



## EXAMINING THE IMPACT OF BREXIT ON SUPPLY CHAIN RISK MANAGEMENT: EVIDENCE FROM THE UK MANUFACTURING SECTOR

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### Abstract

The 2016 Brexit Referendum in the UK resulted in a withdrawal from the EU that has brought a lot of uncertainty to the supply chains (SC) in the manufacturing sector. The manufacturing sector that operates in a highly integrated EU market and relies on a significant number of EU workers is facing sharp changes in the SC. To improve resilience to the SC risks caused by Brexit, supply chain risk management (SCRM) can play a crucial role in adopting effective strategies. Although the literature highlights both, advantages and disadvantages of Brexit, this study focuses on the potential consequences on the SC. Through a systematic literature review approach, the research aimed to analyse Brexit impact on SCRM in the manufacturing sector in the UK. The research reveals that the manufacturing sector is not resilient to a barrier to trade risk and suspending SCRM decisions in the latest sequence of political events didn't help to improve resilience. Findings emphasize the disadvantage of stockpiling due to increased cost and reveal that reorienting SC to a domestic market from the EU could mitigate SC risks more effectively than reorienting to non-EU countries. Research also outlines specific areas where SCM should be aware such as foreign direct investment (FDI) from non-EU countries and increased rates of pay.

**Keywords:** Brexit, supply chain risk management, manufacturing sector, United Kingdom, resilience.

### INTRODUCTION

The Brexit Referendum results in 2016 left considerable uncertainty for the economies around the world over the nature of the EU-UK relationship. The latter sequence of political events, such as Brexit deal rejection, Brexit delay, changes of prime ministers, Parliament suspension, led to uncertainty and reflected a potential of the worst Brexit scenario called "No-Deal Brexit". On December 24, 2020, the UK and the EU struck a provisional free-trade

agreement that ensures the two sides can trade goods without tariffs or quotas. However, key details of the future relationship remain uncertain, such as trade in services (Nelson, 2020). Brexit impact on the economies can be reflected in their supply chains. Competitive advantage can be damaged due to disturbances in operational performance (Rajesh, 2018). Therefore, disruption in the supply chain network can significantly affect the performance of a company. To manage complex networks of suppliers and customers, and ensure a better supply chain (SC) performance, managers have to apply a risks mitigation strategy (Rajesh, 2018).

A starting point to understand why Brexit brings uncertainty to the SCRM in the manufacturing sector is to highlight the benefits of being an EU member. Being a part

#### ARTICLE INFO

##### Article history:

Received: 18 April 2021

Accepted: 14 June 2021

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of the EU means no customs duties, or charges for goods, services, capital between member countries (Eur-lex.europa.eu, 2019a), worker's mobility (Eur-lex.europa.eu, 2019b), research and innovation programmes to ensure global competitiveness (Eur-lex.europa.eu, 2019c), the attractive export market for non-EU countries under WTO rules, and attractiveness for FDI due to a Single Market (Eur-lex.europa.eu, 2019d). It is clear that being a member of the EU since 1973 (European Union, 2019), provided an opportunity for the UK manufacturing sector to improve the supply chain network and attract foreign investors. In fact, the UK accounted for 54% of total EU imports and 46% of EU exports (House of Commons, 2019) in 2018. In the same year, the manufacturing sector employed the largest number (14%) of total EU workers in the country ("Employment by nationality", 2018). Moreover, according to the OECD data, the manufacturing sector counted for 23% of total FDI inflows in 2016 (OECD, 2019). As the statistics demonstrate, the manufacturing sector with highly into the EU market integrated SC is one of the most intensive users of inputs taken from the EU. Consequently, UK withdrawal from the EU can be seen as a sharp change in the legislations affecting SC in the manufacturing sector, and thus, effective supply chain risk management (SCRM) is the biggest concern to remain resilient in the post-Brexit world.

Despite a rich literature on the SCRM, the number of research papers on SC risks analysis in the context of Brexit is scant. The studies have to be brought on a larger scale to identify key SC risks caused by Brexit, and how they affect SC performance. Furthermore, SCRM strategies adopted in the manufacturing sector to mitigate SC risks and remain resilient have to be investigated. Therefore, this study aims to analyse the impact of Brexit on SCRM in the UK manufacturing sector. To achieve this aim, the study will systematically analyse SCRM concepts in light of the uncertainty due to Brexit and develop a conceptual framework of the relationship between SC risks and SC performance in the manufacturing sector. The

study will also investigate common strategies the manufacturing sector employs in response to environmental uncertainty and identify current SCRM strategies adopted by businesses in the transition period of Brexit to remain resilient. Finally, we aim to make recommendations on the uncertainties from Brexit for the SC of the manufacturing sector in the UK.

## LITERATURE REVIEW

In a global environment, companies operate with numerous links connecting wide network firms (Manuj and Mentzer, 2008). It means the more global a company is, the more complex its SC network. However, a dyadic exchange relationship in a global environment means more stress to predict and control SC. Therefore, to improve SC performance companies adopt an SCRM approach to identify, evaluate and mitigate unexpected conditions in the SCM process (Ho et al., 2015). Altogether bankruptcies, breakdowns, natural disasters, economic and political changes affect global SC in terms of performance and resilience. Recently economic and political changes in the UK caused by Brexit has made practitioners concerned about future decisions to maintain SC performance and resilience.

A significant number of journals and various research papers focusing on the Brexit impact on SC were released after the Brexit Referendum, reflecting various opinions about the future of the SC. A division of opinions has been following a transition of Brexit since the Referendum in 2016 when 48 % of citizens voted for remaining in the UK, and 52 % of citizens voted for leaving the EU. A three years of transition process raised a number of questions in terms of the future of the SC. Especially concerned are companies in the UK having tight integration in the EU market, e.g. UK biggest manufacturers expressed their concerns about tariffs and access to trade (Rawlinson, 2018; Tovey, 2018; Jolly, 2019), causing a first Manufacturing Index decrease below 50 on June 2019, representing a contraction in SC (Investing.com, 2019). Hence, it is important to objectively evaluate factors

affecting SCM to maintain an effective SC performance and resilience.

Although extensive researches have been carried out on SC risks in the Brexit context and Brexit impact on international UK companies and their SC, no studies exist identifying the most prominent Brexit-related SC risks and explaining how those risks affect the SC performance. Moreover, research studies on SCM often focus on different industries, e.g. food industry (Symes and Phillipson, 2019; Hendry et al., 2019; Poppy et al., 2019), or the automobile industry (Bailey and Proprius, 2017). Additionally, some studies demonstrate a lack of integration of various aspects, e.g. analysing SC resilience without evaluating SC risks (Safonovs and Upadhyay, 2017). Therefore, this literature review aims to analyse SC risks and their outcomes in the manufacturing sector. To address this aim, a systematic literature review was implemented due to the need for objective observation of conflicting viewpoints, the synthesis of findings, analysis of the evidence used for the researches and its

relevancy to the SCM in the manufacturing sector. Collectively, studies from the different perspectives outline a critical role for theory development for further practical analysis.

## MATERIALS AND METHODS

From an evidence-based practice perspective, this systematic literature review seeks to gather, evaluate and synthesize journal articles to provide relevant information for future decisions in SCRM and minimise uncertainty to increase SC performance and resilience. According to Pettigrew and Roberts (2006, p. 2), a systematic review helps to make sense of a big range of information, and deny spurious certainty. The latter argument is very important in the context of Brexit, as many unreliable research papers may shape a wrong public opinion, bring more uncertainty and affect SCRM. From the management perspective, a systematic literature review helps to support professional development (Pettigrew and Roberts, 2006), e.g. to develop an SCRM practice in a Brexit context.

Table 1. *Keywords Used in SLR Process*

| Keywords   | Discipline   | Subject Terms   | Results       |
|--|--|---|---------------|
| "Risk management" and "Supply chain performance" and "Brexit"  |  | All   | 169           |
| "Uncertainty" and "Supply chain" and "Brexit", but not "Risk management"                               |  | All   | 162           |
| "Supply chain resilience" and "Brexit", but not "Risk management"                                      |  | All   | 36            |
| "Supply chain" and "Risk management" and "Brexit", but not "Resilience" and "Supply chain performance" | Business, economics, international law, engineering, government, political science | All   | 370           |
| "Supply chain risks" and "Supply chain management" and "Supply chain performance", but not "Brexit"    |  | Studies, management, analysis, economics, business, performance, operations research & management science, supply chains, supply chain management, engineering, manufacturing, risk, operations research, production/logistics/supply chain, risk, risk assessment, studies, supply chain management. | 39.276        |
| <b>In total</b>  |  |   | <b>40.013</b> |

### Determining Types of Studies and Data Collection

On an extensive range of sources, there are four main criteria, including relevant keywords, type of sources, dates of sources and quality, for studies selection. Firstly, to increase precision in the sources selection key words were identified. Based on the literature review research questions different combinations of keywords “SC”, “Risk management”, “Brexit”, “SC resilience”, “SC performance”, “Manufacturing”, “Uncertainty” assist in searching relevant studies. Secondly, the type

of sources is academic research papers. Thirdly, not older than 15 years papers were searched to ensure relevance to nowadays business environment. The search was also limited to the 2005-2019 period as research was conducted before the final Brexit sign off in December 2020. This period is relevant for understanding the dynamic nature, innovation, and enhancement of SCRM. Finally, to ensure the quality of the sources, journal papers were chosen based on the Academic Journal Guide (ABS) 2018 ranking, including journals with the ranks of 4\*, 4 and 3\*.

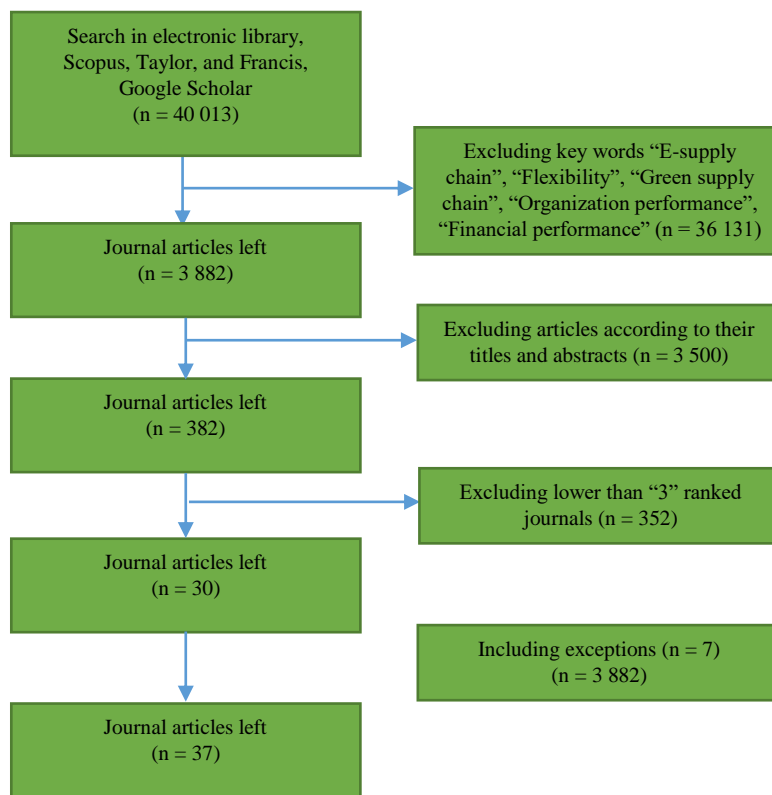


Figure 1. A Scheme of Selection of Journal Articles

The search of journal articles was conducted in several bibliographic databases, including electronic library search, Scopus, Taylor and Francis, Google Scholar. The data collection process commenced from a search of articles using different keywords combination. To avoid repetitive papers the following search excluded keywords used in the previous search (see Table 1). As the last combination of keywords had a large number of results, the search spectrum was narrowed down by using

relevant subject terms. Figure 1 shows the final sampling process followed in the research.

To interpret and integrate data across studies examining SC risks, and SC outcomes, a thematic synthesis – grounded theory method is considered as the most appropriate (Saini and Shlonsky, 2012). Moreover, this method assists in aligning studies in Brexit and non-Brexit contexts, linking together resilience-oriented and performance-oriented studies, comparing studies with a core element of SC

risks and studies where risks are just contextual.

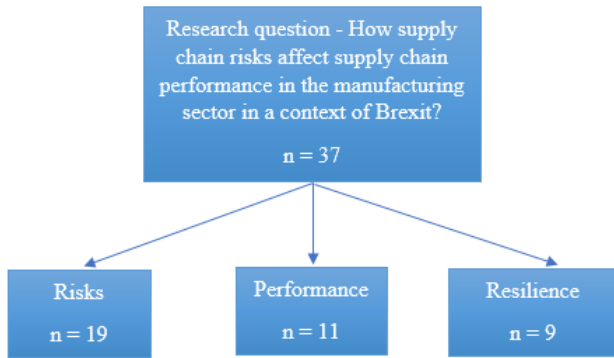


Figure 2. Descriptively Categorized Research Papers

The final 37 journal articles (see Appendix I) by major concepts were categorized into three simple groups with regard to the aim of the literature review: SC risks, performance, and SC resilience (see Figure 2). Some articles covered more than one category, and thus belonged to a few groups. Coding every research paper allowed us to identify core themes and compare papers in each category. Subsequently, the outcomes of each group were aligned. Table 2 presents the journals where the shortlisted sample papers were published.

**RESULTS AND DISCUSSIONS**

The vast majority (51%) of the journal articles from the final sample studied the manufacturing sector while the rest 49% of the papers studied food, real estate, financial industries.

**Thematic Analysis**

Thematic analysis assisted in the extraction of core patterns and themes from every research paper (Tranfield et al., 2003) in the sample. A preliminary categorization of the research papers presented in Figure 2 indicates that they concentrate on different subjects that align in some cases. To visualise and structure the researches, a thematic map was created and presented in Figure 3. Journal articles were thematically categorised by building construction between them with alignments and linkages. At this stage, more specific groups were created according to the findings, contexts, industries, core elements, relationships. This classification implemented coding followed by a comparison of the papers in specific categories. The thematic map indicated the number of articles published per category and demonstrated the connection between specific categories of papers when blue colour meant research papers focused on the manufacturing industry, orange - researches in the Brexit context.

Table 2. Identified Articles by Year and Journal

| Journal  | Journal Ranking | Year |      |      |      |      |      |      |      |      |      |
|--|-----------------|------|------|------|------|------|------|------|------|------|------|
|  |                 | 2005 | 2007 | 2010 | 2013 | 2014 | 2015 | 2016 | 2017 | 2018 | 2019 |
| Academy of Management Journal  | 4*              |      |      |      |      |      | 1    |      |      |      |      |
| British Journal of Management  | 4               |      |      |      |      |      |      | 1    |      |      |      |
| Cambridge Journal of Regions, Economy and Society                      | 3               |      |      |      |      | 1    |      |      |      |      |      |
| European Economic Review   | 3               |      |      |      |      |      |      |      |      | 1    |      |
| Fiscal Studies   | 2               |      |      |      |      |      |      |      |      | 4    |      |
| Intereconomics   | 1               |      |      |      |      |      |      |      |      | 1    |      |
| International Journal of Operations & Production Management            | 4               |      | 1    |      |      |      | 1    |      |      | 1    | 1    |
| International Journal of Production Economics                          | 3               |      |      |      |      |      | 3    | 2    | 2    |      |      |
| Journal of Banking and Finance   | 3               |      |      |      | 1    |      |      |      |      |      | 1    |
| Journal of Common Market Studies                                       | 3               |      |      |      |      |      |      |      |      | 1    |      |
| Journal of Operational Research Society                                | 3               |      | 1    |      |      |      |      |      |      |      |      |
| Journal of Regional Science  | 3               |      |      |      |      |      | 1    |      |      |      |      |
| Journal of Social Policy   | 3               |      |      |      |      |      |      |      | 1    |      |      |
| Journal of Royal Statistical Society: Statistics in Society (Series A) | 3               |      |      |      |      |      |      |      |      |      | 1    |
| National Institute Economic Review                                     | 1               |      |      |      |      |      |      |      | 1    |      | 1    |
| New Political Economy  | 3               |      |      |      |      |      |      |      |      | 1    |      |
| Omega  | 3               |      |      |      |      | 1    |      |      |      |      |      |
| Production and Operations Management                                   | 4               | 1    |      |      |      |      |      | 1    |      |      |      |
| Production Planning and Control  | 3               |      |      | 1    |      |      |      |      |      |      |      |

|   |                 |      |
|---|-----------------|------|
| Regional Studies                                  | 3               | 1    |
| Supply Chain Management: An International Journal | 3               | 1    |
| The European Journal of Comparative Economics     | 3               | 1    |
| Total:  | 1 2 1 1 2 6 4 4 | 12 4 |

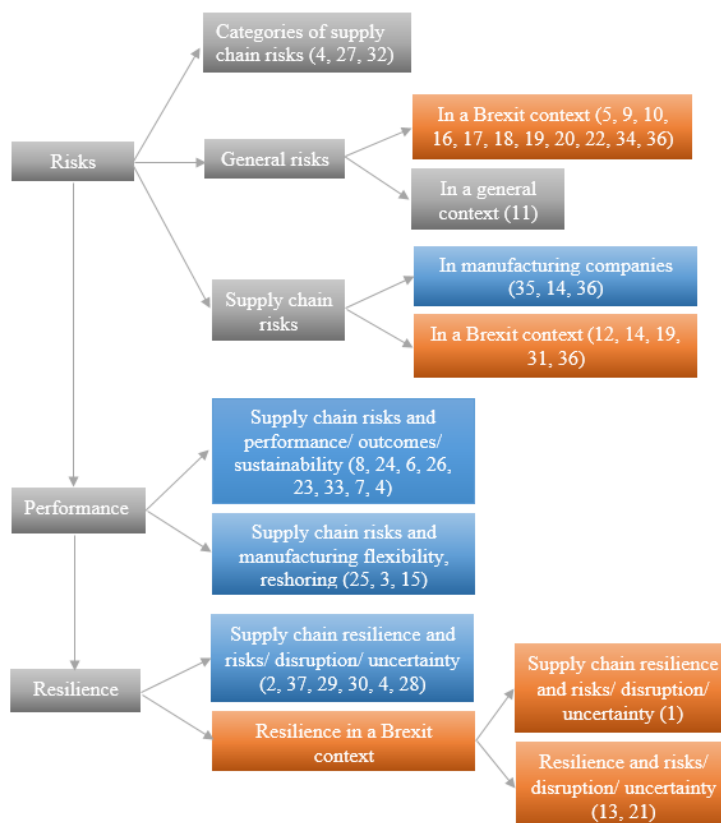


Figure 3. Thematic Analysis Map

At the first stage, risks were analyzed at the macro level, including general risks, and micro level, including SC risks. Moreover, the thematic map demonstrates a high number of studies analyzing potential risks that were linked to the SC risks. Subsequently, risks were linked to the Brexit context. A significant number of researches in the Brexit context showed an expressed concern in this area in recent years. At the second level, most of the journal articles analysed the connection between SC risks and performance. Hence, there was an evident linkage between the first and the second levels. In fact, journal articles were based on the evidence from the manufacturing companies, and a significant

number of articles was focused on SC risks. At the final level, SC risks and performance were linked to SC resilience. In general, a thematic map demonstrates how the broad context is narrowed down to the manufacturing sector and Brexit oriented research.

**Risks**

The framework of the “Risk” category aims to identify SC risks affecting SC of the manufacturers in the UK in the Brexit context. The map suggests that risks have to be examined from two viewpoints: the company as a whole and the SC. A comparison of two viewpoints reveals a broader risk identification area and different risk factors. Furthermore,

each viewpoint investigates risks and uncertainty in the general context, as well as particularly analyses risks caused by Brexit Referendum.

SC risks being an event-oriented concept strongly relate to disruptive events and their consequences (Heckaman et al., 2015). Therefore, SC must respond quickly to internal and external risks to maintain dynamism and efficiency (Aqlan and Lam, 2015). However, uncontrollable risk factors, such as natural disasters, political instability or economic issues, compel SC managers to make decisions under uncertainty without having information about the trigger (Heckaman et al., 2015). Researchers often divide risks into distinct categories (Heckaman et al., 2015; Aqlan and Lam, 2015; Kleindorfer and Saad, 2005), as it is important for understanding risk factors, their impact, prioritising them and making a response plan. From the financial perspective, SC controlling capital resources of the company can face financial risks arising from the losses due to exchange rates, market prices, debts (Heckaman et al., 2015). From an operational

perspective, operational risks often refer to complexity (Heckaman et al., 2015). Other researchers to operational risks category also involve human-centred issues and identify political instability as an important source for SC risks (Kleindorfer and Saad, 2005). Additionally, Aqlan and Lam (2015) refer to political uncertainty and economic issues as “Customer Risk” and “Supplier Risk” factors, related to trade in manufacturing companies. To sum up, journal articles related to risk categorization identify SC risk categories that refer to Brexit are financial risks, operational risks, and risks arising from political instability.

*Categorization of Risks in the Brexit Context*

Figure 4 provides an extended scheme of the “Risk” category from Figure 3 and classifies risks identified in the journal articles. The study measuring default risks on UK stock returns found that an increase of default risk decreases stock market returns (Chen and Hill, 2013). This statement can be compared to the findings of recent studies in the Brexit context.

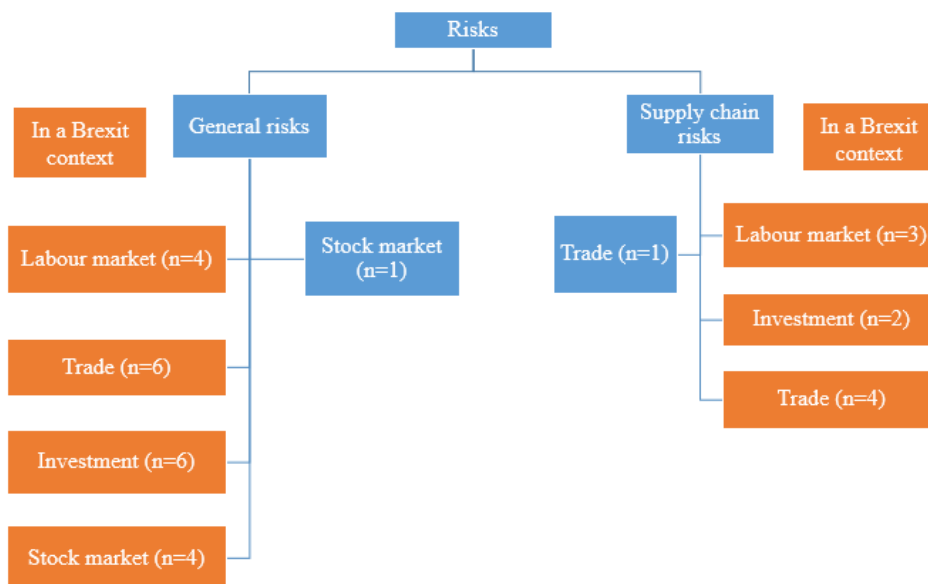


Figure 4. A Scheme of Risks Identified in the Journal Articles

*Stock market*

The research studies based on market research data identify a negative stock price reaction after the Brexit Referendum, by providing evidence from

the FTSE data (Davies and Studnicka, 2018; Hill et al., 2019; Breinlich et al., 2018; Cumming and Zahra, 2016). Differently from other researchers, Hill et al. (2019) presented an extended FTSE

data analysis by providing evidence of the negative reaction of stock prices before the Referendum, when Brexit was a possibility, and significant stock prices decrease after the UK voted for Brexit. Furthermore, Breinlich et al. (2018) extended the analysis to follow stock prices after the former prime minister's speeches. Studies conclude that EU-oriented firms performed worse, while companies with international diversification outside the EU had a greater reaction to the political changes in the UK after the Brexit Referendum (Davies and Studnicka, 2018; Hill et al., 2019). However, sensitivity to political changes can be explained by investors' expectations of an economic slowdown and exchange rate depreciation (Breinlich et al., 2018). An expectation of a "Hard" Brexit leading to tariff barriers was the determinant of a negative stock exchange reaction. Taken together, the results of the studies show that a decrease in stock prices is a reaction to an uncertainty of the trade barriers. As long as there is no certainty in a post-Brexit business, stock prices remain at risk.

#### Investment

The evidence from the previous studies also demonstrates a connection between stock market returns and investors (Breinlich et al., 2018). A decrease in the stock price was a response of investors to the post-Brexit policy that downgraded expectations for the future UK businesses' growth (Breinlich et al., 2018). This evidence supports a theoretical statement provided by Hill et al. (2019) that when political uncertainty increases, firms tend to cut investments. Hence, stock prices reflect investors' reactions to uncertainty. Controversially, Perraton and Spreafico (2019) have noticed that the UK continues to attract FDI inflows. This distinction emerges from the recent

analysis of the time period since the Brexit Referendum, rather than analysing the response to the shocking events. On the other hand, a researcher highlights a considerable uncertainty of the post-Brexit FDI inflows (Perraton and Spreafico, 2019). Several studies have found that a decrease in stock prices has an impact on future investment opportunities (Davies and Studnicka, 2018; Farnsworth, 2017; Breinlich et al., 2018). The UK is a highly dependent on FDI country distinguishing by low corporation taxes, low regulations and low wage taxes (Farnsworth, 2017), accounts for 43 % of total FDI from the EU (Driffield and Karoglou, 2019). Hence, in other conditions, the UK might not be attractive for FDI. Likewise, studies outline that uncertainty about post-Brexit policies puts pressure on investment funds, pushing them to relocate businesses out of the UK (Welfens, 2018; Farnsworth, 2017). Evidence from the case study of an automobile company outlines the negative impact of Brexit on business (Farnsworth, 2017). Uncertainty about the post-Brexit policies encouraged "Nissan" to consider the possibility to relocate activities to other countries. However, promises to grant and support investment from the former prime minister encouraged a company to continue to invest in the UK (Farnsworth, 2017). This case demonstrates uncertainty in future investments in the UK, as there are no assurances that companies will be supported. Moreover, it remains unclear if the other companies from the manufacturing industry will be supported by the UK government. Therefore, the future of investments remains unclear.

#### Trade

Some researchers identify trade uncertainty as a trigger of stock price fluctuation and intention of investment



relocation (Welfens, 2018; Breinlich et al., 2018; Perraton and Spreafico, 2019), as the stock market reflects investors' expectation of high trade tariffs. Therefore, a reasonable amount of research studies have focused on the post-Brexit trade barrier. It is especially important for UK industries that are more dependent on trade with the EU (Bloom et al., 2018), as it may no longer be a member of the EU's Single Market or Customs Union (Breinlich et al., 2018). Instead, the UK might trade under WTO rules, meaning higher tariffs, or under a free trade agreement with the EU and other EEA states (Breinlich et al., 2018). Researchers' findings demonstrate concern in the context of UK-EU trade, as well as in a global environment, as both are in a negotiating process and are difficult to predict. However, Brexit provides more uncertainty to the post-Brexit EU-UK trade (Bloom et al., 2018; Hix, 2018), while in a global environment there seem to be more optimistic viewpoints (Cumming and Zahra, 2016; Ijtsma et al., 2018). One of the studies determines that negotiations between UK and EU27 may lead to a basic free trade agreement (Hix, 2018). Studies also indicate that there may be opportunities to benefit from trade outside the EU, e.g. reorienting export to demanding East Asian countries (Ijtsma et al., 2018), directly negotiate beneficial conditions with North America (Cumming and Zahra, 2016), negotiate free deals with China, India, Canada, Australia and New Zealand (Welfens, 2018). As long as there is no compromise on a trade agreement, a barrier to trade remains a priority risk due to its high uncertainty and stimulation of other risks.

#### Labour market

An existing connection between the immigration of skilled labour force and investment flows associates a barrier to immigrate with other risks, such as

investment relocation, stock price depreciation, and so a barrier to trade (Cumming and Zahra, 2016). However, Cumming and Zahra (2016) didn't provide evidence of how this connection is relevant to the UK. On the other hand, a connection between post-Brexit immigration policy and entrepreneurship in the UK was provided by Breinlich et al. (2018), who concluded that immigration policy was one of the reasons for investors' sensitivity resulting in stock price depreciation. In general, Brexit means a barrier for a free labour trade from the EU to the UK (Breinlich et al., 2018). Different political conditions might lead to a fall in the numbers of immigrants from the EU resulting in a decrease in the workforce. Consequently, companies with a high dependency on EU migrant labour encounter a higher uncertainty (Bloom et al., 2018; Breinlich et al., 2018). The importance of the EU immigrants is demonstrated by Wadsworth (2018), who provided statistical evidence that EU immigrants share a large part of occupation in the UK. At the transition process between pre-Brexit and post-Brexit, a significant number of firms suffer from uncertainty in terms of workforce, as it is not clear who can change a labour force from the EU in the post-Brexit environment.

To sum up, the research papers identify four risks and demonstrate the origins of risks and a strong correlation between them. Uncertainty of the post-Brexit policies affecting trade tariffs and immigration induce investors' reaction, which is reflected in the FTSE data. Consequently, stock prices decrease affects future investments. However, studies covered a wide context from a business perspective. Therefore, to determine its connection to SC, the research papers from the SC perspective were compared.

#### Supply Chain Risks in the Context of Brexit

### *Stock Price Depreciation*

The thematic map (see Figure 3) demonstrates a partial alignment between identified risks for firms and risks for SC. Journal articles around SC didn't distinguished stock price depreciation as a threat to the SC. However, Heckman et al. (2015) highlight the importance of financial risk assessment for SCM. Financial risks can cause losses through debts, exchange rates, loss of investors (Heckman et al., 2015). Therefore, financial losses can limit capital resources, and by contraction, SC activities. Moreover, due to more than half of the value added by foreign firms in the UK, SC in many sectors in the UK are dominated by foreign firms (Driffield and Karoglou, 2019). Therefore, many supply chains are reliant on FDI inflows.

### *Relocation of Investment*

In terms of capital inflow, FDI has a significant impact on SC, as decisions made under post-Brexit uncertainty can move supporting sectors and SC away from the UK (Driffield and Karoglou, 2019). Researchers also highlight the importance of secure SC from financial risks to attract more activities along with SC. However, it highly depends on trade tariffs for supplies from the EU to UK (Driffield and Karoglou, 2019), as anything that puts the SC relationship at risk reduces investment (Bailey and Propriis, 2017). The evidence from case studies of automobile companies demonstrates that a considerable uncertainty that Brexit Referendum left makes companies wait for the clearer terms of Brexit for the future investment decisions on the assembly in the UK due to higher costs and delays at the border (Bailey and Propriis, 2017).

### *Barrier to Trade*

The analysis of trade in the manufacturing sector highlights cost-benefit integration through the chains, resulting in lower-cost production and higher profitability, however, is at the risk in terms of trade policy and international trade rules (Baldwin and Evenett, 2014). To be more specific, different trade agreements with higher tariffs might

encourage relocating FDI inflows to other countries due to the inability to access the EU Single Market through the UK (Bailey and Propriis, 2017). For the manufacturing sector which is fragmented along with global suppliers, a Single Market means an easier way to conduct business across borders (Bailey and Propriis, 2017). Therefore, under higher tariffs, it might become more particularly costly to coordinate complex international SC. Ijtsma et al. (2018) provide evidence that the manufacturing industry is the most intensive user of foreign inputs, and around half of the inputs are taken from the EU. Additionally, Perraton and Spreafico (2019) provide statistical evidence that almost half of companies in the UK, who work with EU27 suppliers are planning to replace their suppliers from the EU27. Together this statistical evidence indicates that trade barriers can disrupt the majority of EU-UK SC in the manufacturing sector.

### *Barrier to Immigrate*

Moreover, the manufacturing sector in the UK employs a higher share of immigrants from the EU (Bailey and Propriis, 2017). The investors are concerned that immigration limits may affect profits in manufacturing companies due to a loss of skilled labour force in assembly and SC and spending extra time on complying with immigration regulations (Bailey and Propriis, 2017). Therefore, skilled labour market flexibility in UK manufacturing companies is an important factor for attracting FDI (Bailey and Propriis, 2017; Driffield and Karoglou, 2019). A loss of low-skilled workers in SC also can increase costs (Green, 2019). Primary research indicates that to fill low-skilled jobs after a restriction of free immigration from the EU, UK based companies have to make it more attractive to UK-born workers, e.g. increase rates of pay (Green, 2019).

All in all, a synthesis of studies reveals four key risk drivers originate from the international uncertainty of post-Brexit policies that are beyond the control of the manufacturers in the UK. A risk arising from uncontrollable risk factors, e.g. political instability, is a trade

barrier. This risk is a foundation for the growing uncertainty and encourages many researchers to analyse it as the number of research papers shows (see Figure 4). Moreover, a barrier to trade raises financial risks, such as stock price depreciation and relocation of investments affecting SC. Finally, operational risks involving human-centred issues reflect a barrier to immigration risk.

### **The Impact of SC Risks on SC Performance**

A conceptual map demonstrates that no studies measuring performance in the context of Brexit have been done. Therefore, this part of the literature review aims to align identified key SC risks, caused by Brexit to SC performance and present them in the Bow-Tie analysis. Although the majority of studies have been done in the context of the Asian manufacturing business environment, the framework reflects relevance to business in the UK.

A strong connection between risks and performance in a supply chain context has been identified by many researchers, suggesting that unavoidable risks often have consequences to performance at a global scale (Ritchie and Brindley, 2007b; Kauppi et al., 2016; Truong Quang and Hara, 2017; Davarzani et al., 2015). Widely used measures for SC performance are categorized into efficiency and effectiveness (Ritchie and Brindley, 2007a, 2007b; Heckmann et al., 2015), where efficiency is regarded to a greater volume of outputs and cost, and effectiveness reflects how the outcomes are achieved. Ritchie and Brindley (2007a) additionally extended performance outcomes to a third dimension – timescale, in which financial improvement is achieved. Researchers Ritchie and Brindley (2007a, 2007b) analysed SCRM from the different perspectives – the analysis of the risks and performance relationship suggests a close collaboration within the chains to achieve SC effectiveness and efficiency (Ritchie and Brindley, 2007b), while the SCRM framework development helps to evaluate risks drivers and its influence to performance (Ritchie and Brindley, 2007a). SC sustainability as an

outcome of the risk management process was also identified by researchers (Giannakis and Papadopoulos, 2016). Nevertheless, listed sustainability-related risks that affect SC sustainability don't match with identified risks pertained to Brexit. Therefore, it is impossible to determine how identified SC risks affect sustainability. The most recent researchers extended a set of performance measures in manufacturing companies to five dimensions (Kauppi et al., 2016; Truong Quang and Hara, 2017). Five performance dimensions cover financial and operational SC performance measures. This allows inferring that an extended set of performance measures contributes to financial, operational and political risks more closely than efficiency and effectiveness. Five SC performance measures are: 1) Supplier performance/ Delivery, 2) Customer service, 3) Innovation and learning/ Quality, 4) Finance/ Cost, and 5) Flexibility.

Supplier performance refers to upstream SC risks, existing due to a failure of the supplier to deliver goods. Truong Quang and Hara (2017) noted that “a large number of procedures engenders delays, difficulties in transactions among members in the SC network and access to capital”, meaning that in a global business environment suppliers' performance is dependent on cross-border delivery procedures. Therefore, leaving the EU's Single Market and Customs Union for the UK manufacturing sector means no access to free trade between the EU and UK, resulting in longer customs procedures. It affects the availability to receive raw materials and inventory for manufacturing on time (Kumar et al., 2018). Hence, supportively to Kauppi et al. (2016) delays in materials can paralyze SC activities due to post-Brexit trade regulations.

Identified SC risks partly affect the customer service dimension. Researchers analyse customer service in terms of customers' preferences (Kauppi et al., 2016; Kumar et al., 2018). However, in a Brexit context identification of customers' needs is unrelated to the identified SC risks. On the other hand, customers' needs can be failed to meet due to disrupted downstream activities in the SC,

caused by raw materials and inventory delay (Kumar et al., 2018). Therefore, longer border check procedures cause disruptions in the whole SC. Moreover, at this stage barrier to immigrate also has an impact on the downstream SC activities. Extra time on complying with immigration regulations can affect the loss of skilled labour force in assembly and SC (Bailey and Propris, 2017). Hence, a lack of skilled workers in assembly or long visa processing time might affect delays in SC downstream activities.

The qualitative SC process increases trust and attracts investments in the forms of fixed assets and R&D for future development (Kauppi et al., 2016). The investors' sensitivity reflecting in the FTSE after the Brexit Referendum (Davies and Studnicka, 2018; Breinlich et al., 2018) and investors' intent to relocate activities to other countries (Farnsworth, 2017) demonstrate downgraded expectations for the future UK businesses growth. Hence, stock price depreciation and relocation of investments affect potential product and process quality improvement processes in manufacturing companies. Moreover, SC requires skilled workers able to quickly react to failures (Kauppi et al., 2016). The fact that EU immigrants share a large part of occupation in the UK manufacturing companies (Wadsworth, 2018) allows assuming that the barrier to immigrate will prevent a free skilled labour force movement from the EU. However, it is difficult to assess how a loss of immigrants will affect quality in SC, as it is unclear how many immigrants from the EU in the manufacturing sector are skilled.

Kauppi et al. (2016) highlight that SCRM practices avoid significant cost impacts on SC. This reflects in investors' reaction as mentioned above. There are several reasons for the possible cost increase after the UK leaves the EU. Firstly, the most pessimistic option is that UK might trade under WTO rules meaning trade tariffs with EU27. However, the optimistic option is a free trade agreement with the EU and EEA states. If the "Hard Brexit" occurs, trade tariffs can increase costs. Evidence provided by Davarzani et al. (2015)

reflects a pessimistic option when the barrier to trade forced a manufacturer to choose domestic supplier products, which reduced profit margin and revenue. Secondly, a delay of raw materials or inventory may result in longer holding, meaning higher stocking costs within the manufacturing process (Kumar et al., 2018). Finally, in order to fill the gap in vacancies after a barrier to immigrate from EU27 occurs, and make low skilled jobs attractive for UK-born employees, manufacturing companies might need to increase rates of pay.

According to Chaudhuri et al. (2018) "Flexibility enhances a firm's ability to effectively cope with fluctuations and disruptions". Controversially, Sreedevi and Saranga (2017) conclude that high manufacturing flexibility increases risk. However, the findings of researches differ in terms of scope. Chaudhuri et al. (2018) associated both internal and external integration with SC risks, while Sreedevi and Saranga (2017) focused on product customization. In the Brexit context, a high degree of coordination within SC requires attention on a large scope of activities. Moreover, a changing environment requires firms to be flexible in responding to uncertainty (Kumar et al., 2018). Therefore, flexibility is crucial for international UK manufacturers in the context of Brexit. Identified SC risks make firms consider other trade opportunities, as firms are intended to replace their suppliers from the EU27 (Perraton and Spreafico, 2019). In the case of current uncertainty, flexibility reflects in the ability to replace suppliers and attract investors from non-EU countries. Research on reshoring UK manufacturers' SC made before Brexit Referendum determines that bringing back offshore activities would be constrained due to the quality and size of the domestic labour market and finance (Bailey and De Propris, 2014). However, some researchers identified potential opportunities to benefit from the trade outside the EU and UK (Ijtsma et al., 2018; Cumming and Zahra, 2016; Welfens, 2018). Researchers have proven that leaving

the EU decreases flexibility in UK international companies. However, UK firms have opportunities to bring back SC to the home

economy or to cooperate with non-EU countries. Figure 5 represents SC risks and SC performance outcomes in the context of Brexit.

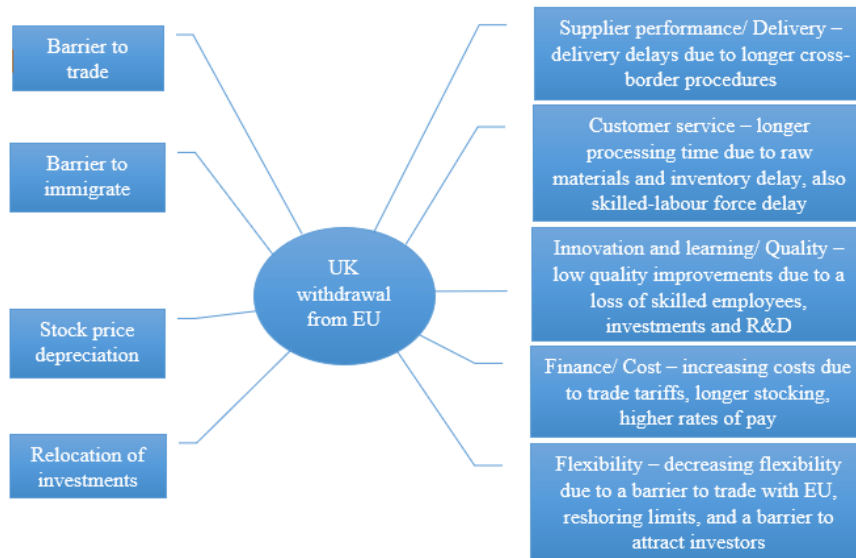


Figure 5. Conceptual Framework

In conclusion, it has been identified that a barrier to trade is the foundation for the economic-political risks on a supply chain in the context of Brexit (Davarzani et al., 2015). In fact, a barrier to trade directly affects supplier performance and customer service through the upstream and downstream SC activities, as well as cost and flexibility, and indirectly affects innovation, learning, and quality. Stock price depreciation and relocation of investment risks affect innovation, learning and quality. A barrier to immigrate directly affects customer service, cost, innovation, learning, and quality, and indirectly affects flexibility.

**SC Resilience under the Uncertainty**

The connection between SC risks, performance and resilience were analysed by several researchers. Munoz and Dunbar (2015) define resilience as “an ability to regain a desired level of performance after a disruptive event”. Kauppi et al. (2016) noted that “the ultimate goal of effective risk management is to create robust and resilient SC potentially impacting operational performance”. Therefore, at the management level SC risks, performance and resilience are inherent for the management decisions.

The researches focused on downstream activities (Gunasekaran et al., 2015), and an experiment in upstream activities (Munoz and Dunbar, 2015) have concluded similarly - SC complexity reduces resilience. Nevertheless, there are few methods to increase resilience in a global business environment. The theoretical framework suggests that resilience depends on the accessibility of resources and organizational structure (Van Der Vegt et al., 2015). However, access to resources encompasses only a part of upstream SC activities but doesn’t cover the processing, assembling, delivering to the customers, which also adds value to SC performance, and thus requires resilience. In terms of organizational structure, the authors suggest improving the connection between employees to spread information within and between organizations (Van Der Vegt et al., 2015). This proposition is more effective in the case of natural disasters rather than economic and political uncertainty when a restriction to supplies occurs. An important role in resilience has government and organizations (van Der Vegt et al., 2015) through legislations. From the practical perspective, other proposed solutions to increase resilience in a global sourcing context

is to reduce lead time in order to avoid delays (Colicchia et al., 2010), and adopt virtual stockpiling (Liu et al., 2016). However, the proposed solutions for transportation from East Asia to Europe to reduce transit time (Colicchia et al., 2010), and integration of the stockpiles into several locations (Liu et al., 2016) are relevant for the immediate reaction after uncertainty occurs or short-term solutions, but not for a long-term perspective when economic-political uncertainty occurs.

As the studies demonstrate, the suggested solutions to increase resilience are not relevant to the Brexit context, as most of them are related to short-term uncertainty or natural disasters. Nevertheless, the role of government, highlighted by Van Der Vegt et al. (2015), has a significant impact on firms' resilience. As an example of "Nissan" demonstrates, the government's promise to grant and support investments (Farnsworth, 2017) is crucial for improving SC performance, and thus building resilience through innovation (Clark and Bailey, 2018). The more specific studies around resilience in UK companies in the Brexit context have proven that a decrease in resilience is unavoidable (Bouoiyour and Selmi, 2018) due to highly integrated manufacturers' SC across Europe, dependency on European R&D funds, and limited access to highly skilled workers. However, Bouoiyour and Selmi (2018) use an Airline company as evidence, which is more limited in choosing suppliers than other manufacturers. Another analysis of the food SC identified that building resilience in a transition period is possible by following the three key steps (Hendry et al., 2019): 1) Gather information to evaluate opportunities and threats; 2) Change SC models and processes; and 3) Influence government.

All in all, SC resilience in the Brexit context refers to the ability to respond to economic, political and operational risks, and quickly adapt to constitutional changes. Brexit being a unique event distinguishes from the other threats, such as natural disasters, and requires different responses than the literature suggests. The resilience also depends on the

level of international SC integration to EU markets as the studies show. Nevertheless, there is one fact that studies agree – resilience highly depends on the government's decisions. The recent study on resilience in the Brexit context suggests that in transition process between pre-Brexit and post-Brexit companies can influence the future shape of the constitution (Hendry et al., 2019), what is a dynamic capability in terms of response to uncertainty.

## CONCLUSIONS

The research has developed a deep understanding of SCRM in the manufacturing sector in the UK in the transition of Brexit. The systematic literature review revealed several interesting findings. Firstly, SC risks were identified. Secondly, the relationship between SC risks and SC performance outcomes was examined. Both objectives outcomes contribute to the identification of four SC risks in the manufacturing sector that have negatively impacted SC performance (supplier performance/delivery, customer service, innovation and learning/quality, finance/cost, flexibility). The barrier to trade is identified as a fundamental risk subsequently causing disruptions in the whole SC and a trigger of financial risks. Differently from the researchers, this systematic literature review identified stock price depreciation as a risk to SC, as well as identified potential SC outcomes in the Brexit context. The thematic map highlighted the importance of SC resilience for SC performance. However, Brexit being a unique event requires different actions to maintain resilience than the literature suggests.

One of the reasons why UK companies attract investors is access to a Single Market through the country. Leaving the EU and thus, a Single Market and Customs Union might be a factor of losing EU and non-EU investors. Therefore, UK withdrawal from the EU can affect attractiveness for FDI from EU countries, and especially from non-EU countries, which tend to access a Single Market through the UK. However, research demonstrated insufficient concern about a possibility to attract less FDI

from non-EU countries. Therefore, it is highly recommended for companies to be aware of the possibility to lose non-EU investors to the same extent as EU investors.

The outcomes of the systematic literature review contribute to the literature and practical implications. In terms of theoretical contribution, this study filled the gap in the literature as there is a lack of reliable research papers on the SCRM in the context of Brexit. The study adapted to a constantly changing negotiation process to provide relevant evidence and analyse relevant information. Moreover, a significant theoretical contribution is the development of the thematic map of the main SC risks caused by Brexit and their impact on SC performance in the manufacturing sector. From a practical perspective, analysis confirmed the relevance of the research topic. Moreover, the analysis helped to assess the ability to mitigate SC risks caused by Brexit and identify effective SCRM strategies.

## REFERENCES

- Aqlan, F. and Lam, S. (2015). A fuzzy-based integrated framework for supply chain risk assessment. *International Journal of Production Economics*, 161, 54-63. <https://doi.org/10.1016/j.ijpe.2014.11.013>
- Bailey, D. and De Propris, L. (2014). Manufacturing reshoring and its limits: the UK automotive case. *Cambridge Journal of Regions, Economy and Society*, 7(3), 379-395. <https://doi.org/10.1093/cjres/rsu019>
- Bailey, D. and De Propris, L. (2017). Brexit and the UK Automotive Industry. *National Institute Economic Review*, 242(1), 51-59. <https://doi.org/10.1177/09502795011724200114>
- Baldwin, R. and Evenett, S. (2015). Value creation and trade in 21<sup>st</sup> century manufacturing. *Journal of Regional Science*, 55(1), 31-50. <https://doi.org/10.1111/jors.12175>
- Bloom, N., Bunn, P., Chen, S., Mizen, P., Smietanka, P., Thwaites, G. and Young, G. (2018). Brexit and Uncertainty: Insights from the Decision Maker Panel. *Fiscal Studies*, 39(4), 555-580. <https://doi.org/10.1111/1475-5890.12179>
- Bouoiyour, J. and Selmi, R. (2018). Are UK industries resilient in dealing with uncertainty? The case of Brexit. *The European Journal of Comparative Economics*, 15(2), 277-292.
- Breinlich, H., Leromain, E., Novy, D., Sampson, T. and Usman, A. (2018). The Economic Effects of Brexit: Evidence from the Stock Market. *Fiscal Studies*, 39(4), 581-623. <https://doi.org/10.1111/1475-5890.12175>
- Chaudhuri, A., Boer, H. and Taran, Y. (2018). Supply chain integration, risk management and manufacturing flexibility. *International Journal of Operations & Production Management*, 38(3), 690-712. <https://doi.org/10.1108/IJOPM-08-2015-0508>
- Chen, J. and Hill, P. (2013). The impact of diverse measures of default risk on UK stock returns. *Journal of Banking & Finance*, 37(12), 5118-5131. <https://doi.org/10.1016/j.jbankfin.2013.06.013>
- Clark, J. and Bailey, D. (2018). Labour, work and regional resilience. *Regional Studies*, 52(6), 741-744. <https://doi.org/10.1080/00343404.2018.1448621>
- Colicchia, C., Dallari, F. and Melacini, M. (2010). Increasing supply chain resilience in a global sourcing context. *Production Planning & Control*, 21(7), 680-694. <https://doi.org/10.1080/09537280903551969>
- Cumming, D. and Zahra, S. (2016). International Business and Entrepreneurship Implications of Brexit. *British Journal of Management*, 27(4), 687-692. <https://doi.org/10.1111/1467-8551.12192>
- Davarzani, H., Zanjirani Farahani, R. and Rahmandad, H. (2015). Understanding economic-political risks: impact of sanctions



- on an automotive supply chain. *International Journal of Operations & Production Management*, 1567-1591. <http://dx.doi.org/10.1108/IJOPM-01-2013-0021>
- Davies, R. and Studnicka, Z. (2018). The heterogeneous impact of Brexit: Early indications from the FTSE. *European Economic Review*, 110, 1-17. <https://doi.org/10.1016/j.eurocorev.2018.08.003>
- Driffield, N. and Karoglou, M. (2019). Brexit and foreign investment in the UK. *Journal of the Royal Statistical Society: Series A (Statistics in Society)*, 182(2), 559-582. <https://doi.org/10.1111/rssa.12417>
- Employment by nationality and industry, 2014-2018. (2018, December 20). *Office for National Statistics*. <https://www.ons.gov.uk/employmentandlabourmarket/peopleinwork/employmentandemployeetypes/adhocs/009456employmentbynationalityandindustry2014to2018>
- Eur-lex.europa.eu. (2019a). Customs. <https://eur-lex.europa.eu/summary/chapter/customs.html?root default=SUM 1 CODED=12>
- Eur-lex.europa.eu. (2019b). Employment and social policy. <https://eur-lex.europa.eu/summary/chapter/employment and social policy.html?root default=SUM 1 CODED=17>
- Eur-lex.europa.eu. (2019c). Research and innovation. <https://eur-lex.europa.eu/summary/chapter/research innovation.html?root default=SUM 1 CODED=27>
- Eur-lex.europa.eu. (2019d). External trade. <https://eur-lex.europa.eu/summary/chapter/external trade.html?root default=SUM 1 CODED=07>
- European Union. (2019). *United Kingdom / European Union*. <https://europa.eu/european-union/about-eu/countries/member-countries/unitedkingdom en>
- Farnsworth, K. (2017). Taking back control or empowering big business? New risks to the welfare state in the post-Brexit competition for investment. *Journal of Social Policy*, 46(4), 699-718. <https://doi.org/10.1017/S0047279417000368>
- Giannakis, M. and Papadopoulos, T. (2016). Supply chain sustainability: A risk management approach. *International Journal of Production Economics*, 171, 455-470. <https://doi.org/10.1016/j.ijpe.2015.06.032>
- Green, A. (2019). Low-skilled employment in a new immigration regime: Challenges and opportunities for business transitions. *National Institute Economic Review*, 248(1), 17-27. <https://doi.org/10.1177%2F002795011924800110>
- Gunasekaran, A., Subramanian, N. and Rahman, S. (2015). Supply chain resilience: Role of complexities and strategies. *International Journal of Production Research*, 53(22), 6809-6819. <https://doi.org/10.1080/00207543.2015.1093667>
- Heckmann, I., Comes, T. and Nickel, S. (2014). A critical review on supply chain risk – definition, measure and modeling. *Omega*, 52, 119-132. <http://dx.doi.org/10.1016/j.omega.2014.10.004>
- Hendry, L. C., Stevenson, M., MacBryde, J., Ball, P., Sayed, M. and Liu, L. (2019). Local food supply chain resilience to constitutional change: the Brexit effect. *International Journal of Operations & Production Management*, 39(3), 429-453. <https://doi.org/10.1108/IJOPM-03-2018-0184>
- Hill, P., Korczak, A. and Korczak, P. (2019). Political uncertainty exposure of individual companies: The case of the Brexit referendum. *Journal of Banking & Finance*, 100, 58-76. <https://doi.org/10.1016/j.jbankfin.2018.12.012>



- Hix, S. (2018). Brexit: Where is the EU-UK relationship heading? *JCMS: Journal of Common Market Studies*, 56, 11-27. <https://doi.org/10.1111/jcms.12766>
- Ho, W., Zheng, T., Yildiz, H. and Talluri, S. (2015). Supply chain risk management: a literature review. *International Journal of Production Research*, 53(16), 5031-5069. <https://doi.org/10.1080/00207543.2015.1030467>
- House of Commons (2019). *Statistics on UK-EU trade*. London: House of Commons.
- Ijtsma, P., Levell, P., Los, B. and Timmer, M. (2018). The UK's participation in global value chains and its implications for post-Brexit trade policy. *Fiscal Studies*, 39(4), 651-683. <https://doi.org/10.1111/1475-5890.12176>
- Investing.com. (2019). *United Kingdom Manufacturing Purchasing Managers Index (PMI)*. <https://www.investing.com/economic-calendar/manufacturing-pmi-204>
- Jolly, J. (2019, February 11). UK's carmakers face twin concerns of global upheaval and Brexit. *The Guardian*. <https://www.theguardian.com/business/2019/feb/11/uk-car-industry-twin-concerns-brexit-global-upheaval>
- Kauppi, K., Longoni, A., Caniato, F. and Kuula, M. (2016). Managing country disruption risks and improving operational performance: risk management along integrated supply chains. *International Journal of Production Economics*, 182, 484-495. <https://doi.org/10.1016/j.ijpe.2016.10.006>
- Kleindorfer, P. and Saad, G. (2005). Managing Disruption Risks in Supply Chains. *Production and Operations Management*, 14(1), 53-68. <https://doi.org/10.1111/j.1937-5956.2005.tb00009.x>
- Kumar, V., Bak, O., Guo, R., Shaw, S., Colicchia, C., Garza-Reyes, J. and Kumari, A. (2018). An empirical analysis of supply and manufacturing risk and business performance: a Chinese manufacturing supply chain perspective. *Supply Chain Management: An International Journal*, 23(6), 461-479. <https://doi.org/10.1108/SCM-10-2017-0319>
- Liu, F., Song, J. and Tong, J. (2016). Building supply chain resilience through virtual stockpile pooling. *Production and Operations Management*, 25(10), 1745-1762. <https://doi.org/10.1111%2Fpoms.12573>
- Manuj, I. and Mentzer, J. (2008). Global supply chain risk management strategies. *International Journal of Physical Distribution & Logistics Management*, 38(3), 192-223. <https://doi.org/10.1108/09600030810866986>
- Munoz, A. and Dunbar, M. (2015). On the quantification of operational supply chain resilience. *International Journal of Production Research*, 53(22), 6736-6751. <https://doi.org/10.1080/00207543.2015.1057296>
- Nelson, E. (2020, December 24). Pound rises as Britain and E.U. announce a post-Brexit trade deal. *New York Times*. <https://www.nytimes.com/2020/12/24/business/Brexit-deal-british-pound.html>
- OECD. (2019). *Table 5 - Foreign direct investment positions by industrial sector: at year end*. Country tables. OECD Publishing, Paris, <https://doi.org/10.1787/a0a2be36-en>
- Perraton, J. and Spreafico, M. (2018). Paying our way in the World? Visible and invisible dangers of Brexit. *New Political Economy*, 24(2), 272-285. <https://doi.org/10.1080/13563467.2018.1484718>
- Petticrew, M. and Roberts, H. (2006). *Systematic Reviews in the Social Sciences*. Malden, MA: Blackwell Publishing,
- Poppy, G., Baverstock, J. and Baverstock-Poppy, J. (2019). Meeting the demand for meat – Analysing meat flows to and from the UK pre and post Brexit. *Trends in Food Science & Technology*, 86, 569-578.

- <https://doi.org/10.1016/j.tifs.2019.01.010>
- Rajesh, R. (2018). Measuring the barriers to resilience in manufacturing supply chains using Grey Clustering and VIKOR approaches. *Measurement*, 126, 259-273. <https://doi.org/10.1016/j.measurement.2018.05.043>
- Rawlinson, K. (2018, July 4). Jaguar Land Rover's £80bn UK investment plan at risk after hard Brexit. *The Guardian*. <https://www.theguardian.com/politics/2018/jul/04/jaguar-land-rovers-80bn-uk-investment-plan-at-risk-after-hard-brexit>
- Ritchie, B. and Brindley, C. (2007a). An emergent framework for supply chain risk management and performance measurement. *Journal of the Operational Research Society*, 58(11), 1398-1411. <https://doi.org/10.1057/palgrave.jors.2602412>
- Ritchie, B. and Brindley, C. (2007b). Supply chain risk management and performance. *International Journal of Operations & Production Management*, 27(3), 303-322. <http://dx.doi.org/10.1108/01443570710725563>
- Safonovs, R. and Upadhyay, A. (2017). Is your Brexit supply chain resilient enough? The British footwear manufacturers' perspective. *Strategic Direction*, 33(11), 34-36. <https://doi.org/10.1108/SD-02-2017-0018>
- Saini, M. and Shlonsky, A. (2012). *Systematic Synthesis of Qualitative Research*. New York: Oxford University Press.
- Sreedevi, R. and Saranga, H. (2017). Uncertainty and supply chain risk: The moderating role of supply chain flexibility in risk mitigation. *International Journal of Production Economics*, 193, 332-342. <https://doi.org/10.1016/j.ijpe.2017.07.024>
- Symes, D. and Phillipson, J. (2019). 'A sea of troubles' (2): Brexit and the UK seafood supply chain. *Marine Policy*, 102, 5-9. <https://doi.org/10.1016/j.marpol.2019.01.015>
- Tovey, A. (2018, October 2). People won't thank leaders for killing our industries. *The Daily Telegraph*. <https://www.pressreader.com/uk/the-daily-telegraph-business/20181002/281629601208728>
- Tranfield, D., Denyer, D. and Smart, P. (2003). Towards a methodology for developing evidence-informed management knowledge by means of systematic review. *British Journal of Management*, 14(3), 207-222. <https://doi.org/10.1111/1467-8551.00375>
- Truong Quang, H. and Hara, Y. (2017). Risks and performance in supply chain: the push effect. *International Journal of Production Research*, 56(4), 1369-1388. <https://doi.org/10.1080/00207543.2017.1363429>
- van Der Vegt, G., Essens, P., Wahlström, M. and George, G. (2015). Managing Risk and Resilience. *Academy of Management Journal*, 58(4), 971-980. <https://doi.org/10.5465/amj.2015.4004>
- Wadsworth, J. (2018). Off EU go? Brexit, the UK labour market and immigration. *Fiscal Studies*, 39(4), 625-649. <https://doi.org/10.1111/1475-5890.12177>
- Welfens, P. (2018). Macroprudential risk management problems in Brexit. *Intereconomics*, 53(5), 281-286. <https://doi.org/10.1007/s10272-018-0766-z>

## Appendix 1: A list of journal articles shortlisted through systematic literature review

| No. | Topic   | Journal   | Year | Authors  | ABS 2018 ranking |
|-----|---|---|------|--|------------------|
| 1   | Local food supply chain resilience to constitutional change: the Brexit effect  | International Journal of Operations and Production Management | 2019 | Hendry, L., Stevenson, M., MacBryde, J., Ball, P., Sayed, M. and Liu, L.             | 4                |
| 2   | Managing risk and resilience  | Academy of Management Journal                                 | 2015 | Van Der Vegt, G., Essens, P., Wahlström, M. and George, G.                           | 4*               |
| 3   | Uncertainty and supply chain risk: The moderating role of supply chain flexibility in risk mitigation                             | International Journal of Production Economics                 | 2017 | Sreedevi, R. and Saranga, H.   | 3                |
| 4   | A critical review on supply chain risk–Definition, measure and modelling  | Omega   | 2014 | Heckmann, I., Comes, T. and Nickel, S.   | 3                |
| 5   | International Business and Entrepreneurship Implications of Brexit  | British Journal of Management                                 | 2016 | Cumming, D. and Zahra, S.  | 4                |
| 6   | Supply chain risk management and performance. A guiding framework for future development  | International Journal of Operations and Management            | 2007 | Ritchie, B. and Brindley, C.   | 4                |
| 7   | Risks and performance in supply chain: the push effect  | International Journal of Production Research                  | 2017 | Truong Quang, H. and Hara, Y.  | 3                |
| 8   | An empirical analysis of supply and manufacturing risk and business performance: a Chinese manufacturing supply chain perspective | Supply Chain Management: An International Journal             | 2018 | Kumar, V., Bak, O., Guo, R., Shaw, S., Colicchia, C., Garza-Reyes, J. and Kumari, A. | 3                |
| 9   | Macroprudential risk management problems in Brexit  | Intereconomics  | 2018 | Welfens, P.  | 1                |
| 10  | Political uncertainty exposure of individual companies: The case of the Brexit referendum   | Journal of Banking and Finance                                | 2019 | Hill, P., Korczak, A. and Korczak, P.  | 3                |
| 11  | The impact of diverse measures of default risk on UK stock returns  | Journal of Banking and Finance                                | 2013 | Chen, J. and Hill, P.  | 3                |

|    |  |  |      |   |   |
|----|--|--|------|---|---|
| 12 | Brexit and foreign investment in the UK  | Journal of The Royal Statistical Society: Statistics in Society (Series A) | 2019 | Driffield, N. and Karoglou, M.  | 3 |
| 13 | Labour, work and regional resilience   | Regional Studies   | 2018 | Clark, J. and Bailey, D.  | 3 |
| 14 | Brexit and the UK Automotive Industry  | National Institute Economic Review   | 2017 | Bailey, D. and De Propris, L.   | 1 |
| 15 | Manufacturing reshoring and its limits: the UK automotive case   | Cambridge Journal of Regions, Economy and Society                          | 2014 | Bailey, D. and De Propris, L.   | 3 |
| 16 | Brexit and Uncertainty: Insights from the Decision Maker Panel   | Fiscal studies   | 2018 | Bloom, N., Bunn, P., Chen, S., Mizen, P., Smietanka, P., Thwaites, G. and Young, G. | 2 |
| 17 | The Economic Effects of Brexit: Evidence from the Stock Market   | Fiscal studies   | 2018 | Breinlich, H., Leromain, E., Novy, D., Sampson, T. and Usman, A.                    | 2 |
| 18 | Off EU Go? Brexit, the UK Labour Market and Immigration  | Fiscal studies   | 2018 | Wadsworth, J.   | 2 |
| 19 | The UK's Participation in Global Value Chains and Its Implications for Post-Brexit Trade Policy                              | Fiscal studies   | 2018 | IJtsma, P., Levell, P., Los, B. and Timmer, M.                                      | 2 |
| 20 | Taking back Control or Empowering Big Business? New Risks to the Welfare State in the post-Brexit Competition for Investment | Journal of Social Policy   | 2017 | Farnsworth, K.  | 3 |
| 21 | Are UK industries resilient in dealing with uncertainty? The case of Brexit  | The European Journal of Comparative Economics                              | 2018 | Bouoiyour, J. and Selmi, R.   | 3 |
| 22 | Brexit: Where is the EU–UK Relationship Heading?   | Journal of Common Market Studies   | 2018 | Hix, S.   | 3 |
| 23 | Understanding economic-political risks: impact of sanctions on an automotive supply chain                                    | International Journal of Operations & Production Management                | 2015 | Davarzani, H., Zanjirani Farahani, R. and Rahmandad, H.                             | 4 |
| 24 | An emergent framework for supply chain risk management and performance measurement   | Journal of Operational Research Society                                    | 2007 | Ritchie, B. and Brindley, C.  | 3 |

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|    |   |   |      |  |   |
|----|---|---|------|--|---|
| 25 | Supply chain integration, risk management and manufacturing flexibility   | International Journal of Operations & Production Management | 2018 | Chaudhuri, A., Boer, H. and Taran, Y.              | 4 |
| 26 | Supply chain sustainability: A risk management approach   | International Journal of Production Economics               | 2016 | Giannakis, M. and Papadopoulos, T.                 | 3 |
| 27 | A fuzzy-based integrated framework for supply chain risk assessment   | International Journal of Production Economics               | 2015 | Aqlan, F. and Lam, S.                              | 3 |
| 28 | On the quantification of operational supply chain resilience  | International Journal of Production Research                | 2015 | Munoz, A. and Dunbar, M.                           | 3 |
| 29 | Building Supply Chain Resilience through Virtual Stockpile Pooling  | Production and Operations Management                        | 2016 | Liu, F., Song, J. and Tong, J.                     | 4 |
| 30 | Increasing supply chain resilience in a global sourcing context   | Production Planning and Control                             | 2010 | Colicchia, C., Dallari, F. and Melacini, M.        | 3 |
| 31 | Low-Skilled Employment in a New Immigration Regime: Challenges and Opportunities for Business Transitions               | National Institute Economic Review                          | 2019 | Green, A.  | 1 |
| 32 | Managing Disruption Risks in Supply Chains  | Production and Operations Management                        | 2005 | Kleindorfer, P. and Saad, G.                       | 4 |
| 33 | Managing country disruption risks and improving operational performance: risk management along integrated supply chains | International Journal of Production Economics               | 2016 | Kauppi, K., Longoni, A., Caniato, F. and Kuula, M. | 3 |
| 34 | The heterogeneous impact of Brexit: Early indications from the FTSE   | European Economic Review                                    | 2018 | Davies, R. and Studnicka, Z.                       | 3 |
| 35 | Value creation and trade in 21st century manufacturing  | Journal of Regional Science                                 | 2015 | Baldwin, R. and Evenett, S.                        | 3 |
| 36 | Paying Our Way in the World? Visible and Invisible Dangers of Brexit  | New Political Economy                                       | 2018 | Perraton, J. and Spreafico, M.                     | 3 |
| 37 | Supply chain resilience: role of complexities and strategies  | International Journal of Production Research                | 2015 | Gunasekaran, A., Subramanian, N. and Rahman, S.    | 3 |

