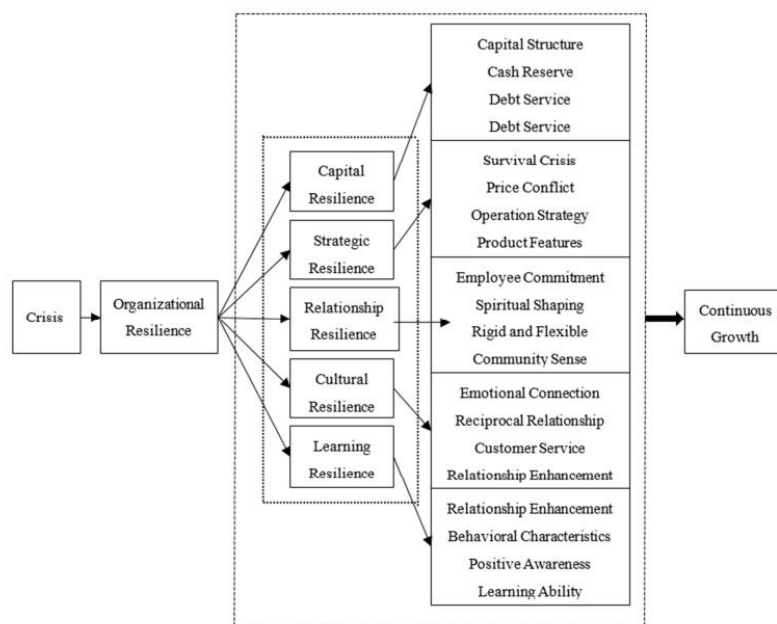
Source: Summary based on (R. Chen et al., 2021, p. 4).

In the context of the organizational resilience literature, some existing studies interpret resilience from different theoretical views and perspectives, as highlighted by R. Chen et al. (2021), the capability perspective, process

perspective, functional perspective, or outcome perspective. Each perspective represents what each researcher considers a component of organizational resilience.

This systematization, as highlighted by R. Chen et al. (2021), on theories that underlie research on organizational resilience, served as the basis for his exploratory case study, whose proposed measurement scales to a better understanding of what constitutes organizational resilience. Additionally, the grounded theory was used to explore the main characteristics of organizational resilience and validate its structural dimensions based on exploratory factor analysis and validation factor analysis for reliability and validity on 526 valid data collected. As a result, according to R. Chen et al. (2021), organizational resilience includes five dimensions: capital resilience, strategic resilience, cultural resilience, relationship resilience, and learning resilience, as illustrated in Figure 6.

Figure 6 - The organizational resilience process



Source: R. Chen et al. (2021, p. 20)

According to R. Chen et al. (2021), this Figure represents the process of organizational resilience, showing the steps that organizations take to become resilient in the face of a crisis, beginning with the organization operating in a dynamic environment, followed by the organization responding to the crisis by

reconfiguring organizational resources, reshaping organizational relationships, and optimizing organizational processes, and then reaching recovery and achieving growth, as well as the five dimensions of organizational resilience (capital resilience, strategic resilience, cultural resilience, relationship resilience, and learning resilience) and the process of organizational response to crises (reconfiguring organizational resources, optimizing organizational processes, and reshaping organizational relationships).

Considering these aspects, the studies on financial resilience under the perspective of the RBV may contribute to understanding how firms can manage and leverage their resources, including both tangible and intangible assets, to increase their chances of surviving and thriving in the face of adversity. Moreover, the theoretical perspective highlights the necessity for firms to demonstrate agility, proactivity, and adaptability in reaction to changing circumstances to maintain their competitive advantage and resiliency.

2.1.4 Financial resilience measurement

As referred to previously, financial resilience is the ability of an organization to anticipate, identify and manage financial shocks (Mouzas & Bauer, 2022; Barbera et al., 2017). It involves the concepts of redundant resources and flexibility, which involve resources in reserve to cope with adversities (Mouzas & Bauer, 2022), and innovate in response to changing conditions (Linnenluecke, 2017).

The reasons enterprises reserve financial resiliency are to minimize the negative impacts of environmental uncertainty and financing constraints on enterprise survival and success, but and take advantage of lucrative investment opportunities (Sahebi et al., 2022).

One of the main challenges regarding research on financial resilience is the lack of consensus in terms of concepts and variables. According to Soufi et al. (2021), there is no precise approach in the literature that can show the financial resilience of firms quantitatively in a certain period. Each author uses a different concept when selecting the proxy variable for financial resilience. Soufi et al. (2021) argue that to measure financial resilience research should distinguish between good

and bad firms based on their financial performance and define the impact of shocks on firms.

Table 5 shows some examples of variables used as a proxy for financial resilience. The analysis of the literature on financial resilience has shown the use of different variables, such as those related to financial performance, cash availability, sales growth, price recovery, and perceived speed recovery.

Table 5 - Examples of proxies for financial resilience

Proxy for Financial Resilience (Dependent variable)	Description	Author
Financial performance	Measure of financial performance based on five financial indicators: stock prices, EBIT, the ratio of total liabilities to the total value of the company's assets, working capital on total assets, and earnings per share.	Soufi et al. (2021)
Cash ratio	Cash ratio, computed as cash and cash equivalents, relative to assets in total, as end-year.	Wieczorek-Kosmala (2022)
Sales and cash flow	Online sales during Covid-19 and cash flow.	Forson et al.(2022)
Recovery	Duration of market price recovery (in weeks) to its pre-crisis level.	Marsat et al. (2022)
Perceived speed of recovery	The predicted time for the firm's revenue to return to pre-Covid-19.	Nguyen et al. (2022)
Trade resilience	Year-on-year monthly % change in total trade volume.	Mena et al. (2022)
Stock returns	Firms' stock price data.	Song et al. (2021)
Firm performance	Measured with perceptions of performance relative to objectives, for three outcomes: sales revenue, sales revenue growth, and customer retention.	Anwar et al. (2021)
Firm survival Firm recovery	The classification of surviving versus failed firms (coded with 1 and 0, respectively) based on the classification of the active versus bankruptcy/liquidation status marker of firms. Recovery = $\ln(\text{sales in 2013}) - \ln(\text{sales in 2008})$	Iborra et al. (2020)
Post-crisis growth Post-crisis performance	Firms' growth as the percentage growth in sales from 2008 to 2010. Performance as the average of the return on assets (ROA) from 2008 to 2010.	Tognazzo et al. (2016)

Considering that empirical quantitative evidence on resilience is still scarce, especially in relation to financial performance (V. Nguyen et al., 2022), in the empirical section of this study, the return on assets (ROA) will be applied as a proxy for financial resilience. The empirical model was inspired by (Iborra et al., 2020; Wieczorek-Kosmala, 2022), with a combination of ideas based on (El Khoury et al., 2022; Soda et al., 2022; Tudose et al., 2022; Grau & Reig, 2021;

Imhanzenobe, 2020; Tognazzo et al., 2016; Margaretha & Supartika, 2016; Hamerman & Johar, 2013). Details will be explained in the methodology section.

2.2 SME characterization

Small and medium enterprises (SMEs) are widely recognized as the backbone of the economy. According to the European Commission (2022), in 2021, 99.8% of all enterprises in the EU-27 non-financial business sector (NFBS) were SMEs. They employed 83 million people, the equivalent of 64% of total employment in the NFBS and generated 52% of the total value added produced by the non-financial business sector. In Portugal, SMEs account for 99.8% of all registered businesses. These companies employ more than 60% of the workforce and generate almost half of the country's GDP.

Given the importance of SMEs for the Portuguese economy, it is essential to understand their financial resilience to ensure their long-term sustainability. Therefore, it is necessary to know the main SME characterizations. Thus, this section presents an overview of the SMEs in Portugal, including some economic, juridic, and accounting aspects.

2.2.1 *Definition and some legal aspects*

The legal and normative aspects of SMEs are of great importance since they guarantee these companies' proper functioning and protect their rights and interests. The legal framework for SMEs in Portugal is based on the European Union (EU) regulations, which are implemented through Portuguese law, and it is composed of laws, regulations, and other legal instruments, which can be divided into two main categories: national and European Union (EU) laws.

This section provides a brief overview of the main legal and normative documents related to SMEs, highlighting the following regulations, the Commission Recommendation 2003/361/EC of 6 May 2003, and the Commission Recommendation 2006/1893/EC, considering the scope of this study.

The main legal instrument at the European Union level is the Commission Recommendation 2003/361/EC of 6 May 2003. This legal instrument establishes the definition of SMEs. According to the official EC definition, SMEs in the EU have fewer than 250 employees, an annual turnover of less than EUR 50 million and a balance sheet total of less than EUR 43 million, according to article 2 of Recommendation no. 2003/361/EC of the European Commission. The staff headcount and financial ceilings determining enterprise categories:

1. The category of micro, small and medium-sized enterprises (SMEs) is made up of enterprises which employ fewer than 250 persons and which have an annual turnover not exceeding EUR 50 million, and/or an annual balance sheet total not exceeding EUR 43 million.
2. Within the SME category, a small enterprise is defined as an enterprise which employs fewer than 50 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 10 million.
3. Within the SME category, a microenterprise is defined as an enterprise which employs fewer than 10 persons and whose annual turnover and/or annual balance sheet total does not exceed EUR 2 million. (2003/361/EC, 2003, Article 2)

Thus, in accordance with this definition, there are three main types of SMEs in Portugal: micro-enterprises, small enterprises, and medium-sized enterprises, as summarized in Table 6, the definitions according to the Commission Recommendation 2003/361/EC, of 6 May 2003.

Table 6 - SME category by dimensions

SME category	Staff headcount	Annual turnover	Balance sheet total
Medium-sized	< 250	≤ € 50M	≤ € 43M
Small	< 50	≤ € 10M	≤ € 10M
Microenterprise	< 10	≤ € 2M	≤ € 2M

Source: Elaborated according to Commission Recommendation 2003/361/EC, of 6 May 2003.

Regarding the classification of industrial activities, the Commission Recommendation 2006/1893/EC of 6 May 2003, approved the classification as NACE Rev. 2, which was transposed into the Portuguese legal system by Decree Law No. 381/2007 to harmonize with the European Union and United Nations classifications of activities.

Although it will not be discussed in detail, considering that it is not the purpose of this study, it is important to highlight that at the national level, the Portuguese legal system is based on the Constitution of Portugal, which sets out the fundamental principles of the country's legal system and provides the basis for

all other laws. In the chapter on the Organization of the Economy, the Constitution establishes Article 86 to SMEs:

1. The state shall encourage entrepreneurial activity, particularly that of small and medium-sized enterprises, and shall inspect fulfilment of the respective legal obligations, especially by enterprises that engage in activities that are of general interest to the economy.
2. The state may only intervene in the management of private enterprises on a transitional basis, in cases that are expressly provided for by law and, as a general rule, subject to prior judicial decision.
3. The law may define basic sectors in which private enterprises and other entities of the same nature are forbidden to do business. (Constitution of the Portuguese Republic, Part II, Article 86)

Another level of the national legal hierarchy is the Portuguese Commercial Companies Code (Decree-Law No. 262/86, of 1986-09-22, last updated by the Law No. 9/2022, of 2022-01-11), which contains specific provisions related to the operation of SMEs. This code outlines the legal requirements for setting up a business, registering a company, and running a business. It also outlines the responsibilities of a company's directors, shareholders, and other stakeholders.

In Europe and Portugal, SMEs are subject to a variety of other legal and normative instruments, such as those related to the protection of intellectual property, the regulation of competition, and the protection of consumer rights. However, this study highlighted only the documents related to the SME definition and the classification of industries, as established by the European Union, considering financial data collection for the empirical part of this study considered the international classification.

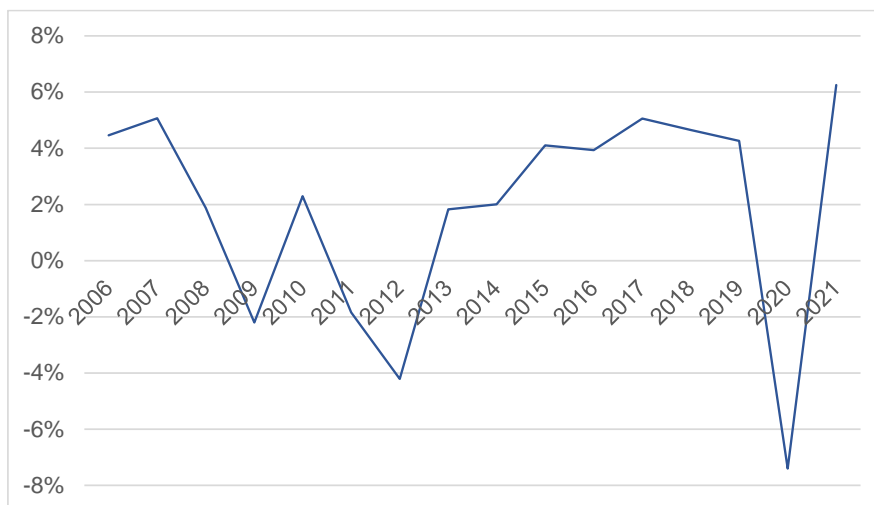
In addition to these legal instruments highlighted above, related to the definition of SME and the respective classification of activities, it is important to mention the main legal and regulatory instruments related to accounting issues that will be the subject of study in the next item.

2.2.2 Impact of crisis on SMEs

SMEs take a significant portion of the GDP and livelihood conditions of millions of people worldwide, including in developing countries (Saad et al., 2021). In 2021, SMEs in Portugal generated over 242,123.0 M € in total revenues, according to the Bank of Portugal, and employed over 3.3 million people. In

addition, the number of SMEs in Portugal has grown steadily, increasing by over 3.2% between 2020 and 2021. According to PORDATA, before the pandemic, the Portuguese economy experienced a period of sustained growth in recent years, between 2014 and 2019. In this period, the country's GDP has grown steadily, as shown in Figure 7. However, the pandemic posed an existential threat to European SMEs' financial resilience with significant consequences for the European economy (Kaya, 2022).

Figure 7 - Portuguese GDP per capita (Annual variation)



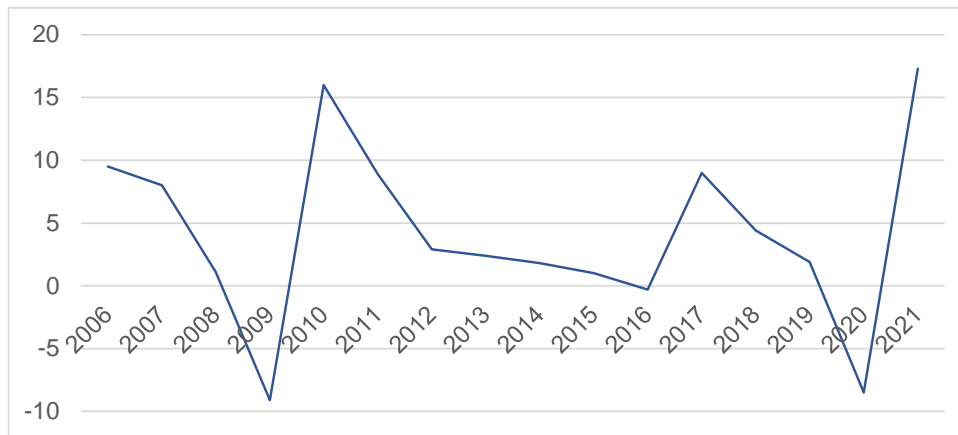
Source: PORDATA

The impact of the pandemic was particularly stronger for SMEs than that of the 2008 global financial crisis (Arcuri & Pisani, 2023). The economic crisis had an especially devastating effect on the SME industry sector mainly due to their limited access to capital, lack of financial resources, and inability to adjust to changing market conditions. Additionally, the rise in costs associated with the economic crisis, including higher taxes and increased energy costs, further reduced the profitability of SMEs.

Recently, the crisis caused by the pandemic had a much more significant effect than the previous crisis. However, due to the specific circumstances of the pandemic, there is no way to compare both crises. Many organizations initiated sudden and unplanned changes to cope with the COVID-19 outbreak without knowing how long the pandemic would last (Manisaligil et al., 2023). Enterprises faced various problems, such as decreased demand, supply chain disruptions,

cancelation of export orders, raw material shortage, and transportation disruptions(Shafi et al., 2020). Figure 8 shows sales annual variation in the Portuguese manufacturing industry.

Figure 8 - Portuguese manufacturing industry sales (Annual variation)



Source: PORDATA

The crisis has caused a sharp decline in economic activity in Europe, particularly in services. According to the European Commission (2020), the crisis has caused a decrease in business confidence and investment, resulting in a decrease in new businesses and employment. In Portugal, the impact of the crisis has been particularly severe. According to the Bank of Portugal (2020), the pandemic severely impacted SMEs with a decline in their activity and profitability. The decline in business confidence and the reduction in investment have led to a decrease in new businesses and employment. Furthermore, the pandemic has caused a decrease in access to finance for SMEs, as banks have become more cautious in granting loans.

Economic recessions have created challenges for SMEs and contributed to disruptions requiring them to be resilient during economic crises because they face major threats to their financial performance and their survival (Pal et al., 2014). Thus, coping with extreme events like a global pandemic is especially challenging for those firms which do not have relevant prior experience in facing such unexpected circumstances (Conz et al., 2023).

Additionally, another issue to highlight is that in normal credit conditions, banks tend to consider SMEs as high-risk borrowers because they are subject to

liquidity shortfalls and bankruptcies reflecting conditions such as asymmetric information and agency problems, liquidity and profitability conditions, and their ownership structure (Arcuri & Pisani, 2023).

Considering this, the importance of developing studies on SME financial resilience is not based only on economic crises and the pandemic. Other kinds of unexpected events and abrupt changes often surprise organizations, such as referred by (Linnenluecke, 2017; Manisaligil et al., 2023), natural disasters disrupt supply chains, terrorist attacks shock the public and paralyze financial markets, and industrial accidents have major ecological and economic consequences that ripple through supply chains, from raw materials to transportation. In this context, it is important to mention the relevance of financial support from the government to SMEs in disruptive situations.

2.2.3 SME government financial support

In recent years, natural disasters, epidemics, and wars have caused much disruption to development and economic activities in many countries (Sundarakani & Onyia, 2021). Financial support from the government is important for SMEs during a crisis because it alleviates its negative impacts and helps them recover (Nguyen et al., 2022).

Some empirical studies have analyzed the relationship between government support and SME financial resilience. For example, this is the case of Sundarakani and Onyia (2021), that studied the impact of the UAE government financial support and found it has helped keep disruptions to the distribution of goods and services to a minimum level, leading to the development of solid business resilience among the industry operators.

On the contrary, the study developed by Nguyen et al. (2022) found a positive relationship between government financial support and financial resilience. However, it was not statistically significant, probably because the amount of funding was insufficient to address the substantial need of businesses given the severe consequences of the long lockdown period (Nguyen et al., 2022).

2.3 The role of accounting in the SME financial resilience

Accounting has an essential role in the SME financial resilience. The worldwide importance of sustaining small and medium-sized enterprises is growing rapidly, and countries are actively working to devise strategies to protect them due to recent global crises (Diegtiar et al., 2021). Financial and managerial accounting are important tools for SMEs to develop and maintain financial resilience by providing them with financial information that may help them understand their financial position, and performance, identify potential risks and opportunities, and develop strategies for long-term financial stability.

According to Hoti and Krasniqi (2022), economic efficiency is also maintained with the consideration of IFRS Standards because it is essential for maintaining trust and transparency in the organizations, as they provide investors with confidence in the integrity of the financial statements. This contributes to the success of SMEs insofar as it ensures that funding can flow from investors to entrepreneurs and small business owners (Kaili et al., 2019). In addition, it facilitates access to bank financing and government subsidies (Zulfikar et al., 2022). However, SMEs face challenges in adopting the IFRS framework, mainly due to the lack of awareness and the low level of knowledge among the SMEs (Hoti & Krasniqi, 2022).

Furthermore, Diegtiar et al. (2021, p. 2) highlight the importance of establishing a management accounting system for SMEs in the context of crisis events and high financial risks, 'to ensure the effectiveness of the management functions of planning, organizing, controlling operational processes, and providing a strategic vector for the development of economic entities in case of instability'.

However, SMEs often struggle to implement management accounting due to a lack of understanding of the possibilities it offers, limited financial resources, and incorrect implementation. Diegtiar et al. (2021) explain that without understanding the economic benefits of an established management accounting system and the financial accounting processes and management decision-making elements, the effectiveness of management accounting can be minimized.

Financial and managerial accounting are essential tools for SMEs to develop and maintain financial resilience. However, these firms often face challenges in implementing these tools due to a lack of awareness and resources. Therefore, it is important for SMEs to understand the economic benefits of the accounting for decision-making, access to credit, investments, profitability, and resilience in challenging periods.

2.4 SME characteristics and financial resilience

SMEs' resilience consists of attitudes adopted toward crisis, characteristics of the business and the entrepreneurs, relationships with institutions, human and social capital, and strategic management (Portuguez Castro & Gómez Zermeño, 2020). According to the academic discussion in the previous sections, several internal and external factors that may impact the financial resilience of SMEs, and more debates need to be developed to improve theoretical bases and empirical findings regarding this research theme.

This section discusses some empirical findings related to firms' characteristics related to SMEs' financial resilience, such as the financial resources available, operating leverage, internationalization, inventory, and firm size. Most of these firm characteristics discussed in this section were tested in the empirical section of this dissertation.

2.4.1 *Financial resources available*

Academic studies have explored the relationship between the financial resilience of SMEs and the availability of financial resources, financial slack, such as cash or liquid assets, in the context of both the pandemic and the economic crisis. According to Mouzas and Bauer (2022), financial slack is the financial resources available that firms need to adapt, implement changes, and invest in new opportunities. This resource available is considered a key driver in determining firm resilience capabilities (Wieczorek-Kosmala, 2022). In addition, according to

Carnes et al. (2023), cash is a critical resource that helps create value in supply chain systems by increasing resiliency and facilitating adaptation and reliable fulfillment of contractual obligations.

In their study, Carnes et al. (2023) explored how cash impact a firm's relationships with its trade partners and how cash-rich firms can appropriate most of the value created by those cash holdings. In this study, the authors proposed that cash enables firms to create value in the supply chain by increasing resiliency and facilitating adaptation and reliable fulfillment of contractual obligations. According to empirical results, Carnes et al. (2023) found that cash-rich firms gain the bargaining power to an appropriate value by obtaining more favorable terms from their trading partners, resulting in higher margins, shorter cash conversion cycles, and, ultimately, higher financial performance.

The study developed by Wieczorek-Kosmala (2022) explored the cash-driven resilience capabilities of industry in response to the COVID-19 shock. It highlighted the importance of financial slack and cash holdings in determining the resilience capabilities of businesses. According to Wieczorek-Kosmala (2022), the empirical results showed that non-resilient companies are more prevalent than resilient ones. The study also indicated that companies with greater cash-driven resilience capabilities were distinguished by higher profitability and less financially constrained.

The value of slack resources for smaller firms was studied by Tognazzo et al. (2016) using a sample of Italian SMEs, considering data from before and after the 2008 world financial crisis to determine whether slack resources drive growth and profitability in organizations with limited resources that operate in mature industries in periods of recession. According to their results, Tognazzo et al. (2016) found that slack resources are important for small firms in mature industries during periods of recession, as they drive profitability. However, potential financial slack is not related to higher growth. The authors also found that resourcefulness, such as cash flow and investment finance, relational networks, material assets, and dynamic competitiveness through strategic and operational flexibility, are key enablers of resilience and financial performance.

2.4.2 *Operating leverage*

According to Bistrova et al. (2021), operating leverage has been unfairly forgotten in the literature. However, it should always be at the center of corporate management's attention because high fixed costs and the inability to cut them down can be critical for business survival during an economic crisis. This indicates the company's operational risk (Grau & Reig, 2021). Firms with higher operating leverage have the incentives to increase cash holdings in coping with potential business crises in the future, but higher operating leverage implies that firms must take more risks in their operations (Y. Chen et al., 2022).

The effect of operating leverage on firms' cash holdings was studied by Y. Chen et al. (2022) in China. They found that operating leverage can effectively increase corporate cash holdings, especially among firms with higher operating risks and asset specificity. It can enhance the positive effect of cash holdings on firm value. Additionally, they concluded that the positive effect of operating leverage on a firm's cash holdings is only significant among the firms whose sales revenue grows discontinuously.

Using panel data from 9,652 European agri-food SMEs from 2009 to 2016, Grau and Reig (2021) analyzed the effect of the operating leverage on the profitability of SMEs both in isolation and indirectly through its other determinants. According to the authors, the results obtained confirm that operating leverage is a fundamental determinant of the profitability of SMEs, but also determines the effect the main risk variables have on profitability. The results confirm that operating leverage or cost structure, in addition to affecting profitability, also affects the relationship between that profitability and other sources of risk that depend on the country where the company operates. Additionally, indebtedness, size, innovation specificity, and reputation all affect profitability to a greater or lesser extent, depending on the company's operating leverage level.

The analysis of the effect of operating leverage on firms' profitability and financial leverage in Chinese firms revealed that operating leverage increases profitability and reduces optimal financial leverage, according to Z. Chen et al. (2019). In

addition, results suggest that as it generates a negative relation between profitability and financial leverage, it is inconsistent with the trade-off theory.

A financial analysis of Latvian companies from 2015-2019, Bistrova et al. (2021) studied these companies' ability to survive during the crisis. Results revealed a substantial improvement in financial sustainability and capital management efficiency, evident in 2018-2019, according to the authors. However, the margins, used as a proxy of competitive advantage, remained at a low level, and the operating leverage level indicates the relatively high riskiness of Latvian companies, which might be critical in overcoming the crisis triggered by COVID-19. Results also suggested that operating leverage indicates high riskiness, a significant gap between best and worst companies, and a discrepancy in the quality of financial conditions by region and industry.

2.4.3 Internationalization

Internationalization is recognized as an increasingly necessary and valuable strategy, especially for SMEs operating in a limited domestic market (Hsu et al., 2013). The strategy of internationalization helps to increase competitiveness, innovation, and technology, and it is fundamental to ensuring the survival and growth of enterprises (Martins et al., 2022). However, internationalization requires a distinct set of company resources and managerial capabilities (Vuorio et al., 2022) and other challenges, such as lack of information because when firms move into new international markets, information-processing demands increase and more complex (Hsu et al., 2013).

The challenges for building resilience in handicraft SMEs in the post-COVID-19 outbreak in India were studied by Agarwal et al. (2022). According to the authors, the impact of the pandemic on the handicraft industry was severe due to its informal nature and seasonal demand. Additionally, findings revealed the influencing challenges for each dimension, such as competition from machine-made products, insufficient government support and incentives for export, and inefficient managerial concern and response to internationalization as the prominent challenges. As mentioned by Agarwal et al. (2022), this study

illustrates the relationships among the identified resilience challenges to the various stakeholders in this sector. It highlights the relevance of government in allocating resources and imposing measures to ensure resilience.

According to Pühr and Müllner (2022), internationalization increases systematic risk and improves resilience against exogenous shocks. They studied multinational firms and their competitors in the United States. The authors also concluded that multinational firms have more advantages over less internationalized firms in terms of shock resilience. This advantage gradually decreases as less internationalized firms learn about the shock, and investors adapt their valuations to the post-shock reality.

As referred Vuorio et al. (2022), internationalization requires a distinct set of managerial capabilities and company resources. Based on their study on the impact of cognitive capabilities on international entrepreneurship, they examined the connection between cognitive and slack resources and the speed of internationalization during the COVID-19 crisis. Their study used a fuzzy set qualitative comparative analysis of 50 Finnish SMEs to examine the difference in early and late internationalization drivers and their impact on international performance. They concluded that the ability to recognize international entrepreneurial opportunities is not enough. It is necessary for other cognitive factors, such as entrepreneurs' ability to respond to changes actively and persist under uncertainty argue Vuorio et al. (2022). According to their results, the authors concluded that cognitive capabilities are important for recognizing international entrepreneurial opportunities. Beyond that, two distinct configurations are connected to early internationalization, and is connected to late internationalization.

2.4.4 Inventory

The inventory of finished products in the manufacturing process, or raw materials, has been discussed in studies on organizational resilience, mainly within the scope of studies related to supply chain disruptions. The availability and supply of a wide range of raw materials, intermediate goods, and finished products have

been seriously disrupted (Xu et al., 2020), mainly after the COVID-19 pandemic. However, while some authors argue that having resources available, in this case, stocks of products and raw materials, may be positive in times of crisis due to possible interruptions in supply (Mouzas & Bauer, 2022), other authors have found evidence that excess stock of products can have a negative effect (Pal et al., 2014), including on the company's profitability.

According to Linnenluecke (2017), firms' redundant resources, such as inventory, may help firms in the face of global adversities. In opposition, (Cagri Gurbuz et al. (2023, p. 3) argue that 'an inventory system is often subject to various demand/supply uncertainties, where customers might, for example, cancel orders during the period of demand reservation, a far more common practice since the COVID-19 pandemic'. Additionally, Pal et al. (2014) found that excess raw material stocks, shortage of supply, or huge storage of finished goods were considered potential inhibitors of resilience development.

However, the considerable safety stock is significant, and according to Xu et al. (2020), firms must give attention to the existing inventory policy by balancing the predicted demand and current capacity of suppliers, ensuring that all inventory is outside the high-risk areas or logistic hubs. Another strategy Xu et al. (2020) recommend having alternative materials suppliers and cooperating with suppliers in different geographic locations. One of the strategies proposed by Taleizadeh et al. (2021) is the importance of selecting an appropriate ratio for backorders during supply disruption, which can lead to lower costs while reducing inventory obsolescence and overstocking risks.

According to Cagri Gurbuz et al. (2023), SMEs can avoid suffering more harm than larger competitors by adopting strategies consisting of an adequate mix of elements, such as network configuration strategies and building flexibility by increasing the number of geographically spread partners. Cagri Gurbuz et al. (2023) used a combination of case study and simulation model to analyze the impacts of global events on different network structures in the presence of supply chain risks in SMEs. For this purpose, the authors analyzed variables, such as size, and geographical spread strategies like collaboration or multi-sourcing. The results suggested that certain proactive measures like collaboration or multi-sourcing are more valuable than others during catastrophic events, and an

effective strategy involves building flexibility by increasing the number of geographically spread partners while allowing deeper discounts to preserve demand without hurting profits.

In an exploratory research on the Swedish textile-related SMEs, Pal et al. (2014) studied the constraints faced by these firms during economic crises to identify antecedents of their resilience, such as threats to their financial performance. The objective was to examine how SMEs responded to these crises in terms of resourcefulness, dynamic competitiveness, and soft aspects like attentive leadership. The study used survey data from 8 firms and annual reports. According to Pal et al. (2014), excess raw material stocks, shortage of supply or huge storage of finished goods were considered potential inhibitors of resilience development, as they compelled the firms to depreciate their stock values, and consequently affected the profitability, sales-turnover, and leverage ratios. Additionally, it highlights the indirect influence of 'soft' learning and cultural aspects on economic resilience, which are beneficial for small or medium-sized family businesses.

2.4.5 Size

Economic theory suggests that growth barriers are intimately associated with firm size, and these barriers is likely to change as firms grow (Karlsson, 2021). Understanding how firm size affects a SMEs performance is important for maximizing profits (Grau & Reig, 2021).

In studies related to SME resilience, it is common to observe that the size and age of the variables are normally used as control variables. Usually, the proxy used for the variable size is the natural logarithm of total assets or the number of employees.

The moderate role of enterprise size was studied by Forson et al. (2022) to examine the relationship between financial resilience and online sales adoption in Sub-Saharan Africa enterprises. They also examined whether large companies were more resilient than small or medium-sized ones when facing an economic crisis like the Covid-19 pandemic. The authors concluded that enterprise size was

observed to improve financial resilience such that large enterprises were more financially resilient than SMEs. Additionally, enterprise size and ownership type were found to moderate the relationship between online sales and financial resilience, and large companies were more resilient than small and medium-sized when facing an economic crisis like the Covid-19 pandemic.

Factors influencing SME business recovery were examined by V. Nguyen et al. (2022) in the context of the Australian bushfires and the COVID-19 pandemic. The authors concluded that planned resilience, risk management, and connectedness positively impact the recovery speed of micro and small businesses. The authors highlighted that regarding firm characteristics, firm size is significantly and negatively associated with the perceived speed of recovery, which means that as firm size increases, the perceived speed of revenue recovery is slower. The smallness gives businesses greater flexibility, allowing them to adjust more quickly and efficiently to changes in the business environment.

Karlsson (2021) examined the relationship between perceived growth barriers and firm size. The results suggested that perceptions of firm growth barriers differ considerably across firm size, and small firms face constraints on equity financing, whereas larger firms face barriers regarding competition and recruitment.

The SME performance and family influence were studied by Lwango et al. (2017) related to the size and age of firms. The authors found that family influence positively impacts the performance of SMEs, but this relationship is moderated by firm size and age. It also suggests that practitioners should maintain higher levels of active ownership in small businesses while reducing it as firms increase in size/age to avoid risks associated with having only members from one's family lacking talent or expropriating benefits.

PART 3 - METHODOLOGY

This study aimed to investigate characteristics of the manufacturing SMEs in Portugal that may influence their financial resilience. Financial information obtained from secondary data was applied as variables in a regression analysis to understand the relationship between SMEs' financial information and their ability to face economic challenges, such as the financial and the COVID crises. Based on this purpose, the specific objectives of this empirical study are:

- To analyze the performance of the sample SMEs and categorize them as resilient or non-resilient based on their ROA.
- To analyze the relation between the SMEs' characteristics and financial resilience.
- To analyze the relation between the financial and COVID crises and the SMEs' financial resilience.
- To contribute insights that may help SMEs increase their financial resilience.

Thus, the research questions proposed to achieve the objectives are:

- What is the relationship between financial slack, operational leverage, internationalization, company size, and age on SMEs' financial resilience in the manufacturing sector in Portugal?
- What is the relationship between the financial crisis (2008-2011) and the pandemic crisis (2020-2021) on the SMEs' financial resilience in the manufacturing sector in Portugal?

The first research question seeks to understand the relation of factors that may influence SMEs' financial resilience in the manufacturing sector in Portugal, considering financial data from 2006 to 2021. A regression analysis was applied to analyze the relation between the independent variables (financial slack, operational leverage, inventory, internationalization, government financial support, company size, and operating time) and the dependent variable (financial resilience, measured by return on assets, ROA). The second research question aims to understand the impact of two distinct crises on SMEs' financial resilience

in the manufacturing sector in Portugal. Thus, to achieve the objectives and seek to answer the research questions, this section addresses the research hypothesis, description of the research design, the sample selection process, description of selected variables, and data analysis.

3.1 Research hypothesis

Based on the literature on financial resilience, to answer the research questions, the following hypothesis were formulated:

Financial slack

According to the literature (Iborra et al., 2020; Pal et al., 2014; Wieczorek-Kosmala, 2022), financial resilience is positively related to the availability of financial slack, which is defined as the amount of funds available to cover unexpected expenses and investments. Financial slack allows SMEs to be more flexible and resilient in economic fluctuations. In this sense, this study intends to test the following hypothesis:

Hypothesis 1: There is a positive relationship between SMEs' financial resilience and financial slack.

Operating leverage

According to Grau and Reig (2021), operating leverage is a fundamental determinant of the profitability of SMEs. Additionally, firms with higher operating leverage have the incentives to increase cash holdings in coping with potential business crises in the future (Y. Chen et al., 2022). Based on this assumption, this study intends to test hypothesis 2:

Hypothesis 2: There is a positive relationship between SMEs financial resilience and operational leverage.

Internationalization

Internationalization has been positively linked to the financial performance of firms, including their financial resilience. As SMEs become more involved in international markets, they gain access to new markets, customers, and

resources, which can help to increase their financial stability (Martins et al., 2022) and also improves resilience against exogenous shocks (Puhr & Müllner, 2022).

Hypothesis 3: There is a positive relationship between SMEs financial resilience and internationalization.

Firm size

Studies have concluded that firm size is negatively associated with financial resilience (Iborra et al., 2020; V. Nguyen et al., 2022; Tognazzo et al., 2016; Wieczorek-Kosmala, 2022).

Hypothesis 4: There is a negative relationship between SMEs financial resilience and firm size.

Firm age

Studies have concluded that firm age is negatively associated with financial resilience (Iborra et al., 2020; V. Nguyen et al., 2022; Tognazzo et al., 2016; Wieczorek-Kosmala, 2022).

Hypothesis 5: There is a negative relationship between SMEs financial resilience and firm age.

Financial crisis

The financial crisis created challenges for many economies and industries, particularly SMEs because they are vulnerable to failures in continuous shifts and unpredictable events (Iborra et al., 2020; Pal et al., 2014).

Hypothesis 6: There is a negative relationship between SMEs financial resilience and the financial crisis (2008-2011).

Covid-19 pandemic

The Covid-19 pandemic has caused an economic shock that has significantly changed the business environment (Forson et al., 2022). Additionally, the pandemic has exposed how many businesses are unprepared to face significant crises (Beninger & Francis, 2022). During this period, many of these businesses have had to reduce their workforce and scale back their operations to remain financially viable (Mouzas & Bauer, 2022). In this sense, this study intends to test hypothesis 7:

Hypothesis 7: There is a negative relationship between SMEs financial resilience and the pandemic crisis (2020-2021).

3.2 Research design

This study applied a quantitative research design with logistic regression analysis to test the hypothesis and examine the correlation between SME characteristics and financial resilience. The dependent variable used in this study has a binary nature (Resilient/Non-resilient). The Return on Assets (ROA) was considered as a proxy for financial resilience, following (El Khoury et al., 2022; Soda et al., 2022; Tudose et al., 2022; Grau & Reig, 2021; Imhanzenobe, 2020; Tognazzo et al., 2016; Margaretha & Supartika, 2016; Hamerman & Johar, 2013).

The independent variables selected are related, for example, to resource management (financial slack, operational leverage, inventory), market strategy (internationalization), government financial support (subsidy), firm size, and age. Additionally, the periods of the financial crisis (2008-2011) and the pandemic crisis (2020-2021) were considered dummy variables in the regression model.

For this purpose, panel data was used with observations of 1,398 SMEs, referring to the period from 2006 to 2021. According to Abou Elseoud et al. (2020) and Pimentel (2012), the advantage of using panel data for this research design is that it provides more informative data, both cross-sectional information, which captures individual variability, and the time series information, capturing dynamic adjustment. Thus, from this view, it is possible to analyze, for example, the financial resilience of the companies in the sample from the perspective of the 2008 crisis and the crisis caused by the pandemic in 2020.

3.3 Data and sample

This study used financial data extracted from the SABI database from Bureau van Dijk – a Moody's Analytic Company. This database provides access to mainly economic and financial data oriented towards the field of accounting and finance,

and it has been very useful when capturing variables on financial characteristics (Acebo et al., 2022). Thus, considering the purpose of this study, the SABI² database was used to extract secondary financial information of Small and Medium-sized manufacturing enterprises (SMEs) in Portugal.

In order to provide a comprehensive and long-term perspective on the financial resilience of SMEs in Portugal, the dataset covered a period from 2006 to 2021 because it was possible to analyze, for example, the financial resilience of the companies in the sample, from the perspective of the 2008 crisis and the crisis caused by the pandemic in 2020. The impact of the crisis on SMEs increased their vulnerability and failure in many European countries (Iborra et al., 2020), including Portugal. For this reason, it is important to study the financial resilience of companies to understand the effects of crises and to provide insights for future situations.

The data collection process on the SABI platform started with the selection of active companies in Portugal. Then, the manufacturing industry sectors were selected according to the NACE Rev.2 Section C classification. For this study, the following sectors were not considered: tobacco products, manufacture of coke, and refined petroleum products, and repair and installation of machinery and equipment.

The small and medium-sized companies were selected according to the classification established by European Commission Recommendation No. 2003/361/EC, considering the limits established for the number of employees and turnover. In this sense, Portuguese companies in the manufacturing industry were selected in simultaneous compliance with the following requirements: a minimum of 10 and a maximum of 249 employees and turnover sales between 10 million and 50 million Euros. The initial sample started with 3,873 firms. Table 7 describes the amount of sample construction processes, including those that were not considered. As this study aimed to analyze only small and medium-sized companies, from the initial sample, 2,324 firms were excluded because they were classified as microenterprises. Additionally, considering the objective of exploring the effects of the 2008 crises and the pandemic, it was decided to keep

² Financial data was retrieved on January 12, 2023, and updated on February 5, 2023.

only small and medium-sized companies active for at least 16 years in the sample. Thus, only the observation of companies facing these two crises was guaranteed. In this sense, 73 firms were excluded for having less than 16 years of activity. Then, 78 firms were excluded because they had missing values for the dependent variable's Return on Assets (ROA). As a result of these selection parameters process, the observed final sample was composed of 1,398 firms from the Portuguese manufacturing industry sector.

Table 7 - Sample construction

Firms in the sample	
Total number of firms in the sample	3,873
Less: Microenterprises	2,324
Less: Firms with less than 16 years of activity	73
Less: Firms with missing values for the ROA variable	78
Final sample	1,398

Table 8 presents the sample size of manufacturing small and medium-sized firms by industry, according to the NACE Rev 2 industry codes, and by business size in 2021. The sample consists of 306 small businesses and 1,092 medium-sized businesses, totaling 1,398.

Table 8 - Sample by manufacturing industry

Industry (NACE REV 2)	Small		Medium		Total	
10. Manufacture of food products	58	19%	142	13%	200	14%
11. Manufacture of beverages	13	4%	21	2%	34	2%
13. Manufacture of textiles	18	6%	91	8%	109	8%
14. Manufacture of wearing apparel	12	4%	102	9%	114	8%
15. Manufacture of leather and related products	4	1%	98	9%	102	7%
16. Manufacture of wood and of products of wood and cork	19	6%	50	5%	69	5%
17. Manufacture of paper and paper products	15	5%	29	3%	44	3%
18. Printing and reproduction of recorded media	12	4%	16	1%	28	2%
20. Manufacture of chemicals and chemical products	19	6%	41	4%	60	4%
21. Manufacture of basic pharmaceutical product	2	1%	13	1%	15	1%
22. Manufacture of rubber and plastic products	20	7%	72	7%	92	7%
23. Manufacture of other non-metallic mineral products	28	9%	72	7%	100	7%
24. Manufacture of basic metals	6	2%	20	2%	26	2%
25. Manufacture of fabric. metal product	35	11%	143	13%	178	13%
26. Manufacture of computer, electronic and optical products	2	1%	8	1%	10	1%
27. Manufacture of electrical equipment	4	1%	23	2%	27	2%
28. Manufacture of machinery and equipment	21	7%	61	6%	82	6%
29. Manufacture of motor vehicles, trailers and semi-trailers	3	1%	31	3%	34	2%
30. Manufacture of other transport equipment	1	0%	10	1%	11	1%
31. Manufacture of furniture	9	3%	36	3%	45	3%
32. Other manufacturing	5	2%	13	1%	18	1%
	306	22%	1,092	78%	1,398	

As shown in Table 8, small firms comprise 22% of the sample, while medium-sized firms comprise 78%. Small firms are most numerous in the manufacture of food products, with 58, followed by fabric metals with 35, and the manufacture of other non-metallic mineral products with 28 firms. Medium-sized firms are most

numerous in the manufacture of fabricated metal products, with 143 businesses, followed by manufacture of food products, with 142 businesses. In summary, medium-sized enterprises are predominant in this sample, with emphasis on the manufacture of food products, metallic products, and wearing apparel.

3.4 Description of the variables and the empirical model

As mentioned in the literature review section, empirical research on financial resilience is still a challenge for researchers, considering the lack of unification in terms of concepts and constructs. There are already several thorough concepts elaborated on estimating SME resilience, which has valuable ideas and different aspects incorporated relying on mainly questionnaire survey data (Tolner et al., 2021). However, according to Soufi et al. (2021), there is still a need for more comprehensive quantitative approaches to measure resilience in various fields, and a more precise way to quantify financial resilience.

For this reason, this empirical study applied a set of variables as accounting-based financial measures, following an adapted approach from models based on prior literature (Iborra et al., 2020; Mouzas & Bauer, 2022; Pal et al., 2014; Tognazzo et al., 2016; Wieczorek-Kosmala, 2022) to analyze the relationship between SME characteristics and the financial resilience. Thus, the logistic regression model to seek to answer the research questions is a form of non-linear regression (A. A. F. Santos, 2022; Yaqin et al., 2021), as follows:

$$Y = \frac{1}{1+e^{-(\beta_0+\beta_1x_1+\dots+\beta_nx_n+\varepsilon)}} , \text{ to our proposed model: } Y = \frac{1}{1+e^{-(\text{Financial Resilience } it)}}$$

Where, “Financial Resilience” in this model is considered as follows:

$$\text{Financial Resilience } it = \beta_0 + \beta_1\text{CSH}_{it} + \beta_2\text{OPL}_{it} + \beta_3\text{INT}_{it} + \beta_4\text{CRI}_t + \beta_5\text{COVID}_t + \beta_6\text{SIZE}_{it} + \beta_7\text{AGE}_{it} + \varepsilon_{it}$$

Here, *i* represents the SME, *t* is the time in years; $\beta_1, \beta_2, \dots, \beta_7$ represent the coefficients; ε_{it} is the error term.

The contextualization and calculation form for the dependent variable and each independent variable are described as follows:

Dependent variable

The dependent variable is financial resilience, and for this measurement, this study adopted, as a proxy, the return on assistance (ROA) to categorize firms as resilient or non-resilient. In this study, the parameter considered was that SMEs with ROA greater than zero were considered resilient. And non-resilient, those with ROA less than or equal to zero for each observed year. This approach was inspired by models developed by (Iborra et al., 2020; Wieczorek-Kosmala, 2022). However, they used other variables as proxy for resilience.

This study adapted those ideas and considered the ROA based on approaches developed by (El Khoury et al., 2022; Soda et al., 2022; Tudose et al., 2022; Grau & Reig, 2021; Imhanzenobe, 2020; Tognazzo et al., 2016; Margaretha & Supartika, 2016; Hamerman & Johar, 2013) to measure financial resilience. The ROA was used as a proxy for financial resilience because, according to Mouzas and Bauer (2022), a firms' performance commonly serves as a dependent variable that allows researchers to compare firms in terms of profits. Additionally, empirical quantitative evidence on organizational resilience is still scarce, especially in relation to financial performance (V. Nguyen et al., 2022).

In this sense, and based on Tognazzo et al. (2016), the ROA was selected as a dependent variable because it measures economic returns before accounting for taxes, the purest single measure of a firm's operational performance. In addition, according to Tognazzo et al. (2016), it demonstrates a firm's ability to absorb a shock while gaining profitability and growth. This profitability rate describes the extent to which the use of a firm's resources and funds generates profit, i.e., a high level of performance measure indicates the efficiency of a company in the use of its resources and funds (Tudose et al., 2022).

To calculate the ROA, the following formula was considered in this study: profit before interest and taxes/total assets (Grau & Reig, 2021; Imhanzenobe, 2020; Tognazzo et al., 2016).

Independent variables

The independent variables selected are related, for example, to resource management (financial slack, operational leverage, inventory), market strategy (internationalization), government financial support (subsidy), firm size, and age. The financial data to obtain these variables were extracted from the SABI database, and they were considered in this study as follows:

Financial slack (CSH) is the financial assets available to an organization, such as cash on hand, that can be deployed easily (Tognazzo et al., 2016). This variable was calculated by the following formula: cash and cash equivalents relative to total assets (Iborra et al., 2020; Tognazzo et al., 2016; Wieczorek-Kosmala, 2022).

Operating leverage (OPL) is essential to improve competitiveness and is a determinant for SMEs' profitability, according to Grau and Reig (2021). This variable was calculated considering: Fixed assets/Total assets (Grau & Reig, 2021).

Internationalization (INT) helps to increase competitiveness, innovation, and technology, and it is fundamental to ensuring the survival and growth of enterprises, according to Martins et al. (2022). In this study, this variable was calculated as follows: Sales in Europe + Sales in other countries/Total sales (Chiao et al., 2006; Martins et al., 2022; Puhr & Müllner, 2022).

Size is one of the firm's characteristics that may affect revenue recovery in a crisis period, according to V. Nguyen et al. (2022). This variable was calculated considering the natural logarithm of total assets (Iborra et al., 2020; Marsat et al., 2021; Wieczorek-Kosmala, 2022).

Age is a firm's characteristic that should be included as a separate variable when examining firm performance (Cowling et al., 2018). It is a sensitive characteristic because many firms have problems related to business continuity in the early years. Additionally, to ensure SMEs' success, access to financial resources and managerial training should be provided in the first 3-5 years, when the most challenging problems arise (Karadag, 2017). This variable was measured considering the natural logarithm of firm age in years (Grau & Reig, 2021; Iborra et al., 2020; Tognazzo et al., 2016).

Table 9 presents the summary of the independent variables, the form of calculation, and the main references that served as the basis for the model.

Table 9 - Summary of variables

Variables	Symbol	Formula	Expected sign	Authors
Financial slack	CSH	Cash and cash equivalents/Total assets	+	Wieczorek-Kosmala (2022) Tognazzo et al. (2016) Iborra et al. (2020) Pal et al. (2014) Grau and Reig (2021)
Operating leverage	OPL	Fixed assets/Total assets	+/-	Y. Chen et al. (2022) Bistrova et al. (2021) Grau and Reig (2021)
Internationalization	INT	Sales Europe + Sales other countries/Total sales	+/-	Puhr and Müllner (2022) Martins et al. (2022) Chiao et al. (2006)
Financial crisis	CRI	Dummy variable, equals 1 for the financial crisis years (2008 to 2011), and 0 otherwise.	+/-	Iborra et al. (2020) Pal et al. (2014)
COVID	COVID	Dummy variable, equals 1 for the Covid years (2020 to 2021), and 0 otherwise.	+/-	Forson et al. (2022) Beninger and Francis (2022) Mouzas and Bauer (2022)
Size	SIZE	Natural logarithm of total assets	+/-	Grau and Reig (2021) Wieczorek-Kosmala (2022) Marsat et al. (2021) Iborra et al. (2020) Tognazzo et al. (2016)
Age	AGE	Natural logarithm of active years	+/-	Grau and Reig (2021) Iborra et al. (2020) Tognazzo et al. (2016) Akhtar et al. (2022)

Additionally, the periods of the financial crisis (2008-2011) and the crisis caused by the pandemic (2020-2021) were also considered as dummy variables in the regression model.

Financial crisis (CRI) in this study was considered a dummy variable, equals to 1 for the financial crisis years (2008 to 2011) and 0 otherwise.

COVID also was considered a dummy variable, assuming 1 for the Covid years (2020 to 2021) and 0 otherwise.

3.5 Data analyses

The sample data analysis was based on descriptive statistics and logistic regression analysis. The descriptive statistics were calculated for all the collected variables. For quantitative variables, the mean, median, standard deviation, first and third quantiles (corresponding to 25th and 75th percentiles, respectively), and the minimum and maximum values were reported. Categorical variables were summarized using the absolute (n) and relative (%) frequencies.

Regarding the statistical analysis, a Generalized Linear Mixed Model (GLMM) was employed to explore the relationship between the variables and SMEs' financial resilience. This model type is suitable for analyzing non-normal longitudinal data as it allows for different distributions of the dependent variables and considers the correlation of repeated measurements (Hedeker, 2005).

As the dependent variable was binary (with two categories), the GLMM was fitted using binomial errors and a logit link function. Furthermore, SME ID was included in the GLMM models as a random variable to account for the repeated measures (collected from 2006 to 2021 for each company). The absence of multicollinearity, an assumption of GLMM, was checked by calculating the Variance Inflation Factor (VIF). It was confirmed that the assumption was met, as all VIFs calculated were below 2 (Hair et al., 2019).

In relation to the coefficients of the binomial GLMM model, when exponentiated, correspond to Odds Ratios (ORs). ORs that do not differ statistically from 1 (i.e., that include 1 in their 95% confidence interval) indicate that the independent variable is not associated with the outcome of Resilience. ORs statistically greater than 1 indicate that the independent variable is associated with an increase in the odds of resilience. ORs statistically below 1 indicate that the independent variable is associated with a decrease in the odds of resilience. For numerical independent variables, the OR indicates the expected change in the odds of resilience for each unit increase in the independent variable. For categorical independent variables, the interpretation of the OR depends on the reference category: the OR indicates the change observed in the odds of resilience when

the company belongs to the category being investigated versus when it belongs to the reference category (Tenny & Hoffman, 2022).

All statistical analyses were performed using the software R v. 4.1.0 (R Core Team, 2021). The GLMM was calculated using the `glmer` function from the `lme4` package (Bates et al., 2015).

PART 4 - RESULTS ANALYSIS

This section aims to analyze the results obtained from the empirical research model conducted to analyze the financial resilience of manufacturing small and medium enterprises (SMEs) in Portugal. This study was based on a quantitative analysis of a sample of 1,398 manufacturing SMEs retrieved from the SABI financial database. The main objective was to study the relationship between the dependent variable Resilience in relation to financial slack, operating leverage, international activities, inventory (finished products, work-in-process, and raw materials), company size (natural logarithm of total assets), and age (natural logarithm of years of operation of the company).

A generalized linear mixed model (GLMM) was employed to analyze the factors associated with SMEs' financial resilience. GLMMs are appropriate for analysing nonnormal longitudinal data, as they allow dependent variables from different distributions and account for the correlation of the repeated-measured data (Hedeker, 2005). Due to the binary nature of the dependent variable Resilience (two categories: non-resilient and resilient), the GLMM was fitted by specifying binomial errors and a logit link function. Companies' ID was included in the GLMM models as a random variable to account for the repeated measures (collected from 2006 to 2021 for each company).

Statistical analyses were conducted in software R v. 4.1.0 (R Core Team, 2021). The function `glmer` from the `lme4` package (Bates et al., 2015) was employed to run the GLMM.

This section is structured in two stages, the first aims to present the characteristics of the sample based on the percentages of SMEs considered resilient and non-resilient by sector and location. In the second part, the results of the descriptive statistics of the variables, statistical tests of the models, the most suitable model, and the results of the statistical model will be presented in this section and discussed in the context of the literature.

4.1 SME financial resilience analysis

This section aims to provide a percentage analysis of the financial resilience of manufacturing small and medium enterprises (SMEs) in Portugal. This analysis was based on the sample of the manufacturing sector SMEs, classified as resilient or non-resilient, for 2020 based on their financial performance. For this purpose, the ROA was the parameter used to classify resilient and non-resilient companies. Table 10 presents the proportion of SME financial resilience by industry. For the elaboration of this table, firms that presented ROA greater than zero for the year 2020 were considered resilient. And the others, non-resilient. According to this parameter, about 45% of the SME sample was classified as resilient and 55% as non-resilient.

From the perspective of medium-sized enterprises, when looking at the individual sectors, the highest proportion of resilient firms is in the manufacture of food products, with 45% of the sample classified as resilient. This is followed by the manufacture of fabricated metal products (43%) and textiles (28%). According to this sample analysis, in the context of medium-sized enterprises, the lowest proportion of resilient firms is in other manufacturing (4%) and computer, electronic optical products (2%).

Table 10 - SME financial resilience by industry (2020)

Industry (NACE REV 2)	Small				Medium				Total
	Resilient		Non-resilient		Resilient		Non-resilient		
		%		%		%		%	
10. Manufacture of food products	45	18%	13	5%	114	45%	28	11%	200
25. Manufacture of fabricated metal products	26	10%	9	4%	110	43%	33	13%	178
13. Manufacture of textiles	17	7%	1	0%	72	28%	19	7%	109
15. Manufacture of leather and related products	2	1%	2	1%	70	27%	28	11%	102
22. Manufacture of rubber and plastic products	19	7%	1	0%	67	26%	5	2%	92
14. Manufacture of wearing apparel	9	4%	3	1%	65	25%	37	15%	114
23. Manufacture of other non-metallic mineral prod.	24	9%	4	2%	63	25%	9	4%	100
28. Manufacture of machinery and equipment	19	7%	2	1%	53	21%	8	3%	82
16. Manufacture of wood and of prod. wood cork	18	7%	1	-	41	16%	9	4%	69
20. Manufacture of chemicals and chemical prod.	17	7%	2	1%	37	15%	4	2%	60
31. Manufacture of furniture	9	4%	-	-	30	12%	6	2%	45
17. Manufacture of paper and paper products	15	6%	-	-	26	10%	3	1%	44
29. Manufacture of mot. vehicle trailers semi-trailers	2	1%	1	-	24	9%	7	3%	34
24. Manufacture of basic metals	4	2%	2	1%	20	8%	0	-	26
27. Manufacture of electrical equipment	4	2%	-	-	19	7%	4	2%	27
11. Manufacture of beverages	11	4%	2	1%	16	6%	5	2%	34
18. Printing and reproduction of recorded media	6	2%	6	2%	13	5%	3	1%	28
21. Manufacture of basic pharmaceutical products	1	0%	1	0%	11	4%	2	1%	15
30. Manufacture of other transport equipment	-	-	1	0%	10	4%	-	-	11
32. Other manufacturing	5	2%	-	-	10	4%	3	1%	18
26. Manufacture of computer, elect optical prod.	2	1%	-	-	5	2%	3	1%	10
	255		51		876		216		1398

In relation to the proportion of non-resilient medium-sized enterprises, it is highest in the manufacture of wearing apparel (15%) and Manufacture of fabricated metal products (13%). The proportion of non-resilient SMEs is lowest in the manufacture of food products (5%) and fabricated metal products (4%). Regarding the small firms, the highest proportion of resilient firms is also in the manufacture of food products, with 18%, followed by the manufacture of fabricated metal products (10%).

The proportion of resilient and non-resilient firms was also analyzed according to geographic location. Table 11 presents the number of SMEs by region, and the percentage of resilient and non-resilient firms. According to the regional breakdown of SMEs, North Portugal had the highest number of SMEs, with 740, of which 53% (466) were resilient, and 61% (131) were non-resilient (in relation to the medium-sized enterprises). Centre Portugal was the second highest region with 335 SMEs, of which 24% (209) were resilient, and 21% (45) were non-resilient. Lisbon and Vale do Tejo had the third highest number of SMEs, with 276, of which 20% (175) were resilient and 16% (34) were non-resilient.

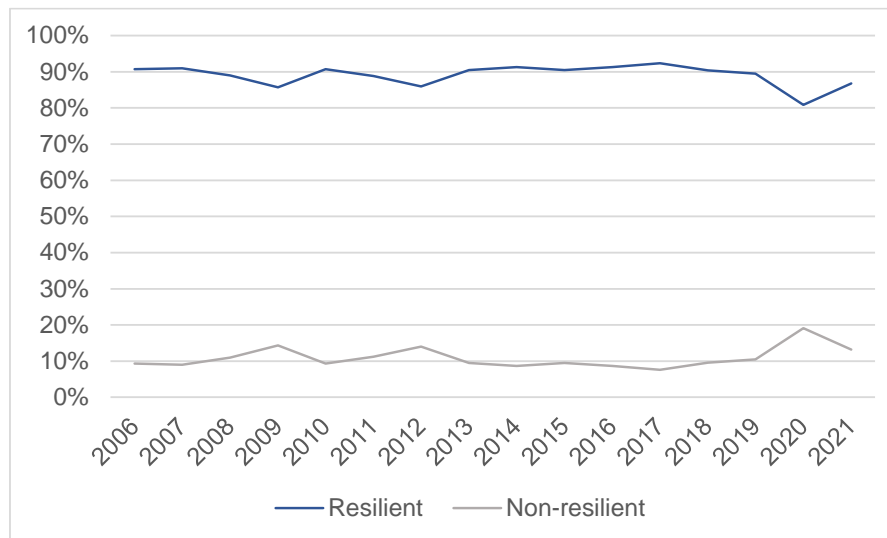
Table 11 - SME financial resilience by region (2020)

SME by region	Small				Medium				Total
	Resilient		Non resilient		Resilient		Non resilient		
North Portugal	125	49%	18	35%	466	53%	131	61%	740
Center Portugal	67	26%	14	27%	209	24%	45	21%	335
Lisbon and Vale do Tejo	51	20%	16	31%	175	20%	34	16%	276
Alentejo	3	1%	2	4%	13	1%	4	2%	22
Açores Autonomous Region	3	1%	1	2%	9	1%	-	-	13
Madeira Autonomous Region	4	2%	-	-	2	0%	2	1%	8
Algarve	2	1%	-	-	2	-	-	-	4
Total	255		51		876		216		1398

Considering the parameters adopted in this study for categorizing of resilient and non-resilient companies, this analysis suggests that most of SMEs in Portugal were considered resilient, most located in North Portugal and Centre Portugal. The regional variations in financial resilience may be related to geographic and economic differences. For example, the North of Portugal is the most populous and economically developed region, while the South is less populous and less developed.

Figure 9 shows the proportion of resilient and non-resilient SMEs by year from 2006 to 2021.

Figure 9 - Proportion of SMEs by year



According to the parameter considered in this study to categorize the sample SMEs into “resilient” and “non-resilient”, it is observed that the proportion of SMEs is higher for companies categorized as “resilient”, around 90% in most of the years considered for this analysis.

As presented in Figure 9, the proportion of SMEs categorized as resilient and non-resilient does not vary significantly over the analyzed period. However, it is visible in this Figure, a slight increase in the proportion of SMEs considered non-resilient in the years referring to the financial crisis (2008-2010) and the COVID-19 crisis (2020-2021). On the other hand, the trend is the opposite for SMEs considered resilient, i.e., a slight reduction in the proportion of companies considered resilient to the same periods of crisis.

From the perspective of the data of the sample analyzed and considering the parameter selected in this study to categorize samples of the sample in “resilient” and “non-resilient”, it is assumed that about 90% of manufacturing SMEs in Portugal, in general, were categorized as resilient. However, it is possible to observe the impact of crises on the resilience of these companies.

However, this analysis only briefly introduces statistical analysis that will be performed in the following items and contextualized with the literature on financial resilience.

4.2 Descriptive statistics of variables

This section presents the descriptive statistics of the variables considered in the empirical models. Table 12 shows the mean, standard deviation (SD), median, and minimum-maximum values of the numerical variables calculated for the sample's non-resilient and resilient SMEs. Table 14 also shows the frequency and percentage of dummy variables. Regarding the numerical variables (CSH, OLP, INT, INV, SIZE, and AGE), the descriptive statistics analysis revealed differences between the non-resilient and resilient SMEs.

The mean of the CSH variable is 0.06 for non-resilient and 0.1 for resilient, showing that resilient SMEs have a higher proportion of financial slack to total assets than non-resilient ones. In other words, this analysis suggests that, on average, the resilient SMEs in the sample maintain around 10% of the value of their assets considered financial slack. While for SMEs considered non-resilient, this financial reserve corresponds, on average, to around 6% of their assets.

In relation to the OPL variable, the mean for non-resilient SMEs was slightly higher than the average of companies categorized as resilient, 0.34 and 0.29, respectively. This may suggest that, on average, companies categorized as non-resilient have higher operational leverage than resilient SMEs, which favors increased business risk.

The INT variable presented a mean of 0.4 for non-resilient and 0.41 for resilient SMEs. This may suggest that, within the scope of this sample, the level of internationalization (sales to other countries in relation to total sales) does not differ much between SMEs considered resilient and non-resilient.

The same pattern is observed for the INV variable, the median is 0.19 for both non-resilient and resilient SMEs, suggesting that within the scope of this sample, SMEs considered resilient and non-resilient, in average, maintain a similar proportion of product inventories (finished products, products in process and raw materials in relation to total assets).

Table 12 - Descriptive statistics of the variables

Variable		Mean	SD	Median	Min - Max
<u>Numeric variables:</u>					
CSH	Non-resilient	0.06	0.1	0.02 (0.01 - 0.07)	0 - 0.65
	Resilient	0.10	0.13	0.04 (0.01 - 0.14)	-0.20 - 0.88
OPL	Non-resilient	0.34	0.2	0.32 (0.18 - 0.47)	0.00 - 0.94
	Resilient	0.29	0.17	0.26 (0.15 - 0.39)	0 - 0.95
INT	Non-resilient	0.40	0.36	0.33 (0.04 - 0.77)	0 - 1
	Resilient	0.41	0.36	0.32 (0.05 - 0.76)	0 - 1.13
INV	Non-resilient	0.19	0.15	0.17 (0.08 - 0.27)	0 - 0.84
	Resilient	0.19	0.14	0.16 (0.08 - 0.27)	0 - 0.89
SIZE	Non-resilient	8.90	0.85	8.89 (8.26 - 9.50)	6.52 - 11.48
	Resilient	8.86	0.8	8.81 (8.28 - 9.41)	6.14 - 12.51
AGE	Non-resilient	3.46	0.54	3.47 (3.13 - 3.77)	0.74 - 5.79
	Resilient	3.36	0.55	3.38 (3.04 - 3.69)	0.07 - 5.79
<u>Dummy variables:</u>					
CRI (n=22368)	Non-resilient	2439			
	Non-crisis	1799	74%		
	Crisis	640	26%		
	Resilient	19929			
COVID (n=22368)	Non-crisis	14977	75%		
	Crisis	4952	25%		
	Non-resilient	2439			
	Non-crisis	1987	81%		
GOV (n=22368)	Crisis	452	19%		
	Resilient	19929			
	Non-crisis	17585	88%		
	Crisis	2344	12%		
GOV (n=22368)	Non-resilient	2439			
	Non-financial support	1429	59%		
	Financial support	1010	41%		
	Resilient	19929			
GOV (n=22368)	Non-financial support	11531	58%		
	Financial support	8398	42%		

SD = standard deviation; Max = maximum value; Min = minimum value; Q1 = first quartile (25th percentile); Q3 = third quartile (75th percentile).

The mean of the SIZE variable is 8.90 for non-resilient and 8.86 for resilient, suggesting that resilient firms, on average, are slightly smaller than non-resilient ones. The analysis of the descriptive statistics of the numerical variables, in average, suggests that resilient SMEs have a higher financial slack, lower operating leverage, and slightly smaller size and age compared to non-resilient ones. Table 13 presents the Pearson correlation matrix calculated for the numeric independent variables (CSH, OPL, INT, INV, SIZE, and AGE).

Table 13 - Pearson correlation matrix

	CSH	OPL	INT	INV	SIZE	AGE
CSH						
OPL	-0.313*					
INT	0.075*	-0.142*				
INV	-0.197*	-0.277*	0.188*			
SIZE	-0.076*	0.092*	0.058*	-0.046*		
AGE	0.064*	0.000*	0.044*	0.126*	0.249*	

* $p < .05$ in the correlation test.

The results regarding the correlations matrix reveal the relationships between the variables CSH, OPL, INT, INV, SIZE, and AGE. The results show a moderate negative correlation between CSH and OPL (-0.313), which means that as one of the variables increases, the other decreases. Furthermore, there is a weak positive correlation between INT and INV (0.188), implying that as one of the variables increases, the other increases. Additionally, a weak positive correlation was found between SIZE and AGE (0.249).

4.3 Statistical tests of the models

This section presents the results of the statistical tests for the GLMM logistic regression. In order to validate the model's estimates, aspects related to the model's predictive ability, efficiency, and multicollinearity were analyzed. Table 14 presents the results of the statistical tests carried out for the two models.

The statistical tests suggest that the difference between the two models is very small. The Pseudo R² was analyzed to evaluate the model's predictive ability. The results showed that the models have a Pseudo R² of 0.085 and 0.084 for the fixed effects, respectively. This result indicates that both models provide a good prediction of the data. The total Pseudo R² is 0.463 for both models. This result indicates that the models have the same predictive power, and it explains approximately 46.3% of the data variance.

Table 14 - Statistical tests of the models

Model 1	Model 2
Pseudo R ² (fixed effects) = 0.085	Pseudo R ² (fixed effects) = 0.084
Pseudo R ² (total) = 0.463	Pseudo R ² (total) = 0.463
$\chi^2(9) = 401.74$	$\chi^2(7) = 400.10$
AIC = 12,923.814	AIC = 12,921.457
BIC = 13,011.806	BIC = 12,993.450
VIF < 2	VIF < 2

In order to evaluate how well the model fits the data, the Chi-squared value for both models were analyzed. Model 1 had a Chi-squared of 401.74, and Model 2 had a Chi-squared of 400.10, indicating that both models fit the data well.

Then, the Akaike Information Criterion (AIC) was applied to compare and select the model. Model 1 had an AIC of 12,923.814, and Model 2 had an AIC of 12,921.457, which showed that Model 2 was the better model with the lower AIC.

Additionally, the Bayesian Information Criterion (BIC) was used to select the best logistic regression model based on Bayes information. Model 1 had a BIC of 13,011.806, and Model 2 had a BIC of 12,993.450, which again showed that Model 2 was the better model with the lower BIC.

The absence of multicollinearity, an assumption of GLMM, was checked by calculating the Variance Inflation Factor (VIF). The results showed that the VIF values for both models were below 2, indicating no significant multicollinearity between the variables (Hair et al., 2009). Thus, the results of the statistical tests suggest that Model 2 is the best model for the GLMM logistic regression for this sample data.

4.4 Empirical model results

This section seeks to answer the research questions and research hypotheses of this dissertation based on the estimation results of the GLMM models. The objective was to evaluate the relationship between the binary dependent variable “Resilient/Non-resilient” and the independent variables selected for the model, as discussed in the literature. As a proxy for the dependent variable, ROA was used to categorize the SME as resilient or non-resilient, as previously mentioned.

The model was tested twice. In the initial model, the following numerical independent variables were used: CSH, OPL, INT, INV, SIZE, and AGE, representing, respectively, financial slack, operational leverage, level of internationalization (sales to other countries/total sales), inventories (finished products, work in process and raw materials), firm size and age.

And the dummy variables GOV, CRI, and COVID, representing, respectively, if the SME received or not government support, years referring to the crisis/non-financial crisis and years referring to the crisis/non-crisis caused by the pandemic. Table 15 presents the result of the estimation of the GLMM models.

In the first model, all variables referred to above were considered. This GLMM model 1 showed that, except for GOV and INV, all the variables were statistically associated with Resilience. In other words, government support and inventory were not statistically associated with the dependent variable resilience.

The odds ratio (OR) greater than 1 for CHS and SIZE indicate that increases in those variables are associated with increased odds of a company being resilient. On the other hand, the ORs below 1 for OPL, INT, and AGE indicate that increases in those variables are associated with decreased odds of a company being resilient. The categorical variables, CRI and COVID, also presented ORs below 1. This indicates that being in a crisis is associated with decreased odds of a company being resilient compared to a non-crisis scenario. Considering the 95% confidence interval, the results of the first model suggest that, for each unit increase in CSH, the chance that an SME in the sample belongs to the resilient category increases about 27 times. Regarding the OPL, at each addition of one unit, the chance of an SME belonging to the resilient SME category decreases by 87%.

Table 15 - Generalized linear mixed model (binomial distribution and logit link)

Independent variables	Model 1			Model 2		
	OR	CI 95%	p	OR	CI 95%	p
CSH	27,142	13.084; 56.303	<0.001 ***	28,830	14.225; 58.430	<0.001 ***
OPL	0.130	0.081; 0.208	<0.001 ***	0.136	0.088; 0.212	<0.001 ***
INT	0.738	0.576; 0.945	0.016 **	0.737	0.577; 0.942	0.015 **
SIZE	1,335	1.196; 1.489	<0.001 ***	1,351	1.212; 1.505	<0.001 ***
AGE	0.577	0.483; 0.689	<0.001 ***	0.580	0.488; 0.691	<0.001 ***
COVID						
Non-crisis	-----	-----		-----	-----	
Crisis	0.434	0.374; 0.504	<0.001 ***	0.443	0.384; 0.511	<0.001 ***
CRI						
Non-crisis	-----	-----		-----	-----	
Crisis	0.739	0.657; 0.832	<0.001 ***	0.730	0.649; 0.820	<0.001 ***
GOV						
Non-financial support	-----	-----				
Financial support	1,073	0.949; 1.212	0.26			
INV	0.828	0.449; 1.526	0.545			
	Pseudo R ² (fixed effects) = 0.085			Pseudo R ² (fixed effects) = 0.084		
	Pseudo R ² (total) = 0.463			Pseudo R ² (total) = 0.463		
	$\chi^2(9) = 401.74$			$\chi^2(7) = 400.10$		
	AIC = 12,923.814			AIC = 12,921.457		
	BIC = 13,011.806			BIC = 12,993.450		
	VIF < 2			VIF < 2		

OR = Odds Ratio; CI = confidence interval

Considering that in this first model two variables were not statistically associated (GOV and INV), the second model was tested without these two variables.

However, as referred to in the previous section, the tests performed revealed little difference between the models. According to the results, model 2 proved slightly better than Model 1, which is why Model 2 was selected for analysis and discussion.

This second model showed that all the variables are statistically associated with the dependent variable, Resilience. The ORs greater than 1 for CHS and SIZE indicate that increases in those variables are associated with increased odds of a company being resilient. On the other hand, the ORs below 1 for OPL, INT, and AGE indicate that increases in those variables are associated with decreased odds of a company being resilient. The categorical variables, CRI and COVID, also presented ORs below 1. This indicates that being in a crisis is associated with decreased odds of a company being resilient compared to a non-crisis scenario.

In this sense, and considering the 95% confidence interval, the results of the second model suggest that, for each unit increase in CSH, the chance that SMEs in the sample belong to the resilient category increases about 28.8 times. This result confirms hypothesis 1, which is also in line with the literature regarding the importance of the financial slack and cash holdings in favoring the pursuit of a sustainable competitive advantage (Duchek, 2020; Mouzas & Bauer, 2022; Tognazzo et al., 2016), and consequently, in determining the resilience capabilities (Iborra et al., 2020; Wieczorek-Kosmala, 2022). Indeed, financial resources, mainly in cash flow, proper budgetary control, and financial solid reserves, were considered the most significant factors to keep firms resilient in the face of adversity, as referred by (Iborra et al., 2020; Pal et al., 2014).

However, it is important to point out that having resources is a necessary but insufficient condition for value creation because the resources have to be managed dynamically (Tognazzo et al., 2016). In addition, economic resilience through production effectiveness in manufacturing firms also demands proper execution of lean management and continuous improvement approaches (Pal et al., 2014).

The SIZE variable was also positively correlated and statistically significant in relation to the financial resilience of the SMEs in the sample. In this sense, the ODs suggest that at each unit increase in the SIZE variable, the chance of the

SME belonging to the category of resilient companies increases by approximately 35.1%. Given this result, hypothesis 4 was not confirmed. Contrary to authors who argue that firm size is negatively associated with the perceived speed of recovery from the crisis (V. Nguyen et al., 2022), this result corroborates the literature that argues that larger companies usually have more resources at their disposal and, in general, are easier to adapt to adverse situations and, consequently, tend to be more financially resilient than smaller ones (Forson et al., 2022).

Although due to their size, SMEs that operate in traditional manufacturing industries might be less equipped to face economic downturns than larger businesses (Tognazzo et al., 2016), even so, SMEs have specific characteristics that may help them in times of crisis, such as flexibility in adjusting their strategies and processes (Eggers, 2020).

On the contrary, these two variables, the results of the coefficients of the other variables (OPL, INT, AGE, CRI, and COVID), indicate that there is a negative relationship with SME financial resilience.

The OPL variable was the one that proved to be more negatively associated with financial resilience than the others. According to the ODs, the result suggests that with each unit increase in the OPL variable, the chance of the SME belonging to the category of resilient firms decreases by 86.4%. In other words, this result suggests that the more leveraged the SME, the greater the chances of belonging to the non-resilient category. Thus, this result does not confirm hypothesis 2 and is contrary to (Y. Chen et al., 2022; Grau & Reig, 2021).

Regarding the variable that represents internationalization, contrary to what some authors (Martins et al., 2022; Pühr & Muellner, 2022), in this sample, the internationalization showed to be negatively related to financial resilience. The results suggest that at each variable unit increase, the chance of a company belonging to the resilient SME category decreases by approximately 26.3%. This result does not confirm hypothesis 3, but it is in line, for example, with Forson et al. (2022), that concluded domestic SMEs were relatively more financially resilient compared to large-foreign and large domestic enterprises.

Regarding the AGE variable, at each unit increase, the chance of the company being in the resilient category reduces by 42%. In other words, in the context of this sample, the results suggest that the older the SME, the greater the chances of not belonging to the category of resilient companies. This result confirms hypothesis 5. It is in accordance with V. Nguyen et al. (2022), that found a negative relationship between age and speed of recovery, indicating that younger businesses are more likely to quickly recover than older ones. These results also corroborate the findings of Tognazzo et al. (2016), in which firm age is negatively related to post-crisis performance. According to Tognazzo et al. (2016), older companies perform less well in times of recession than younger companies do, probably because of the inflexibility and organizational inertia associated with increased age.

Regarding the variable indicative of the 2008-2011 financial crisis (CRI), the results suggest that each year of financial crisis, the chance of the company being in the resilient category reduces by 27%, confirming hypothesis 6. This negative correlation between the crisis and the company's resilience is usually the result pointed out by the literature. In fact, at times of economic crises, SMEs face significant threats to their financial performance and survival, requiring them to be resilient (Pal et al., 2014).

However, another type of result has also been reported in the literature. According to Tognazzo et al. (2016), their results demonstrated a positive correlation between a firm's profitability growth before a crisis and its performance and growth in years after the crisis. The authors suggest it may be explained that SMEs that operated in traditional, stable markets improved their efficiency in terms of managing their investments and used them to generate higher returns, being more successful in the post-crisis period than SMEs that could not do so.

In relation to the crisis caused by the pandemic, represented by the variable COVID, results suggest that in each pandemic year, the chance of the company being in the resilient category reduces by about 55.7%, confirming hypothesis 7. This result is in accordance with X. Chen et al. (2021), whose results indicate that COVID-19 has had a negative impact on firm sustainable growth.

When comparing the impact of the two crises (Financial 2008-2011 and pandemic 2020-202) on the financial resilience of SMEs, according to the analysis, the

results suggest that, in the context of this sample, the chances of an SME belonging to the resilient category are lower during the pandemic crisis compared to the financial crisis of 2008-2011.

Additionally, according to V. Nguyen et al. (2022), SMEs experiencing some disasters before the pandemic, their perceived speed of revenue recovery is significantly slower than those facing only the COVID-19 pandemic. These authors highlight the importance of risk management strategies, arguing that SMEs with these kinds of strategies in place are likely to recover more quickly from the pandemic than those without risk management.

Other strategies for SMEs to minimize the impacts of crises are also discussed in the literature on financial resilience, for example, online sales strategies (Forson et al., 2022), several management practices, including organizational learning, cross-training, reward systems, employee involvement and psychological empowerment (Gayed & El Ebrashi, 2023).

Furthermore, some authors argue, based on empirical evidence, found that the impact of the COVID-19 crisis was minimized due to the government's financial support, contributing to firms' financial resilience (V. Nguyen et al., 2022; Sundarakani & Onyia, 2021).

CONCLUSION

The outbreak of COVID-19 has raised questions about how firms should better face these challenges and remain resilient in extreme and multifaceted uncertainty. Considering this, academic researchers have been interested in understanding financial resilience is and how firms achieve this feature. In the business field, the pandemic posed an existential threat to European SMEs' financial resilience with significant consequences for the European economy.

Considering this magnitude and the relevance of these companies to the economy and the challenges faced during the pandemic and motivated by the gaps pointed out by the literature, this study aimed to provide both theoretical discussion and empirical evidence on SME financial resilience on SME financial resilience in the manufacturing sector in Portugal.

Regarding the theoretical discussion of this topic, a science mapping was carried out to explore the international scientific production on resilience to provide an overview of the state-of-the-art and improve debates on organizational and financial resilience using bibliometric techniques. The empirical evidence aimed to investigate specific firm characteristics that may explain SME financial resilience in the manufacturing sector in Portugal from 2005 to 2021.

This study applied a quantitative research design with logistic regression analysis to test the hypothesis and examine the correlation between SME characteristics and financial resilience using secondary account-based data extracted from the SABI database from 2006 to 2021. The final sample comprised 1,398 firms from the Portuguese manufacturing industry sector.

The dependent variable used in this study has a binary nature (Resilient/Non-resilient). Based on the literature, the return on assets was considered as a proxy for financial resilience to categorize firms as resilient or non-resilient. In this study, as a parameter, SMEs with ROA greater than zero were considered resilient. And non-resilient, those with ROA less than or equal to zero for each observed year.

The independent variables selected were related, for example, to resource management (financial slack, operational leverage, inventory), market strategy

(internationalization), firm size, and age. Additionally, the periods of the financial crisis (2008-2011) and the pandemic crisis (2020-2021) were considered dummy variables in the regression model.

Considering the parameters applied to categorize the SME as resilient or non-resilient, regarding the year 2020, the analysis showed that about 45% of the SME sample were classified as resilient and 55% as non-resilient. From the perspective of medium-sized enterprises, when looking at the individual sectors, the highest proportion of resilient firms was in the manufacture of food products, with 45% of the sample classified as resilient. This is followed by the manufacture of fabricated metal products (43%) and textiles (28%). In relation to the proportion of non-resilient medium-sized enterprises, it is highest in the manufacture of wearing apparel (15%) and manufacture of fabricated metal products (13%).

In relation to the geographic analysis, in 2020, North Portugal had the highest number of SMEs, with 740, of which 53% (466) were resilient, and 61% (131) were non-resilient (in relation to medium-sized enterprises). Centre Portugal was the second highest region with 335 SMEs, of which 24% (209) were resilient, and 21% (45) were non-resilient. Lisbon and Vale do Tejo had the third highest number of SMEs with 276, of which 20% (175) were resilient, and 16% (34) were non-resilient. This analysis suggests that most of the SMEs in Portugal were considered resilient, most located in North Portugal and Centre Portugal for 2020. The regional variations in financial resilience may be related to geographic and economic differences.

In relation to the descriptive statistics of the variables considered in the empirical model suggested that, on average, the resilient SMEs in the sample maintain around 10% of the value of their assets considered as financial slack. While for SMEs considered non-resilient, this financial reserve corresponds, on average, to around 6% of their assets. In relation to the OPL variable, results suggested that, on average, companies categorized as non-resilient have a higher degree of operational leverage than resilient SMEs, which favors increased business risk.

Regarding the logistics regression analysis, the results suggested that for each unit increase in CSH, the chance that SMEs in the sample belong to the resilient category increases about 28.8 times. This result is in line with the literature, which

argues that financial resources, mainly cash flow and financial solid reserves, were considered the most significant factors to keep firms resilient in the face of adversity.

The firm size was also demonstrated to be positively correlated and statistically significant in relation to the financial resilience of the SMEs in the sample, suggesting that at each unit increase in this variable, the chance of the SME belonging to the category of resilient companies increases by approximately 35.1%. This result corroborates the literature that argues that larger companies usually have more resources at their disposal and, in general, are easier to adapt to adverse situations and, tend to be more financially resilient than smaller ones.

On the contrary, these two variables, the results of the coefficients of the other variables (OPL, INT, AGE, CRI, and COVID), indicate a negative relationship with SME financial resilience. For the OPL, the ODs ratio suggests that with each unit increase in the OPL variable, the chance of the SME belonging to the category of resilient firms decreases by 86.4%, suggesting the more leveraged the SME, the greater the chances of belonging to the non-resilient category.

Regarding internationalization, contrary to what some authors, in this sample, internationalization was negatively related to financial resilience, suggesting that at each variable unit increase, the chance of a company belonging to the resilient SME category decreases by approximately 26.3%. For firm age, in each unit increase, the chance of the company being in the resilient category reduces by 42%, suggesting that the older the SME, the greater the chances of not belonging to the category of resilient companies.

In relation to the financial crisis, the results suggest that each year of the financial crisis, the chance of the company being in the resilient category reduces by 27%, corroborating the literature which argues that in times of economic crises, SMEs face significant threats to their financial performance and their survival requires them to be resilient. Regarding the crisis caused by the pandemic, results suggested that each year, the chance of the company being in the resilient category reduces by about 55.7%, indicating that COVID-19 has had a negative impact on the firm sustainable growth. Comparing the impact of the two crises, results suggested that, the chances of an SME belonging to the resilient category were lower during the pandemic than during the financial crisis of 2008-2011.

This study presents many limitations. First, the construct considered financial resilience is in line with a stream of researchers that considers financial performance a good indicator for this variable. However, due to the lack of consensus in the literature, there is no unique construct to measure financial resilience. For this reason, other authors have been applying other proxies, such as time of sales recovery, cash-driven capabilities, and survival or non-survival. The second limitation refers to the variables selected as independent variables. Regarding this, other accounting-based variables may be more relevant for this type of analysis considering specific contexts. Other limitations may be considered regarding the comprehensive sample of various industry sectors. An analysis directed to a single industrial sector may provide a more efficient and assertive analysis in relation to the results and respective inferences.

Considering these limitations, some suggestions for future studies should consider other constructs for financial resilience and other accounting-based variables for independent variables. In addition, future studies should consider selecting one industry sector so that the analysis is specialized within this specific sector.

Despite the limitations related to the concept, construct, and variables used, it is expected that this study can contribute in some way to enrich academic debates and provide insights for managers and public policymakers.

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