Lisbon School of Economics & Management
Universidade de Lisboa

MASTER

MANAGEMENT AND INDUSTRIAL STRATEGY

MASTER´S FINAL WORK

DISSERTATION

RESILIENT SUPPLY CHAINS: AN EMPIRICAL ANALYSIS OF RECOVERY IN THE RETAIL SECTOR

BRUNA PAULO LOURENÇO

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SUPERVISION:

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ABSTRACT

This dissertation addresses the question of how supply chain dynamic capabilities influence companies' resilience after a disruption. The current world context is characterised by a climate of instability and uncertainty. Considering this, the study was motivated by the increasing necessity for companies to adapt to these volatile environments. Furthermore, another motivation resides in the limited research on how these capabilities, in practice, interact to create supply chain resilience. The main goal of this study is related with the identification of the capabilities that contribute to the recovery of companies in the retail sector. In this context, resilience is associated with the concept of recovery, and was assessed using performance measures in the years before and after the COVID-19 pandemic.

To answer this question, data from real companies in the Eurozone retail sector were extracted from the ORBIS database. Supply chain dynamic capabilities – Supplier Efficiency, Inventory Management and Operational Flexibility – were operationalised with that data and logistic regression models were built to estimate the impact of supply chain dynamic capabilities variables on company recovery. The results indicate that Supplier Efficiency has a positive and significant effect on company recovery, suggesting that companies that are more efficient in managing supplier costs are more likely to recover after a disruption. Inventory Management and Operational Flexibility are shown to be unrelated to a company's recovery, which may be related to the complexity of these capabilities.

RESUMO

A presente dissertação aborda a questão de como as capacidades dinâmicas da cadeia de abastecimento influenciam a resiliência das empresas após uma disrupção. O contexto mundial atual é caracterizado por um clima de instabilidade e incerteza. Perante isto, o estudo foi motivado pela crescente necessidade de adaptação das empresas a estes ambientes voláteis. Além disso, outra motivação reside na escassez de investigação sobre a forma como estas capacidades, na prática, interagem para criar resiliência na cadeia de abastecimento. O objetivo central deste estudo está relacionado com a identificação das capacidades que contribuem para a recuperação das empresas no setor do retalho. Neste contexto, a resiliência está associada ao conceito de recuperação, medida através do EBITDA nos anos pré e pós pandemia da COVID-19.

De forma a dar resposta a esta questão, foram extraídos dados de empresas reais do setor do retalho da Zona Euro a partir da base de dados ORBIS. As capacidades dinâmicas relacionadas com a cadeia de distribuição – "*Supplier Efficiency*", "*Inventory Management*" e "*Operational Flexibility*" – foram operacionalizadas a parir dos dados das empresas obtidos nessa base de dados e construíram-se modelos de regressão logística com o objetivo de estimar o impacto das variáveis das capacidades dinâmicas da cadeia de distribuição na recuperação das empresas. Os resultados obtidos indicam que a variavel "*Supplier Efficiency"* tem um efeito positivo e significativo na recuperação das empresas, sugerindo que empresas que são mais eficientes na gestão de custos com fornecedores têm uma maior probabilidade de recuperar após uma disrupção. As restantes variáveis, "*Inventory Managemnt"* e "*Operational Flexibility"*, mostraram não estar relacionadas com a recuperação, o que poderá estar relacionado com a complexidade destas capacidades.

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GLOSSARY

BLR - Binomial Logistic Regression

COGS – Costs of Goods Sold

DSCCs - Dynamic Supply Chain Capabilities

EBITDA - Earnings Before Interest, Taxes, and Amortisation

NACE Rev. 2 - Nomenclature of Economic Activities, Revision 2

RBV - Resource-Based View

VRIN - Valuable, Rare, Inimitable, Non-substitutable

1. INTRODUCTION

The current world context, characterised by a climate of instability and uncertainty, makes the resilience of supply chains a determining factor for the continuity and prosperity of companies, particularly in the retail sector. This study aims to explore the impact of dynamic capabilities related to company's supply chains - Supplier Efficiency, Inventory Management and Operational Flexibility – on the recovery capacity of companies after the COVID-19 pandemic. The relevance of this study comes from the growing necessity of companies to adapt to volatile and uncertain environments, and the need to understand how they can face these new challenges.

This study is based on the dynamic capabilities theory developed by Teece and Pisano (1994, 1997), which argues that, in order to gain competitive advantage, companies must be able to adapt and reconfigure their capabilities to respond quickly and flexibly to the external environment. The contribution of Defee and Fugate (2010) is used as a basis for understanding dynamic capabilities applied to the supply chain, as well as the importance of combining and integrating them, arguing that dynamic capabilities should not be restricted to the company alone but should be created together with its partners, such as suppliers. The work developed by Rice and Sheffi (2005) is relevant for understanding the concept of organisational resilience in the supply chain and for analysing the results of the Inventory Management and Operational Flexibility capabilities. Additionally, other authors who also made important contributions to this work are Christopher and Peck (2004) for the understanding of resilience and for the understanding of the key factors associated with increased vulnerability and the creation of resilience. Finally, Jüttner & Maklan (2011) contribute through a practical example where they addressed, from their perspective, the fundamental capabilities for creating resilience.

Thus, it is possible to identify five main concepts present in this work. dynamic capabilities, which refer to companies' competencies that evolve, reconfigure and adapt according to the external environment (Ambrosini & Bowman, 2009); resilience, which can be defined as the ability of companies to recover or improve their position after the occurrence of a disruptive event (Christopher & Peck, 2004); Supplier Efficiency, which is related to efficiency in managing costs with suppliers (Defee & Fugate 2010; Ali et al., 2024); Inventory Management, linked to inventory management, particularly its turnover (Stadtfeld and Gruchmann, 2024); and finally Operational Flexibility, which corresponds to the ability of companies to adjust their inventory level in response to disruptions (Alzate et al., 2024; Ali et al., 2024).

Although dynamic capabilities have been widely studied by several authors, their application to supply chains is still limited, especially in the retail sector. Furthermore, there are still few studies on how these capabilities, in practice, interact to create resilience and promote recovery. This study aims to fill this gap by investigating the relationship between supply chain dynamic capabilities and financial recovery after the pandemic in retail companies.

This research focuses on the following research question - *How do supply chain dynamic capabilities affect companies' resilience in the retail sector?* – and the main objectives of this study are to empirically analyse the impact of each of these dynamic capabilities on companies' recovery and to evaluate the contribution of the interaction of these capabilities.

To achieve the objective of this work, the study adopts a quantitative approach based on financial data extracted from the ORBIS database. Logistic regression is used to analyse the impact of independent variables on the probability of recovery of companies, measured through the variation of EBITDA in the years before and after disruption. This analysis includes the exploration of several models to assess the robustness and relationships between the variables of the models.

Regarding the main contributions of this study, it is possible to highlight the empirical application of the dynamic capabilities theory applied to the phenomenon of resilience and supply chains, more specifically, to the financial recovery of companies in the retail sector of the Eurozone. The operationalisation of the three aforementioned capabilities allowed the relationship with the concept of recovery, measured through EBITDA, and contributed to making this subjective and abstract concept a measurable and comparable indicator. Furthermore, the results obtained for the Supplier Efficiency variable suggest that an improved management of costs associated with suppliers can be an important strategy for generating resilience. The results obtained for the Inventory Management and

Operational Flexibility variables reinforce the importance of adapting the metrics used in the operationalisation of capabilities to the complexity of the phenomenon.

This work is organised into five chapters. Chapter 2 presents a review of the relevant literature for the contextualization and theoretical framework. Chapter 3 addresses the methods used in the execution of the work. Chapter 4 presents the results obtained and their discussion in light of the literature review. Chapter 5 summarises the main conclusions obtained in this study as well as suggestions for future research.

2. LITERATURE REVIEW

2.1 Resource-Based View Theory and Sustained Competitive Advantage

The Resource-Based View theory (RBV), initially proposed by Wernerfelt (1984) and later developed by Barney (1991), was one of the main theories used to explain the source of sustainable competitive advantage by companies. This theory was positioned against the assumptions established by the industrial organisation vision developed by Porter and Bain (Kraaijenbrink et al. 2010). According to Bain (1968) and Porter (1980, 1985), a company generates a competitive advantage through factors related to the external environment. Namely, through the exploration of opportunities and neutralisation of threats (Porter, 1980, 1985). The RBV theory did not replace but complemented this vision, Mahoney & Pandian (1992), since its main objective is to explain how a company's internal resources can be a source of competitive advantage. This explanation is based on the assumption that the internal resources possessed by companies are heterogeneous, that is, the resources are not the same for all companies. Therefore, when these same resources are simultaneously valuable, rare, inimitable, and nonsubstitutable (VRIN), they can give rise to a sustained competitive advantage (Barney 1991). According to Barney (1991), the sustainability of this advantage is possible thanks not only to the heterogeneity of resources but also to the fact that they are not completely mobile across the firms, which allows the advantage to occur for a longer period.

While Barney (1991) focused his study on the fundamental characteristics of resources that give a company a competitive advantage, Grant (1991) went further and addressed the importance of capabilities in the process of transforming these resources into strategic value. Therefore, it is important to clarify the distinction between resources and capabilities. Resources are basic units that constitute the processes and include "capital equipment, skills of individual employees, patents, brand names, finances and so on" (Grant, 1991, p. 118, our translation). While capability is the company's ability to group or combine a set of resources to perform a certain process or activity. According to (Grant, 1991), "resources are the source of a firm's capabilities, capabilities are the main source of its competitive advantage." (p. 119)

Furthermore, years later after the publication of his first work, Barney (2012) explained the relationship between purchasing and supply chain management processes with RBV theory and explained how these processes can be capabilities with characteristics that lead a company to generate competitive advantage. It is the ability to manage and apply resources effectively that sets a company apart from its competition. For this reason, when purchasing, the supply chain management capabilities are developed internally, and based on the assumption that the resources that compose them have VRIN attributes, a competitive gain can be generated. In addition, Barney (2012) reinforces the importance of the existence of unique conditions to create capabilities that are difficult to imitate. Examples include retailer Walmart, which differentiates itself from its competitors through its strategic decisions, efficient management of its resources and the creation of internal capabilities. Namely, through the self-developed management system for the warehouse and stores (Timilsina, 2015). The combination of operational decisions and the choice of resources results in a VRIN business model that allows Walmart to gain a sustained competitive advantage. (Timilsina, 2015)

2.2 Dynamic Capabilities Theory in Fast Changing Environments

As presented previously, the RBV theory assumes that resources are distributed among companies heterogeneously and that these differences between resources are maintained over time. Based on these assumptions, the theory points out that companies that have VRIN resources can obtain a sustainable competitive advantage. (Eisenhardt & Martin, 2000; Barney, 1991). Verification of these assumptions assumes the existence of a stable and static external environment so that this advantage can be maintained. However, in dynamic markets, this theory is no longer applicable because, due to the rapid changes that occur in this type of market, the advantage obtained becomes insignificant and less important over time. (Teece, 2007).

The dynamic capabilities theory, initially proposed by Teece and Pisano (1994), emerged as a complement to the RBV Theory with the aim of explaining how companies can obtain competitive advantage in environments of rapid and constant change, contrary to that explored by RBV theory. Thus, Teece and Pisano (1997) introduced the concept of dynamic capability, which they defined as “the firm’s ability to integrate, build, and reconfigure internal and external competences to address rapidly changing environments.“ (p. 516) and argued that the source of competitive advantage comes from “dynamic capabilities rooted in high performance routines operating inside the firm, embedded in the firm's processes, and conditioned by its history” (Teece and Pisano,1994 , p. 537). Subsequently, other authors contributed with their definitions of dynamic capabilities, such as Zahra et al. (2006), who identified them as “the abilities to re-configure a firm’s resources and routines in the manner envisioned and deemed appropriate by its principal decision maker” (p. 918). It is also important to clarify, apart from the definitions given previously, the difference between dynamic capabilities, capabilities and resources. These dynamic capabilities are different from resources in the sense that dynamic capabilities are capabilities that a company possesses that impact and use resources in the most appropriate way with the aim of transforming and reconfiguring them so that adaptation and evolution is possible according to changes in the environment. From this explanation arises the difference between dynamic capabilities and the capabilities mentioned in the RBV theory. Since the latter are static and oriented towards short-term competition. Unlike the first, which aim to maintain advantages in the long term. (Ambrosini & Bowman, 2009).

According to the dynamic capabilities theory, having VRIN resources is not enough to gain an advantage over the competition. In addition to having these resources, it is also necessary to have “timely responsiveness and rapid and flexible product innovation, along with the management capability to effectively coordinate and redeploy internal and external competences” (Teece & Pisano, 1994, p. 537). In other words, if a company has VRIN resources but is not capable of developing dynamic capabilities, it will also not be able to retain its advantage and consequently generate profits, especially when it is inserted in rapidly changing scenarios.

2.3 Supply Chain Dynamic Capabilities

It is essential to highlight that dynamic capabilities can be applied in different areas, particularly logistics. Morash et al. (1996) investigated the relationship between strategic logistics skills and company performance. The results show that there is a positive relationship between the two. Namely, the logistical capabilities: delivery speed, reliability, responsiveness, and low-cost distribution were identified as positively related to performance and fundamental for creating competitive advantage.

Although logistics capabilities play a fundamental role in creating advantage, they constitute only part of a broader landscape since logistics is one of the processes that compose the supply chain. By broadening the focus to supply chain capabilities, it is possible to fully understand where, beyond logistics, there may be a potential competitive advantage. The relationship between the dynamic capabilities theory and the supply chain is particularly relevant not only due to the disruptive and dynamic nature that supply chains present but also due to the current context that is characterised by rapid evolution, hyper competitiveness and globalisation (Defee and Fugate, 2010). Consequently, the durability of competitive advantages is reduced, making inadequate the notion that to achieve these advantages in a sustainable way, it is only necessary to have resources that distinguish companies from others (Defee and Fugate, 2010).

In this context, Defee and Fugate (2010) argue that dynamic capabilities are particularly relevant for logistics and supply chain and introduce the idea that dynamic capabilities should not be restricted to just one company, but rather encompass the multiple members of the supply chain, such as partners and suppliers, with the aim of maximizing the obtained advantage. In their research, they state that when shared and implemented across all supply chain companies, dynamic capabilities can result in increased performance as a result of a more responsive and adaptable supply chain to the dynamic environment (Defee and Fugate, 2010). The authors define dynamic supply chain capabilities (DSCCs) as "a learned pattern of interorganizational activities that facilitates the creation of new static capabilities or the modification of existing capabilities across multiple supply chain members" (Defee and Fugate, 2010, p. 187). What makes these dynamic capabilities different from those described previously is the fact that they are not centred on a single company and are embedded in routines shared by all companies that form the supply chain through collaborative processes. That is, different participants can develop, adapt or reorganise capabilities.

In their work, the authors developed a conceptual model with the aim of understanding the origin of DSCCs and what affects the effectiveness of their use. In this way, Defee and Fugate (2010) introduced two Specific dynamic capabilities: access to knowledge and co-evolution. With regard to knowledge, this DSCC is described as a form of collaboration where it is possible to take advantage of the capabilities that each company in the supply chain has without the need to try to replicate them, which avoids redundancy and improves both efficiency and productivity. This allows each company to focus on the capabilities it develops best and benefits from others coming from its partners. Co-evolution is understood in this context as a dynamic capability that is shared between two or more companies in the chain and allows new capabilities to be created in collaboration with other companies in the chain. It is a continuous and flexible process in that the objective is to have a constant evolution of dynamic capacity, always adapted to the external environment. Consequently, this collaboration creates synergies which result in unique capabilities, making them more difficult for competitors to imitate. In this way, supply chain members aim to maximise the period in which they have a competitive advantage in order to make it as sustainable as possible (Defee & Fugate 2010).

In addition to the capabilities identified above, other authors have further contributed to this discussion by proposing additional DSCCs. Therefore, it is relevant to explore their contributions, which allow us to broaden our understanding of the role of DSCCs in creating more resilient supply chains. The literature on DSCCs has evolved significantly in recent years. Increasing global disruptions, particularly the COVID-19 pandemic, have highlighted the need for companies to understand how they can overcome and thrive in the face of these disruptions. Recent studies, such as Ali et al. (2024), Alzate et al. (2024) and Stadtfeld and Gruchmann (2024), provide complementary perspectives that allow a more comprehensive understanding of the relationship between DSCCs and resilience. The study developed by Ali et al. (2024), similar to the present work, aims to understand how Irish companies developed DSCCs to build resilience in the face of the disruption caused by the COVID-19 pandemic. Based on interviews, the authors identified DSCCs as "Supply Chain Resilience Capabilities" and divided them into three groups: adaptation, response, and learning capabilities. According to the authors' perspective, adapting capabilities refer to companies' ability to modify their processes and readjust their resources to cope with significant environmental changes (Ali et al., 2024). The DSCCs operational flexibility and supplier diversification were identified as belonging to this group. Responding capabilities were defined as companies' ability to respond quickly and efficiently to disruptions (Ali et al., 2024). Within this group, the results highlighted agility and collaboration as the main DSCCs that contribute to corporate resilience. Finally, learning capabilities were identified as the ability of companies to acquire, create, and disseminate knowledge, which allows for improved response in the event of a new disruption (Ali et al., 2024). As a result, the authors concluded that these three groups of capabilities are interrelated and that their mutual interaction allows companies not only to recover from external shocks but also to generate competitive advantage.

Additionally, in their study, Alzate et al. (2024) explored how DSCCs, applied to the Colombian agrifood sector, contribute to the creation of resilient supply chains. This article aligns with the ideas previously presented by other authors about the importance of DSCCs for building resilience and combines a systematic literature review with a case study. Based on the systematic literature review, the authors were able to identify eight fundamental DSCCs that are critical to supply chain resilience: contribution, collaboration, integration, agility, flexibility, adaptability, reconfiguration, and competitive priorities. Subsequently, this theoretical framework was empirically tested through the case study, which allowed observing dynamic capabilities in practice (Alzate et al., 2024). The results obtained show that the DSCCs that contribute the most to building resilience are flexibility and adaptability. Alzate et al. (2024) associate supply chain flexibility with its ability to "adapt and respond effectively to changes and disturbances in demand, supply, or external factors, maintaining efficiency and satisfying customer requirements" (Alzate et al., 2024, p. 18). Adaptability, meanwhile, translates into a “type of flexibility that a supply chain can possess or develop, which allows it to respond to the diversity of possible changes in the environment, or to some possible disturbance in its operations" (Alzate et al., 2024, p. 18). Furthermore, the important role that collaboration and interdependence play is also reinforced, and resilience is interpreted as a systemic and interorganizational phenomenon, which results from the interaction between the different members of the chain.

Lastly, the article by Stadtfeld and Gruchmann (2024) represents a consolidation of the DSCCs theme. In their work, the authors integrate several contributions made by different authors over the past few years. Through a meta-review, the authors developed a conceptual model that demonstrates how supply chain resilience results from the interaction, development and accumulation of multiple DSCCs — some of which are cited by the authors cited above— such as visibility, anticipation, preparedness, speed, social capital building, redundancy, robustness, flexibility, agility, responsiveness, and recovery. Stadtfeld and Gruchmann (2024) organised these dynamic capabilities into four micro foundations: sensing, seizing, holding/buffering, and transforming, which correspond, respectively, to the chains' ability to detect, act, stabilise, and transform in the face of disruptions.

Therefore, and taking into account the previous theoretical framework, the supply chain dynamic capabilities selected for this study correspond to the following: Supplier Efficiency, Inventory Management, and Operational Flexibility. These capabilities were chosen to capture the main aspects that contribute to the creation of resilience identified in the literature. Specifically, Supplier Efficiency aligns with the adaptive and responsive dimensions identified by Ali et al. (2024), as it translates into the ability to collaborate with suppliers to reconfigure relationships and ensure supply continuity (Defee & Fugate 2010). Regarding Inventory Management, it can be related to the ability to ensure robustness and operational continuity, which allows companies to absorb shocks and ensure a balance between resilience and operational efficiency (Stadtfeld and Gruchmann, 2024). Finally, as highlighted by Alzate et al. (2024), Operational Flexibility expresses the ability to readjust processes, structures, and resources in the face of sudden disruptions. Therefore, considering the scope of this work, these three capabilities synthesise some of the most important aspects of supply chain resilience, allowing us to understand how companies use their resources to resist, adapt, and recover from disruptions.

Considering what was aforementioned, it is possible to understand the Supplier Efficiency variable as the ability of a company to obtain value through its suppliers by minimising the costs associated with the latter and, consequently, maximising its profits (Defee & Fugate 2010; Ali et al., 2024). The Inventory Management variable can be defined as the ability of a company to adjust its stock levels to demand, making it more efficient (Stadtfeld and Gruchmann, 2024). In regard to the Operational Flexibility variable, it can be understood as the capacity of companies to adjust their processes and decisions quickly in response to disruption (Alzate et al., 2024; Ali et al., 2024). Thus, the following hypotheses are proposed:

Hypothesis 1: Supplier efficiency is positively associated with the probability of recovery after a disruption.

Hypothesis 2: Inventory management capability is positively associated with the probability of recovery after a disruption.

Hypothesis 3: Operational flexibility is negatively associated with the probability of recovery after a disruption.

Hypothesis 4: The combination of the capabilities, Supplier Efficiency, Inventory Management and Operational Flexibility is positively associated with the probability of recovery after a disruption.

2.4 Resilience in Supply Chain Management

To understand the importance of resilience in the proper functioning of supply chains, it is essential to define this concept as well as its characteristics within the scope of the theme of this dissertation. Currently, the markets that make up our economies are characterised by being more volatile than they were in previous decades. Christopher and Peck (2004) define vulnerability in the supply chain as an "exposure to serious disturbance, arising from risks within the supply chain as well as risks external to the supply chain" (p. 6). This volatility can be understood as a result of the increasing complexity of supply chains due to globalisation and the optimisation of operations, combined with economic and geopolitical instability. In addition to these, other factors contribute to chain instability. Namely, the shorter life cycles of products and technology derived from the constant introduction of new products due to strong competition, consequently making demand less predictable (Ponomarov & Holcomb, 2009).

As a result, one of the main challenges for companies is to manage and mitigate these risks by creating resilient supply chains with the aim of overcoming disruptive events that may compromise the continuity of operations. Building resilient supply chains makes it possible to create and maintain competitive advantage because it allows companies to respond quickly and effectively to changes in the environment, differentiating them from competitors who are less prepared to face sudden changes (Christopher & Peck, 2004). There is a close relationship between the dynamic capabilities theory and supply chain resilience in that it can be understood as a dynamic capability that provides competitive advantage (Mandal et al., 2014).

Resilience is a subjective term and may have many interpretations, which is why it is important to define it. From the point of view of supply chain management, several authors have contributed to defining and deepening this topic. Namely, Christopher & Peck (2004) did not limit themselves to defining resilience as the ability to reverse a disruptive situation but rather as "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed" (p. 4). In this way, they highlight resilience as an opportunity to innovate and improve the company's position in the long term. This notion was later addressed by Ponomarov and Holcomb (2009). The resilience proposal given by Ponomarov and Holcomb (2009) in their paper represents a multidimensional phenomenon defined as "the adaptive capability of the supply chain to prepare for unexpected events, respond to disruptions, and recover from them by maintaining continuity of operations at the desired level of connectedness and control over structure and function." (p. 131). This last interpretation will also be the one that will be adopted throughout this work. Unlike the first definition that focuses on recovery from a disruptive event, the latter emphasises the importance of proactivity and anticipation in dealing with them. According to Barroso et al. (2011), the concept of supply chain resilience is defined as "the supply chain's ability to react to the negative effects caused by disturbances that occur at a given moment in order to maintain the supply chain's objectives." (p.165). Although all of these definitions agree that disruptions must be addressed, they differ on when an intervention should take place. That is, whether it is a reactive or proactive action.

Furthermore, the construction and development of a resilient supply chain depends on a set of formative elements that, when verified simultaneously, allow organisations to act proactively in order to anticipate, face and recover from the consequences caused by disruptive events (Jüttner & Maklan, 2011). Different authors have different opinions about what elements contribute to resilience. Furthermore, there are also different opinions regarding its designation. These formative elements are defined by some authors as "key elements" that constitute resilience (Christopher & Peck, 2004; Peck, 2005). Ponomarov and Holcomb (2009) understand them as "antecedents" and Jüttner and Maklan (2011) suggest interpreting these elements of formative resilience as capabilities.

Research and work carried out on this topic identified these resilient capabilities. Namely, Christopher & Peck (2004) highlight the importance of resilience being integrated into the strategic design from the beginning of the supply chain creation. The second capability is related to the need for a high level of collaboration, especially with the aim of identifying risks and vulnerabilities so that they can later be mitigated. Agility is also considered one of the most important capabilities for creating resilience due to the role it plays in formulating a rapid reaction in response to disruptions. Thus, constituting one of the main competitive advantages in this context. Finally, the creation of a risk management culture in the organisation promotes the habit of identifying and mitigating risks, which consequently results in improved resilience (Christopher & Peck, 2004).

In addition to these, Rice and Sheffi (2005) also identified redundancy and flexibility as capabilities that can contribute to increased resilience. According to the research carried out by these authors, redundancy, in this context, is mainly associated with safety stock and the use of capacity below its maximum limit, which allows for the existence of reserves in the event of an interruption or unexpected peaks in demand and a greater responsiveness. Redundancy is also associated with having more than one supplier with the aim of mitigating risks associated with supply and avoiding excessive dependence that could compromise the continuity of operations. These redundant scenarios incur an opportunity cost because there is an increase in costs in order to ensure resilience. Moreover, the authors argue that there is a significantly greater advantage in creating flexible chains rather than redundant ones, since flexibility means developing capabilities that work organically and allow us to respond to threats quickly and efficiently, which increases the resilience of the organization and consequently generates competitive advantage (Rice and Sheffi, 2005). The Land Rover example mentioned in this paper illustrates the risks associated with relying on a single supplier. In 2001, the only company that supplied the chassis for one of the Land Rover models (UPF-Thompson) went into insolvency. Due to its exclusive dependence on this company, after its insolvency, Land Rover was in an extremely vulnerable position, either paying the amount demanded by UPF to resume production or having to completely stop production of that model. The car brand ended up paying the amount demanded while looking for another long-term solution.

Finally, Christopher (2011) mentions that, for supply chain resilience to be achieved, there must be a margin at critical points. It is at these points that flow limitation may occur in the event of an interruption. Another highlighted prerequisite is access to information. This must be done as quickly as possible and must also include knowledge sharing in order to enable greater visibility throughout the chain. When this visibility exists, it is possible to implement the culture of shared ownership that allows risks to be mitigated and managed more effectively (Christopher, 2011). According to Jüttner and Maklan (2011), the four capabilities that are mentioned most frequently and that are most consensual among authors are flexibility, velocity, visibility and collaboration.

It is precisely at this point that the supply chain's ability to adapt becomes relevant. Adaptive capacity is considered a fundamental element for the existence of resilient ecosystems (Ponomarov & Holcomb, 2009). This adaptability not only strengthens organisational resilience but also has the ability to directly impact operational performance. A supply chain that can adjust its resources and structures in response to changes caused by the environment is considered adaptable (Christopher & Peck, 2004; Peck, 2005). This adjustment is only possible due to the existence of a combination of the key factors described above. It is the dynamic nature of these adaptive capabilities that make it possible for the supply chain to recover after it has been disrupted (Ponomarov & Holcomb, 2009). In this sense, it is important to understand how these capabilities, and consequently the development of resilience, translate into gains in operational performance.

The study conducted by Jüttner and Maklan (2011) investigates, considering a sample of 3 companies, how supply chains reacted to the 2008 financial crisis and the importance of certain resilient supply chain capabilities to face this disruption. In this case, the resilient supply chain capabilities under study were flexibility, visibility, speed and collaboration. The authors collected data for this investigation through interviews they conducted before the resection began, with a different objective, and at the end of the resection period. The main objective of these interviews was to collect information about the effects of this risk event on the supply chain and which factors contributed to its recovery. According to Jüttner and Maklan (2011), and as a result of the analysis of the data collected, it is confirmed that there is a relationship between supply chain resilient capabilities and supply chain vulnerability in disruptive scenarios. The main conclusion presented is that these four capabilities contribute positively to minimising the negative effects caused by the financial crisis, that is, by a risk event. Specifically, flexibility allowed the three companies to contain some of the negative effects of the recession, helping both the cost and revenue axes. This occurred due to the possibility of having multiple suppliers, which made it possible to negotiate prices, increasing bargaining power, but also due to the flexibility to reallocate capacity and optimise its use. Speed, combined with flexibility, had a direct impact on the response given by companies to face this scenario. An example of this was the speed with which two of the companies were able to use redundant resources, for example, extra production capacity, to cope with fluctuations in demand. Not only were they able to meet demand, but they also gained an advantage in the market over competitors who were not as quick to do so. (Jüttner & Maklan, 2011)

Given the unpredictable nature and prolonged duration of the effects of a recession, having visibility across the entire chain was crucial to the success of these companies. Visibility, which is related to sharing information about risk exposure, allowed vulnerable suppliers to be identified at an early stage. This avoided interruptions in operations and reduced the financial impact on companies. Finally, collaboration allowed the three companies studied to contain the negative impact of the lockdown on costs and inventory availability, allowing operations to continue. Namely, through monitoring contingency plans between companies and suppliers, which made it possible to prioritise customers and maintain lead times (Jüttner & Maklan, 2011).

In short, the conclusions drawn from this empirical study reveal that a risk event can cause a bullwhip effect. That is, small changes by the end consumer result in large variations in production for suppliers in the rest of the chain (Wang & Disney, 2015). Furthermore, it was also proven that all four resilient capabilities studied contributed positively to companies becoming faster and more efficient in responding to rapid changes.

3. Methodology

3.1 General Context

With the intention of understanding whether the adoption of specific supply chain capabilities affects the resilience of companies following a disruptive event, a sample of 748 companies was analysed. This sample size already reflects the application of the criteria described in the paragraph below. Considering that the disruptive event chosen for analysis was the COVID-19 pandemic, the data collected concerns two distinct periods: the pre-pandemic (2019) and the post-pandemic period (2023). Following Iborra et al. (2019), the collected data encompasses active companies established up to 2019, companies currently active and companies that became inactive after January 1, 2020.

3.2 Sample Collection

The data used for this study were obtained from Moody's ORBIS database, which provides financial information on both public and private companies worldwide. To ensure that significant and relevant results were obtained for this research, the target population was defined as large retail companies based within the Eurozone. More specifically, the selection of the retail sector was due to its heightened exposure to risks, given the sector´s considerable dependence on suppliers and vulnerability to external factors (Oke & Gopalakrishnan, 2009).

The focus on large companies from the Eurozone allowed, respectively, larger availability of data and greater homogeneity, given that all companies operate under similar economic conditions and regulations. Within this target population, only companies that simultaneously met the following criteria were included: located in the Eurozone; classified under code 47 - Retail trade, except of motor vehicles and motorcycles, according to the NACE Rev. 2 nomenclature; classified as large companies in 2019 according to the guidelines of the European Commission (European Commission, 2020), that is, more than 250 employees and more than 50 million euros in sales; established until 2019. In addition to these criteria, two mutually exclusive criteria regarding the status of the companies were also applied. Namely, only active companies and companies inactive since January 1, 2020 were considered. These two criteria ensure that companies were considered active both at the time of this study´s elaboration and were also active in the year prior to the beginning of the COVID-19 pandemic, that is, 2019.

Furthermore, the following financial indicators were collected for the companies that met the aforementioned criteria: cost of goods sold (COGS), operating revenue, stock turnover, inventory and EBITDA. To ensure data reliability, companies that did not report values for these financial indicators were excluded from the analysis.

3.3 Variables Description

This section presents and describes the variables used for this analysis, specifying their purpose, definition and calculation methods. The set of selected variables was grounded on the literature review on supply chain resilience as well as on supply chain dynamic capabilities. It was constructed using the financial indicators extracted from ORBIS database, mentioned in the previous section. The variables are organised into three categories: dependent, independent and control variables.

As mentioned in the literature, resilience is a subjective and multidimensional phenomenon subject to various interpretations, involving the capacity for adaptation and recovery (Christopher & Peck, 2004; Ponomarov & Holcomb, 2009). Given this complexity, and similarly to Iborra et al. (2019) approach, this study focuses specifically on the recovery aspect of organisational resilience. For this purpose, the dependent binary variable, defined as Recovery, was introduced. A recovery is considered to have occurred when the company has recovered financially in 2023 compared to 2019. The independent variables of this study correspond to the variables: Supplier Efficiency, Inventory Management and Operational Flexibility and were used as proxy measures of supply chain dynamic capabilities. These variables were measured using data from the year 2023. This year was selected because is the year that represents more accurately the firm´s situation after the disruption.

The company´s age and size, the latter measured by the number of employees in 2023, were used as control variables. Table I summarises the variables included in the study.

TABLE I

SUMMARY OF THE VARIABLES USED IN THE STUDY

Variables	Operationalization
Supplier Efficiency	$\frac{\text{COGS}}{\text{Operating Revenue}}$
Inventory Management	Stock Turnover (the value was extracted directly from ORBIS database)
Operational Flexibility	$\text{Number of days stock in hand} = \frac{\text{Inventory}}{\text{COGS}} \times 365$
Recovery	1 if EBITDA(2023) > EBITDA(2019) and EBITDA(2023) > 0, 0 otherwise
Size	$\ln(\textit{Total number of employees reported in } 2023)$
Age	$\ln(\text{Years since incorporation} = 2023 - \text{year of incorportation})$

The Supplier Efficiency variable aims to measure the proportion of a company's revenue that is absorbed by COGS. Since there is no in-house production of the products that are sold in the retail sector, COGS predominantly reflect the amount paid to suppliers for finished products. Consequently, this measure provides insights into the company's efficiency in managing supplier costs, especially regarding negotiation and supplier selection. A lower value for this ratio suggests that the company has the capacity to generate a higher amount of revenue with lower expenditure on supplier costs, which may indicate that there is greater bargaining power with suppliers. Conversely, a higher ratio value implies that a significant portion of revenue is being consumed by these costs, which can translate into greater vulnerability to price fluctuations or potentially dependence on a single supplier.

The Inventory Management variable is represented by stock turnover. The value of this indicator was provided directly by ORBIS. This ratio shows how many times a company rotates its inventory in a given period of time and is especially important for understanding how effective a company is in managing and liquidating its inventories (Rao & Rao, 2009; Sunjoko & Arilyn, 2016). In this context, low values of this ratio may mean excessive idle inventory, inaccurate demand forecasting, or supply chain inefficiencies. On the opposite side, higher values suggest faster conversion of stock into sales, resulting in greater efficiency in inventory management (Sunjoko & Arilyn, 2016).

Although Operational Flexibility is a comprehensive concept and consists of several dimensions, in this study, the number of days stock in hand ratio was used as an approximation variable (Bose, 2006). This decision was made because it is one of the most operational and relatable indicators available in the ORBIS database. This ratio indicates the average number of days a company holds its inventory before being sold. Similar to the stock turnover ratio, this metric measures the efficiency of stock sales. However, in this case, lower values mean greater efficiency, since the fewer days a company holds stock, the faster it is sold (Bose, 2006).

The Recovery dependent variable is used to capture the recovery dimension of resilience. Therefore, from now on, resilience will be measured using the Recovery dependent variable. This variable assumes a value 1 if the company's EBITDA in 2023 is greater than the company's EBITDA value in 2019. This indicates that the company was able to reestablish and exceed its financial performance after the disruptive event occurred. Otherwise, this variable assumes the value 0, and it is assumed that the company was not able to recover EBITDA, considering the same period of time. To ensure a correct interpretation of the recovery concept, only firms with a positive EBITDA in 2023 were considered eligible for the outcome of the variable Recovery equal to 1. Hence, this prevents firms with a negative EBITDA in both years from being wrongfully classified as recovered simply because the amount of loss has decreased.

Finally, two control variables were included in this study to ensure that the recovery analysis was not influenced by other characteristics inherent to the companies. The inclusion of these controls ensures that the effects of the explanatory variables are not biased, contributing to the robustness of the model.

4. DATA ANALYSIS AND DISCUSSION

To determine whether the Dynamic Capabilities of the supply chain have an impact on the resilience of companies, a binomial logistic regression (BLR) was employed. This regression was chosen since it is a dependent variable with only two possible outcomes: whether the company recovered after the disruptive event or not. Coded as 1 and 0, respectively (Kutner et al., 2005). BLR estimates the probability of a given event occurring through the logistic function that transforms the results into probabilities with values between 0 and 1. Thus, the main objective of choosing this regression is to analyse whether the selected independent variables influence the probability of a company recovering after a disruption (Hilbe, 2015; Harrell, 2015). To this end, the following models were estimated in SPSS software (29.0.2.0) and used to test the hypotheses defined previously. Next, the descriptive statistics and correlations, model estimation and results are presented.

4.1 Descriptive Statistics and Correlations

Table II compiles information regarding the statistics described and Pearson's bivariate correlations between the variables. Through the mean and standard deviation, it is possible to observe how the variables are distributed and their variability. The remaining columns in the table indicate the strength and direction of the relationship between the variables. This table provides, in the first instance, some impression of how dynamic capabilities may be related to the recovery of companies.

TABLE III

DESCRIPTIVE STATISTICS. MEAN, SD, AND PAIRWISE CORRELATIONS

	Mean	S.D.	1	2	3	4	5	6
1. Recovery	0.65	0.48	1					
2. ln(Size)	6.97	1.25	0.131**	1				
3. ln(Age)	3.41	0.64	0.048	0.126**	1			
4. Supplier Efficiency	0.63	0.16	0.177**	0.071	0.090*	1		
5. Inventory Management	18.40	41.14	0.061	-0.090*	0.041	0.121**	1	
6. Operational Flexibility	111.56	343.61	0.018	0.015	0.041	-0.142**	-0.0862*	1

Notes: N=748.
** Correlation is significant at $\rho < 0.01$
* Correlation is significant at $\rho < 0.05$

To ensure that there was no multicollinearity between the independent variables, the variance inflation factors (VIF) test was performed. This allowed us to conclude that all variables presented VIF values approximately equal to 1 and, consequently, that there is no risk of multicollinearity between the independent variables (Kutner et al., 2005). A logarithmic transformation was applied to the control variables in order to mitigate the effects caused by the large amplitude and extreme values of the results obtained. The same was not done for the independent variables of the model, which were kept in their original form, since when the natural logarithm was applied to them, the VIF test was compromised, revealing multicollinearity between the variables.

The analysis of the correlations presented in Table II reveals that among the three dynamic capabilities studied, Supplier Efficiency presents a significant correlation with the dependent variable Recovery. In addition to being significant, this relationship is also positive, which is aligned with the expectations. Additionally, the variable ln(Age) also presents a positive and significant correlation with the dependent variable, which suggests the importance of controlling for this variable.

4.2 Regression Analysis: Model Estimation and Results

In this section, the results obtained for the regression models are presented and analysed. These models were constructed with the intention of analysing the effect produced by each variable, both individually and when combined with the others. To this end, a base model (Model 1) was employed to assess the isolated impact of the control variables on the probability of recovery. Models 2, 3 and 4 test hypotheses 1, 2 and 3 and consequently, the influence of the variables Supplier Efficiency, Inventory Management and Operational Flexibility, respectively, individually. Models 5, 6 and 7 test the combined effect of the independent variables in pairs with the control variables. Finally, Model 8 aims to determine the impact caused by the action of all variables simultaneously, thus testing hypothesis 4.

(1) $\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age)$

(2) $\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Supplier\ Efficency$

(3) $\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Inventory\ Management$

(4) $\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Operational\ Flexibility$

(5) $\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Supplier\ Efficency + \beta_4 \cdot Inventory\ Management$

(6) $\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Supplier\ Efficency + \beta_4 \cdot Operational\ Flexibility$

(7) $$\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Operational\ Flexibility + \beta_4 \cdot Inventory\ Management$$

(8) $$\ln\left(\frac{P(Recovery=1)}{1-P(Recovery=1)}\right) = \beta_0 + \beta_1 \cdot \ln(Size) + \beta_2 \cdot \ln(Age) + \beta_3 \cdot Supplier\ Efficency + \beta_4 \cdot Inventory\ Management + \beta_5 \cdot Operational\ Flexibility$$

The results of the logistic regression models are presented in Tables III and IV. This division was made to facilitate reading and ensure analytical clarity.

The control variables were included in all eight models to control for the effects produced by firm age and size on the probability of recovery after a disruptive event. When analysing the results, it is possible to observe that the variable ln(Size) presents positive B coefficients and statistical significance in all models (p-value < 0.001). The values of the odds ratio [(Exp(B)] are between 1.246 and 1.282, which indicates that a one-unit increase in the logarithm of the number of employees generates between 1.246 and 1.282 times more probability of a company recovering after a disruption. These values are constant and robust in all models. On the other hand, the variable ln(Age) does not show signs of generating a relevant impact on the probability of recovery since it presents, in all models, low values for the coefficients and a lack of statistical significance. Despite registering values for Exp(B) ranging from 1.057 to 1.115, there is no indication that the maturity of companies influences the capacity for recovery.

TABLE IIIII

RESULTS OF BLR REGARDING FIRM RECOVERY FOR MODELS 1,2,3 AND 4

Variables	Model 1	Model 2	Model 3	Model 4
Constant	B = -1.344; Exp(B) = 0.261; p-value = 0.025	B = -2.444; Exp(B) = 0.087; p-value < 0.001	B = -1.509; Exp(B) = 0.221; p-value = 0.013	B = -1.355; Exp(B) = 0.258; p-value = 0.024
ln(Size)	B = 0.231; Exp(B) = 1.260; p-value < 0.001	B = 0.220; Exp(B) = 1.246; p-value = 0.001	B = 0.246; Exp(B) = 1.279; p-value < 0.001	B = 0.231; Exp(B) = 1.260; p-value < 0.001
ln(Age)	B = 0.109; Exp(B) = 1.115; p-value = 0.372	B = 0.066; Exp(B) = 1.068; p-value = 0.595	B = 0.098; Exp(B) = 1.103; p-value = 0.426	B = 0.108; Exp(B) = 1.114; p-value = 0.378
Supplier Efficiency		B = 2.138; Exp(B) = 8.481; p-value < 0.001		
Inventory Management			B = 0.006; Exp(B) = 1.006; p-value = 0.080	
Operational Flexibility				B = 0.000; Exp(B) = 1.000; p-value = 0.674
Wald Chi-Square	14.190 (p-value < 0.001)	34.844 (p-value < 0.001)	19.127 (p-value < 0.001)	14.417 (p-value = 0.002)
Nagelkerke R Squared	2.6%	6.3%	3.5%	2.6%
−2 Log likelihood	953.396	932.742	948.459	953.169

TABLE IV

RESULTS OF BLR REGARDING FIRM RECOVERY FOR MODELS 5,6,7 E 8

Variables	Model 5	Model 6	Model 7	Model 8
Constant	B = -2.505; Exp(B) = 0.082; p-value < 0.001	B = -2.853; Exp(B) = 0.058; p-value < 0.001	B = -1.557; Exp(B) = 0.211; p-value = 0.012	B = -3.055; Exp(B) = 0.047; p-value < 0.001
ln(Size)	B = 0.231; Exp(B) = 1.260; p-value < 0.001	B = 0.224; Exp(B) = 1.251; p-value = 0.001	B = 0.248; Exp(B) = 1.282; p-value < 0.001	B = 0.240; Exp(B) = 1.271; p-value < 0.001
ln(Age)	B = 0.061; Exp(B) = 1.062; p-value = 0.627	B = 0.063; Exp(B) = 1.065; p-value = 0.615	B = 0.096; Exp(B) =1.101; p-value = 0.434	B = 0.055; Exp(B) = 1.057; p-value = 0.660
Supplier Efficiency	B = 2.039; Exp(B) = 7.680; p-value < 0.001	B = 2.562; Exp(B) = 12.956; p-value < 0.001		B = 2.552; Exp(B) = 12.834; p-value < 0.001
Inventory Management	B = 0.004; Exp(B) = 1.004; p-value = 0.181		B = 0.006; Exp(B) = 1.006; p-value = 0.075	B = 0.005; Exp(B) = 1.005; p-value = 0.117
Operational Flexibility		B = 0.001; Exp(B) = 1.001; p-value = 0.099	B = 0.000; Exp(B) = 1.000; p-value = 0.527	B = 0.002; Exp(B) = 1.002; p-value = 0.052
Wald Chi-Square	37.336 (p-value < 0.001)	38.582 (p-value < 0.001)	19.776 (p-value < 0.001)	42.537 (p-value < 0.001)
Nagelkerke R Squared	6.7%	6.9%	3.6%	7.6%
−2 Log likelihood	930.250	929.004	947.810	925.049

The Supplier Efficiency variable presents positive coefficients and high significance across all models in which it participates (Models 2, 5, 6 and 8). Furthermore, it is the variable with the best explanatory power, with the highest Exp(B) values, varying between approximately 7 and 13. In other words, whenever the value of this ratio increases by one unit, the probability of the company recovering increases by approximately 7 to 13 times more than if the ratio had not increased. These results support hypothesis 1, which states that there is a positive relationship between Supplier Efficiency and the probability of a company recovering, since the effect caused by this variable is consistent and robust.

The Inventory Management variable reveled not statistically significant in every model in which it was integrated (Models 3, 5, 7 and 8), due to the high p-values and the lack of relationship with the independent variable. Furthermore, the values of the coefficients are very close to 0, and the corresponding values of Exp(B) are approximately 1 in all models, which shows a very weak and practically non-existent relationship. These results suggest that inventory management capability has no impact on the probability of recovery, thus rejecting hypothesis 2.

Regarding the Operational Flexibility variable, contrary to expectations, the coefficients have positive values in all models in which this variable is part (Models 4, 6, 7 and 8). However, although positive, the values of these coefficients are very close to 0, and the Exp(B) values are very close to 1, which indicates that there is practically no effect between the variable and the probability of recovery. Therefore, these results do not support hypothesis 3, which establishes the existence of a relationship between this variable and the probability of recovery. Even so, it is important to note that in Model 8, this variable is very close to the threshold of being considered statistically significant. However, since it is in Model 8, this result may be influenced by the simultaneous presence of the other independent variables. More specifically, due to the presence of the Supplier Efficiency variable, which has a high explanatory power, improves the overall quality of the model, making the effects of variables with weak effects more visible. This is demonstrated in Models 6, 7 and 8, since when combined with the Supplier Efficiency variable, the significance of the Operational Flexibility variable improves significantly, unlike what happens when it is combined with the Inventory Management variable. This reveals that, although this variable does not produce relevant effects in isolation (Model 4), it can produce a combined effect with other variables (Model 8).

Model 8 deserves special attention since it is the model that encompasses all the variables present in this study, and is therefore the most complete. The main objective of constructing this model is to evaluate the combined effect of the independent variables on the recovery capacity. In general, this model is statistically significant, which is proven by the high value and significance of the Chi-Squared test ($\chi = 42.537$; p-value = < 0.001). This means that as a whole, Model 8 significantly improves the recovery prediction of companies when compared to the null model. In addition, when compared to the null model, Model 8 also presents a better fit to the observed data, which is proven by an improvement in the value of the -2 Log likelihood, which assumes the value of 925.049 and 967.586 in the null model. The observed value for Nagelkerke R-squared explains approximately 7.6% of the variability in recovery probabilities. The fact that this value is low can be justified by the complexity of the dependent variable, and because this is an exploratory study. Accordingly, Model 8 partially supports hypothesis 4 since, despite the robustness and significance of the model, not all variables present in the model are considered statistically significant. Only the Supplier Efficiency variable has a significant impact on the dependent variable. Although the Operational Flexibility variable may present a possible association with the dependent variable, it is not strong enough to establish this relationship with confidence. In addition, the Inventory Management variable does not suggest any relationship with the Recovery variable. Hence, it is possible to conclude that the combination of independent variables contributes to explaining Recovery, although in a limited way.

In general, in the remaining models, it is possible to observe that Models 1, 3, 4, 5, 6 and 7 are significant, although the significance of Models 3 and 6 is weak. The only model that is not significant is Model 2, because it only includes the Inventory Management variable.

4.3 Discussion of the Results

This section critically interprets the effects of the studied capabilities – Supplier Efficiency, Inventory Management and Operational Flexibility – on the probability of companies' recovery. It is also the objective of this section to discuss the main results obtained in relation to the theoretical framework previously outlined in the literature review section.

The results obtained for the control variable ln(Size) indicate that larger companies have a higher probability of recovery. This may be explained by larger companies having more financial and human resources, which translates into a greater capacity to absorb the shocks caused by disruptions. On the other hand, the control variable ln(Age) did not demonstrate any relationship with the Recovery variable, suggesting that maturity, in isolation, is not synonymous with adaptability and depends on its conjunction with other factors.

The Supplier Efficiency variable proved to be the most relevant factor in explaining recovery, since a small increase in this ratio causes a substantial increase in the probability of recovery. This can be explained by the direct relationship that the ratio has with EBITDA, which corresponds to the indicator used to measure resilience. In practice, companies that present lower COGS in relation to revenue retain more value in each sale they make, which translates into a higher EBITDA and therefore, according to what was established in this study, a greater probability of recovery. The findings are in line with what was presented in the literature, since the results suggest that this capacity can be seen as a dynamic capacity that contributes positively to resilience. It is possible to establish this relationship since companies with greater efficiency in cost management tend to adapt better to price fluctuations after a disruption (Teece and Pisano, 1997). These lower COGS values may be a result of greater bargaining power with suppliers, more stable relationships or greater diversification, which is in line with what was stated by Defee and Fugate (2010) and by Rice and Sheffi (2005). The contribution to resilience is corroborated by Christopher (2011), who highlights the importance of efficient management at critical points in the supply chain.

The Inventory Management variable, measured through stock turnover, did not show any effect on the probability of recovery. Although authors such as Christopher & Peck (2004) and Rice & Sheffi (2005) argue that flexibility and agility – characteristics that can be attributed to inventory management – contribute to the creation of resilience, stockturnover turnover as a metric may not have a direct impact on EBITDA and only manifest effects in terms of the company's responsiveness. Additionally, this lack of relationship between the two variables can be explained by the fact that several companies adopt different inventory strategies, namely with regard to the decision to maintain or not safety stock, which causes high variability in the sample. According to Rice and Sheffi (2005), the creation of safety stock to ensure business continuity in the event of disruption is considered a practice associated with the creation of resilience. However, this strategy may cause the value of inventory turnover to decrease as a consequence of keeping inventory in stock for a longer period. In other words, from an operational point of view, lower values for this ratio do not necessarily mean inefficiency. They may simply mean that the company has taken precautions against potential risks. However, in this study, resilience was measured using EBITDA, which means that, in this context, higher stock turnover values indicate greater efficiency and faster conversion of stock into sales. In other words, taking into account the chosen model, higher stock turnover values are interpreted as being better for the company because they are associated with the capacity for financial recovery after a disruption.

The results obtained regarding the Operational Flexibility variable revealed that there is practically no relationship between this variable and the Recovery variable. As mentioned in the methodology section, and supported by the authors Rice and Sheffi (2005) and Jüttner and Maklan (2011) in the literature review, the flexibility capability encompasses a wide variety of dimensions, which means that the method chosen to approximate this variable, in practice, may not be able to capture this complexity. This can be considered one of the reasons for the lack of relationship between the two variables. Similar to what occurs with the Inventory Management variable, there is also ambiguity in the interpretation of the results for the Operational Flexibility variable. This occurs because, according to the literature, in the context of creating resilience, a higher number of days inventory on hand ratio may be a good practice. However, considering the context in which this work is inserted, lower values of this ratio are more desirable due to the financial nature of the dependent variable. In this reality, lower ratio values are associated with lower inventory costs, greater liquidity and therefore greater financial sustainability. In addition to the above, it is also important to note that the fact that this variable did not demonstrate a relationship with the Recovery variable in isolation does not mean that it is not relevant when combined with other capabilities. This idea aligns with the results obtained, given that significance was obtained for this variable in Model 8. This idea is also in line with the literature, as Teece and Pisano (1994, 1997) argue that a company's ability to adapt to constant changes comes from the way it can combine and integrate multiple capabilities.

5. Conclusion

The main objective of this study involved analysing whether the capabilities – Supplier Efficiency, Inventory Management and Operational Flexibility – have an influence on the probability of companies recovering in a disruptive context. Recovery was measured by comparing EBITDA for the years 2019 and 2023. The results obtained, through logistic regression models, revealed that, of the three variables under study, only the Supplier Efficiency variable was statistically significant and had an impact on the probability of recovery. In practice, this means that companies that are more efficient in managing their costs with suppliers have a higher chance of recovery after a disruption. On the other hand, the results obtained for Inventory Management and Operational Flexibility showed no signs of being related to companies' recovery. However, the Operational Flexibility variable proved to be statistically significant when combined with the other variables.

From a theoretical perspective, the results reinforce the relevance of dynamic capabilities, namely supply chain dynamic capabilities, in creating resilience. Nonetheless, they confirm the complexity of the phenomenon under study and the challenges associated with its measurement. The partial validation of the hypotheses through the results exposes relevant questions about the alignment between theory and the indicators chosen to carry out this study. In practical terms, the results suggest that retail companies should prioritise the efficient management of costs with suppliers to ensure their recovery after periods of disruption. Additionally, the findings highlight the importance of using an integrated approach for supply chain management in order to leverage results, given that the combination of several relevant capabilities can generate a more consistent and robust impact than the isolated action of each one.

Even though the results produced were relevant, this study has some limitations. The complexity and multidimensionality of the concept of resilience make this phenomenon difficult to measure, which also makes it difficult to capture its results accurately. Therefore, one of the main limitations of this study lies in the way in which resilience was operationalised. This concept was measured based on the variation in results between the 2019 EBITDA and the 2023 EBITDA, assuming that superior financial performance in the post-pandemic year would translate into greater adaptive capacity and recovery on the part of the company. However, even though this metric is relatable to the phenomenon and generates objective and comparable results, it does not capture all dimensions of the phenomenon, capturing only the financial dimension. Therefore, by limiting the analysis to this dimension alone, it is possible that the remaining dimensions of resilience were not captured. In addition, and as a consequence of what was mentioned above, another limitation present in this study is related to how dynamic capabilities were operationalised. This operationalisation was done through indicators present in the ORBIS database, which restricted the analysis to the available indicators and left out other measurable dimensions.

Based on the above discussion, future research may benefit from a more comprehensive approach that combines both quantitative and qualitative variables, such as interviews. This combination of strategies may be closer to fully capturing the various dimensions that constitute resilience. Furthermore, the significant trend recorded for the Operational Flexibility indicates that this variable may have a relevant impact on recovery, especially when combined with other variables. Thus, future research may investigate this relationship through larger samples or through other ways of operationalising the variable.

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