



**Supply chain resilience and business responses to
disruptions of the Covid-19 pandemic**

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Abstract

Purpose: At its peak, the Covid-19 pandemic has created disruption to food supply chains in the UK and for the entire world. Although societal changes created some resilience within the supply chains, high volatility in demand creates supply, logistics and distribution issues. This is reflected in the economic instability of businesses and SMEs. In this paper, we explore factors behind this initial disruption in the supply chains and offer suggestions to businesses based on the established practices and theories.

Design: We use mixed methods research. First, we conducted an exploratory study by collecting data from published online sources. Then we analysed possible scenarios from the available information using regression. We then conducted two interviews with UK retail sector representatives. These scenarios have been compared and contrasted to provide decision making points to businesses and supply chain players to tackle current and any future potential disruptions.

Findings: Our findings from the current exploratory study inform the volatility of supply chains. We suggested some possible responses from businesses, during and after the pandemic.

Value: Our regression model provides a decision-making approach to help supply chain businesses during the pandemic outbreak. Once a complete data set of Covid-19 is available, we can create a resilience model that can help businesses and supply chains.

Keywords - Supply chain management, supply chain disruption, business entrepreneurial resilience, resourcefulness, bricolage

1. Introduction

The Covid-19 pandemic is a global crisis, and it is impacting us all, affecting governments, corporations, individuals, and businesses alike. At the governmental level, the pandemic has created institutional uncertainties as nations took war-time actions such as closing international borders, restricting the movement of people in order to stop the spread of the virus whilst mitigating the impact of the pandemic. At the corporate level, Covid-19 is disrupting the nature of work and restructuring outlook of industries. Although premature, the full impact of Covid-19 is expected to have dire socio-economic and financial consequences on industries, particularly the global supply chain industry (Deloitte, 2020). The Covid-19 pandemic has stretched supply chain resilience to the brink, testing the agility of businesses in the supply chain industry to respond to the quickly evolving global crisis.

With the outbreak of the Covid-19 pandemic, both global supply chains and businesses including local small and medium enterprises (SMEs) are struggling to meet the unprecedented demand for basic amenities, food, and other supplies. The ongoing crisis, therefore, raises

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3 salient questions as to how SMEs (Polyviou et al., 2019) faced with limited resources build
4 resilience (Scholten et al., 2020) as they respond to significant supply chain disruptions.
5 Waldman et al., (2011) prescribes resilience as a *competence* necessary for responding to
6 unprecedented challenges. In particular, we argue that collaborative resilience is a distinctive
7 capability necessary for businesses to build supply chain resilience. This pandemic provides a
8 unique opportunity for businesses and international non-governmental organisations to
9 examine their responses during a major disruption (Saleh and Karia, 2020; Kuckertz et al.,
10 2020). Several assessment methods have been used widely across the globe to measure the
11 efficiency of handling of Covid-19 situation and resilience (Priya et al., 2021; Agarwal et al.,
12 2021). This study provides an explorative examination as to how UK businesses in the supply
13 chain industry initially responded to Covid-19. The global context is also discussed when
14 necessary. Based on various responses from different business sectors, we have made some key
15 pointers on how businesses can respond to the Covid-19 disruptions focussing on supply chain
16 resilience.

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28 In a crisis period, resilience is crucial for business survival. For all businesses, including
29 SMEs, their responses and resilience to the Covid-19 pandemic may have a longstanding
30 impact on their survival. A very interesting research note on this topic is recently authored by
31 Ivanov and Das, (2021). Our research study aims to provide valuable contributions to the multi-
32 level dimensionality of resilience as we explore supply chain resilience in tandem with
33 businesses. With this study, we integrate two bodies of literature, namely supply chain
34 resilience and business resilience, providing a conceptual basis for supply chain resilience and
35 entrepreneurs role during the global disruption. With this explorative study, we emphasise
36 connections between the two different resilience. To this effect, we aim to add to the supply
37 chain disruption literature (Altay and Ramirez, 2010; Golgeci and Ponomarov, 2013; Kwak et
38 al., 2018; Polyviou et al., 2019), with implications also for the emerging discourse on business
39 resilience. In particular, we ask the following research questions: What are the new priorities
40 of businesses during and after pandemic? How can supply chains in the changing Covid-19
41 scenario be resilient?

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The ability of businesses in pooling resources, networking with their supply chains, and
exploit new business potentials beyond their conventional domain (basic food, specialist food,
non-food, and more) is critical for their survival in crises such as the Covid-19 pandemic. This
collective bricolage has been cited in the literature but has not been discussed well-enough. The
main contribution of this paper lies in bringing the literature on bricolage to help businesses
seize on new opportunities in order to improve supply chain resilience giving the Covid-19

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3 disruption as the context. We use a range of research methods and available secondary data to
4 support this contribution.
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8 The rest of the article is presented as follows: Section two presents a research background
9 along with Covid-19 situation, theoretical background on supply chain and business resilience
10 literature, and synthesising both streams of literature. Section 3 briefly presents the research
11 context and data analysis from the current data for this explorative study. Sections 4 discusses
12 the research model and findings with respect to supply chain and business entrepreneurial
13 resilience. Section 5 discusses the results in detail and section 6 concludes with further
14 discussions, limitation, and future research direction.
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22 **2. Research background and Covid-19 situation**

23 In this section, we discuss a few theories relating to supply chain resilience. In this section,
24 we also discuss the literature on resilience of supply chains and businesses. We first look at a
25 few theories that can act as lens to understand and analysis the developments in the fields of
26 supply chain and entrepreneurial resilience.
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31 **2.1. Theoretical background**

32 In the literature of management, many theories have been used to highlight various situations
33 arising from uncertainty of supply chain or business operations, economic difficulty and
34 societal vulnerability. The supply chain resilience theory has been developed to enhance and
35 build internal capacity to face any consequences of uncertainty. In some cases, it can also
36 provide solutions to tackle the situation (Christopher and Peck, 2004). On the other hand,
37 systems theory approach originated in a field of science, introduced by biologist Ludwig Von
38 Bertalanffy in 1950s, can be interpreted for the society as composition of many interacting
39 elements. The interacting elements can be viewed as environmental factors, such as the
40 Covid-19 pandemic, that affect supply chains, financial instabilities and the health of
41 businesses. According to systems theory, on every occasion, various elements underlying
42 different factors will have continuous interactions and hence the whole system will learn from
43 mistakes and grow faster than ever. Thus, the systems theory is encouraging societal
44 involvement in building the society and to enhance its value.
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56 Another prominent theory, contingency management theory (Otley, 2016) has discussed
57 widely across several areas of research including business and management (Runyan, 2006).
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3 The contingency theory developed by Fred Fielder in the mid-1960s, looks at a specific
4 situation in the presence of different leadership traits. A more appropriate and suitable
5 leadership will be adapted considering the nature of the societal need and flexibility. We
6 consider this organisation focused theory to involve society as integral part of the
7 organisation to adapt a suitable style of entrepreneurial approach.
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12 2.2. Supply chain resilience and business resilience

14 Supply chain resilience addresses a supply chain's ability to respond to and recover from the
15 effects of disruptive events (Jütter and Maklan, 2011). Disruptive events are unplanned
16 occurrences which limit the optimal functioning of any supply chains (Ivanov and Dolgui,
17 2020), disrupting the flow of goods and materials within a supply chain and exposing
18 businesses to operational and financial risks (Craighead et al., 2007).
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23 A supply chain's ability to respond quickly to disruptive events is a distinctive
24 capability (Chowdhury and Quaddus 2017), potentially impacting on the competitiveness and
25 long-term success of the organisations in the supply chain (Bode *et al.*, 2011). Echoing the
26 distinctive capability position, Ponomarov and Holcomb (2009:131) defines supply chain
27 resilience as '*the adaptive capability of the supply chain to prepare for unexpected events,*
28 *respond to disruptions, and recover from them by maintaining continuity of operations at the*
29 *desired level of connectedness and control over structure and function*'. This characterisation
30 of supply chain resilience depicts resilience as a competence (Waldman *et al.*, 2011) which
31 organisations employ as they respond to a major disruption.
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39 Collaboration with supply chain partners is an important distinctive capability necessary
40 for building supply chain resilience (Christopher and Peck, 2004; Scholten and Schilder, 2015).
41 Collaboration in a supply chain relates to the ability of two or more supply chain working
42 together, planning and executing supply chain operations towards a common goal (Cao et al.,
43 2010; Cao and Zhang, 2011). In such a situation, businesses within the supply chain share
44 information, knowledge and resources to reduce the environmental uncertainties caused by a
45 disruptive event (Christopher and Peck, 2004; Scholten and Schilder, 2015). Consequently,
46 collaborative supply chain relationships facilitate risk sharing; transaction costs reduction and
47 enhances supply chain productivity (Cao and Zhang, 2011; Ramanathan et al., 2011;
48 Ramanathan, 2013). Higher level of international collaboration indirectly pushes global
49 businesses to adopt sustainability practices (Apaydin, 2018).
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58 Collaboration leverages on the resources and knowledge of partners such as suppliers and
59 customers, integrating the flow of products and information across the supply chain (Cao *et al.*,
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3 2010). As such, collaboration enables the development of synergies among businesses,
4 facilitating combined planning and encouraging real-time information exchange required as
5 businesses respond to and recover from supply chain disruptions (Scholten and Schilder, 2015).
6 We therefore contend that collaboration is a formative element to build supply chain resilience
7 (Scholten and Schilder, 2015) as we experienced multiple waves of the Covid-19 pandemic.
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11 Since limited resources of business impact on their resilience ability, we argue that
12 building collaborative bricolage is an essential form of supply chain resilience for businesses.
13 Bricolage is the ability of businesses to combine existing resources to solve new problems and
14 maximise emerging business opportunities (Baker and Nelson, 2005). Bricolage has been
15 associated with business improvisation and self-efficacy (Tsilika et al. 2020). Bricolage stands
16 for a form of resourcing behaviour that can allow businesses to navigate resource constraints
17 (An et al. 2018 and 2019) in times of crisis. Bricolage is particularly relevant for SMEs facing
18 a business disruption where a lack of resources and unpredictable environmental changes create
19 challenges and opportunities for them. Collaborative bricolage therefore enables SMEs to
20 mobilise resources among each other, reconfigure existing resources (Desa, 2012) as they
21 respond to business disruption challenges. Collaborative bricolage activities can enable SMEs
22 to overcome resource constraints (Baker and Nelson, 2005) as it involves resource sharing;
23 information and knowledge sharing and risk sharing (Duymedjian and Ruling, 2010).
24 Collaborative bricolage is a process of co-shaping, involving interactions and mutual
25 adjustment between businesses. With this study, therefore we argue that collective bricolage
26 represents a fundamental element of supply chain resilience in that it allows supply chain
27 networks to collaboratively share resources and knowledge as they collectively attempt to
28 mitigate disruptions caused by a disaster such as Covid-19. Collaborative bricolage is a crucial
29 strategy to fight major disruptions because environmental disruptions limit the operational
30 functions of supply chains. Collective bricolage enables SMEs' access to much needed
31 resources (Tasavori et al., 2018) as they respond to new consumption levels during a disruption
32 period. We therefore believe that this study offers a fresh perspective on supply chain resilience
33 at the entrepreneurial level.
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51 **2.3. Consumer behaviour during disruptions**

52 This section briefly reviews a limited literature on consumer behaviour during a crisis. A crisis
53 affects the psychology and expectations of all consumers. A crisis can present unfavourable
54 outcomes to consumers in the form of unemployment and a fall in income. The uncertainty of
55 the duration of unemployment influence consumption. The degree of uncertainty depends on
56 the severity of crisis. Increasing uncertainty leads to a reduction in consumption, particularly
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3 in the consumption of discretionary goods (Kaytaz and Gul, 2014). Consumption depends on
4 consumers' having disposable income, feeling confident about their future, trusting in business
5 and the economy, and embracing lifestyles that encourage consumption (Kaytaz and Gul,
6 2014). Dutt and Padmanabhan (2011) note that the classification of goods into necessity and
7 discretionary categories under crisis conditions is arbitrary because of lack of empirical
8 evidence. Nonetheless, the consumption of food, clothing, shelter, and perhaps transportation
9 and health care would be deemed essentials by consumers during a crisis period.

15 **2.4. UK Supply chain response to Covid-19**

16 Social distancing and self-isolation were suggested by the UK government, as is the case all
17 over the world, after the outbreak of the Covid-19 pandemic. Every household in the UK
18 received a letter from the UK Prime Minister Mr Boris Johnson, in April 2020 along with
19 important guidance on self-isolation. As previously mentioned, supply chain disruptions at the
20 time of pandemic are huge and highly unpredictable. A recent report highlights UK growers'
21 concern on lack of availability of workers to harvest fruits on time during this pandemic
22 (Courtney-Guy, 2020). Consumer stockpiling due to the Covid-19 pandemic led to product
23 shortages in major supermarkets across the country, and significantly increased volume of
24 home deliveries. In response to the potential food crisis, a collaborative group called the
25 SCALA Covid-19, was established to facilitate supply chain businesses to work together
26 withstand the huge pressure it is under to supply the UK with essential products throughout this
27 pandemic (Scala 2020). The group brought together UK's foremost manufacturers and suppliers
28 of food, drink and other consumer essentials, and retailers, food service and logistics
29 companies. We believe such collaboration is an example of collective bricolage as actors within
30 the UK supply chain industry share resources and knowledge in order to mitigate potential food
31 crisis resulting from the Covid-19 pandemic.

35 **3. Research context and Research approach including data description**

36 **3.1 Context**

37 The UK government has prescribed social distancing and self-isolation as a pathway to reduce
38 the spread of Covid-19 pandemic. As given in Figure 1, UK government enforced lockdown
39 and isolation in staggered calendar. In line with this plan, supply chain disruptions at the
40 time of pandemic have been huge and highly unpredictable. As mentioned earlier, recent reports
41 have highlighted the UK growers' concern on lack of availability of workers to harvest fruits
42 on time during this pandemic (Courtney-Guy, 2020). Consumer stockpiling due to the Covid-
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19 pandemic led to product shortages in major supermarkets across the country in summer 2020 and significantly increased volume of home deliveries.

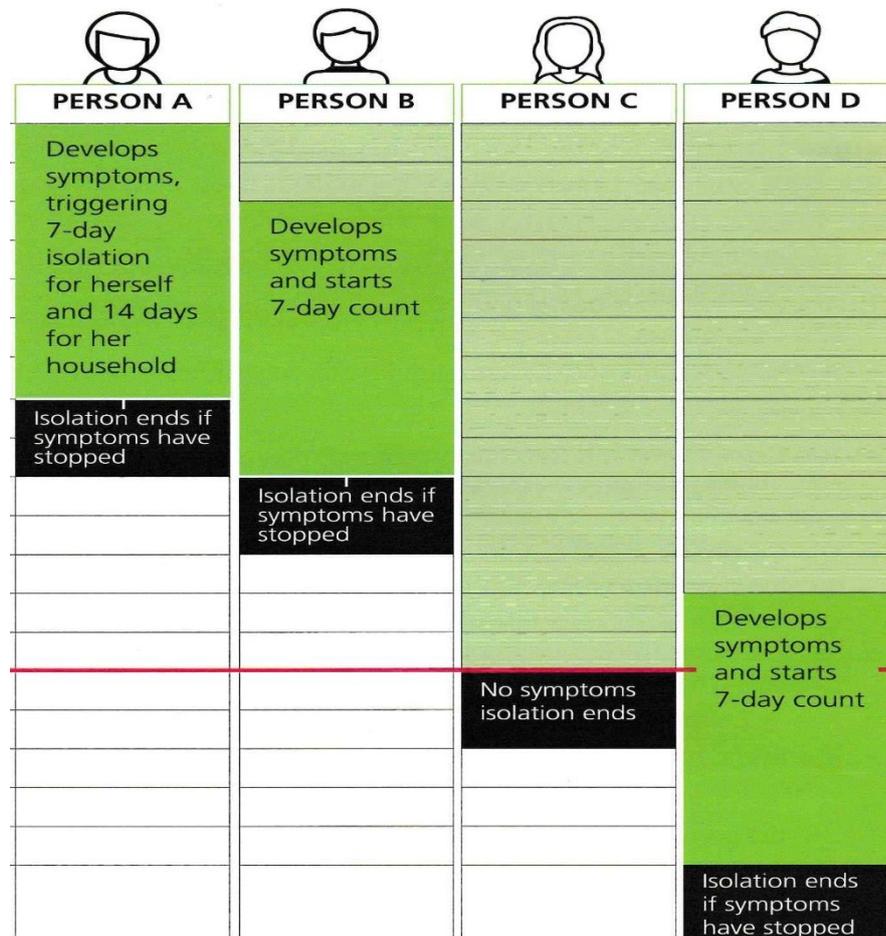


Figure 1: Isolation roadmap (Source: UK Government household leaflet)

3.2 Research approach

Given that data on the immediate effects of the Covid-19 crisis and the subsequent lockdown in the UK are still emerging, this study employs a mixed methods approach involving primary and secondary data collection and analysis. We utilise information from published sources namely magazines, television news and data from government sources such as the UK Office for National Statistics. We have also conducted two brief interviews with local UK retailers. First interview was conducted with a leading retail company that shed light on important complexities of movement of food supplies especially at this difficult time. We have also managed to talk to the head of Business Association from Southern England. One of the insights from this interview was about difficulties faced by food businesses such as flour mills. Most of

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3 these flour mills are micro and SMEs who suffered during lockdown and closures. As Covid-
4 19 pandemic outbreak is new of its kind to the UK, and we do not have any historic data to
5 refer. Also, it is challenging to understand the customer behaviour at this difficult time,
6 predicting average retail sales with respect to volume and sales value is highly complicated
7 task. We have considered using a simulated data based on the available information. Our basic
8 assumption for the simulation is every household will have realised lockdown situation at
9 different time period and isolation started following the lockdown. For example, if household-1
10 started isolation in week 2, the buying pattern of the consumer will be huge in week-1. This
11 panic buying will go down over the period of time as supply would be high or need for a new
12 purchase will be low. This information is being used for simulation to generate retail
13 consumption and purchase data in section 4.1.

14
15 We have collected data from credible data sources to understand the current status of
16 manufacturing (See Figure 2) and sales (see Figure 3). Please note that the data includes
17 important months linked to the impact of Covid-19 pandemic: Sep. 2019 (pre-pandemic
18 situation), December 2019 (beginning of the pandemic), February 2020 (First wave), June 2020
19 (relative calm) and December 2020 (second wave). Data in 2021 was not available uniformly
20 for all the countries listed. For most of the economies, the pandemic has affected industrial
21 production. While China had the impact in early 2020, most economies suffered the reduction
22 in June 2020. While most economies seemed to have recovered somewhat by December 2020,
23 countries such as the Philippines have seen continued decline in industrial production. Due to
24 the lack of uniform data, the impact of the second wave cannot be captured in this paper. Due
25 to the reduction in industrial outputs from several leading economies the supply of various
26 products around the globe will also face shortages. Since the impact of Covid-19 pandemic is
27 not the same in all countries as it has outbreaks at different time period in varying scales, the
28 overall supply of the global network will be balanced especially for the food production and
29 distribution. All governments and local councils are taking care of food supply to maximum
30 possible level to support people during lockdown period.

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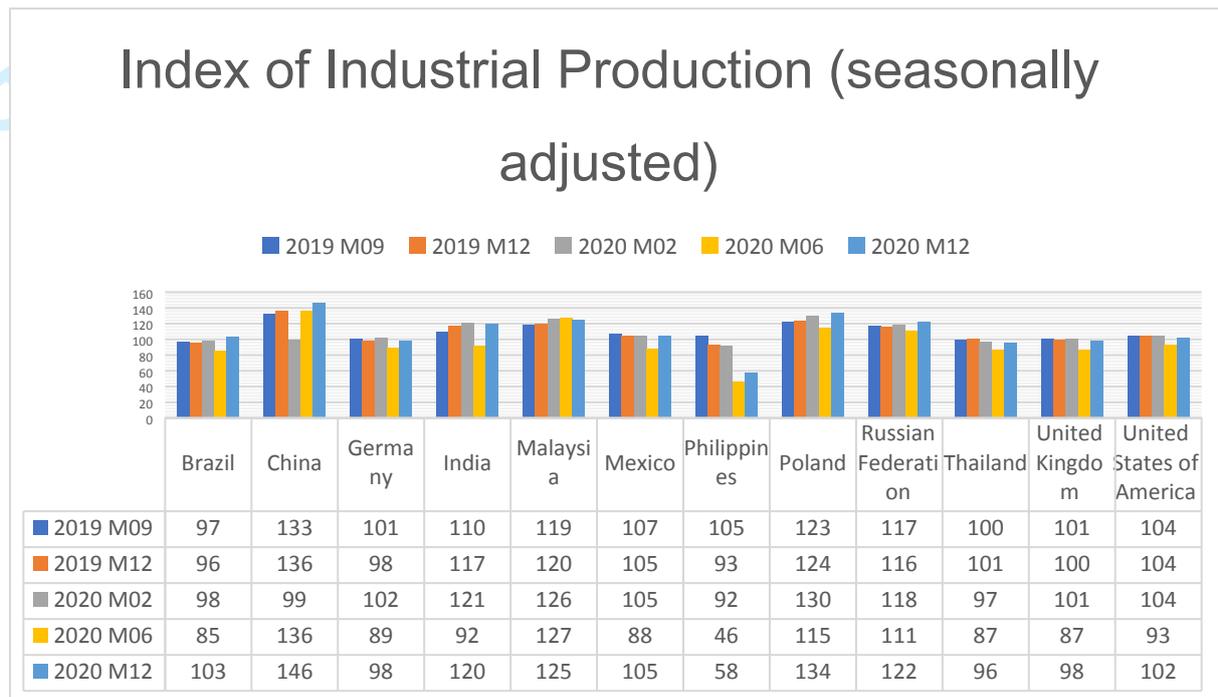


Figure 2: Global manufacturing activity during Covid-19

Figure 3 provides more detailed data on the impact of the first wave of the pandemic in the UK. The four component images provide how food sales (in volume and in value) varied for specific months (September 2019 – pre-pandemic, December 2019 – beginning of the first wave, February 2020 – impact of first wave and December 2020 – beginning of the second wave). In September 2019, there has been a good growth of food and non-food sales compared to the previous month (August 2019). However, this growth was negative in December 2019, probably due to the impact of Brexit and initial perceptions of the pandemic. The full impact of the first wave began to show in February 2020 but there was slow recovery by December 2020. This explains the lockdown situation of majority of the workforce and less need for partywares and sports wares in comparison to food and household items.

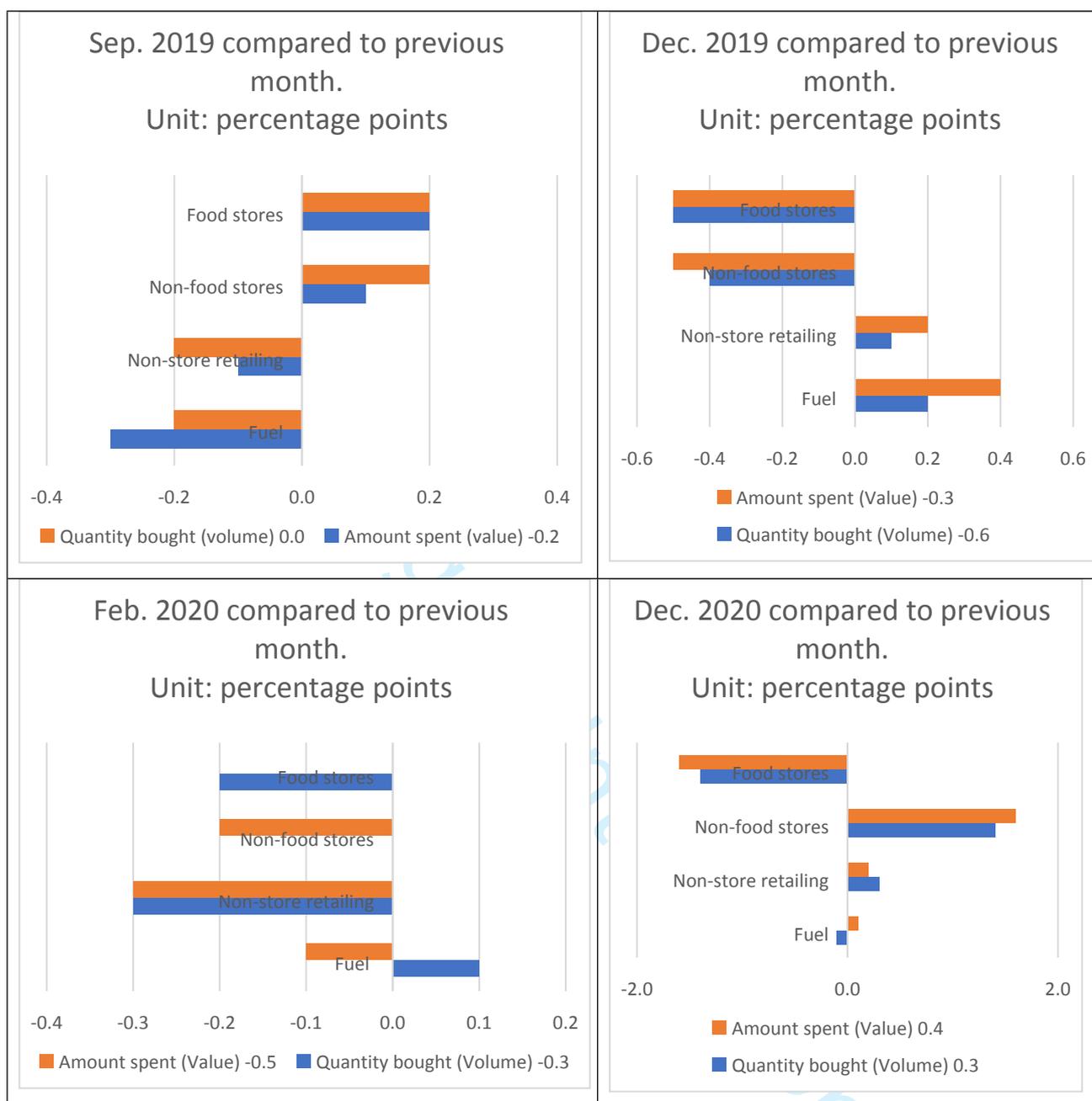


Figure 3: Month-on-month contributions to growth by sector for multiple months in the UK
 (Source: ONS statistics,
<https://www.ons.gov.uk/businessindustryandtrade/retailindustry/bulletins/retailsales/february2020> , accessed 16 Jun21)

Table 1: Monthly growth rates for the value and volume of sales in food stores
(consolidated first 6 months of pandemic)

Store type	Weight in RSI	Month-on-month growth rate (per cent)	
		Value	Volume
Supermarkets	35.3	10.2	10.3
Specialist Food	2.1	5.0	4.5
Alcohol	0.7	32.6	31.4
Total	38.1	10.3	10.4

Source: Office for National Statistics - Monthly Business Survey - Retail Sales Inquiry

4. A simulation model for supply chain behaviour during Covid-19

Data from Table 1 and Figure 3, which are retail sales data obtained from ONS, form the basis for bulk of our analysis. It is interesting to see from Figure 3 and Table 1 that the purchase behaviour of people changed over the period of lockdown tremendously. At the beginning of outbreak, consumers indulged in panic buying of food items retail stores (source: BBC and Sky news). The UK population believed that the lockdown will continue for at least four weeks and started stocking their food for the next four weeks. However, some optimistic customers were not showing any rush in the first week of lockdown but subsequently they showed similar behaviour as every other customer. This created a huge demand for food items in the UK retail stores and around the globe.

4.1 A simple simulation model and related assumptions

To illustrate supply chain behaviour and entrepreneurial response we read consumer behaviour during the first 3-6 months of lockdown period. A clear trend of purchase behaviour has resulted a huge supply at one point with not much demand for perishable items and possibly ended in food waste. The biggest challenge for businesses is the availability of investment during this outbreak to increase the internal capacity to serve the society with enough supply.

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3 Figure 4 represents a scenario of customer demand and supply in UK retail stores for a period
4 of 14 weeks since the lock down. Based on frequent visits to the local retail stores, the authors
5 have made an informed-assumption of customer behaviour of three different families for 14
6 weeks. Supply assumption (product availability) is based on the availability of items in the shelf
7 at a particular time of the day. For example if we consider three customers purchase behaviour
8 in fourteen week time period with three scenario 1) Customer 1 is buying heavily in the first
9 two weeks with reduced amount of purchase in the following weeks; 2) Customer 2 is showing
10 less spending in the first two weeks and then starts with very heavy purchase in the third week
11 and stable or less buying in the following weeks and 3) Customer 3 is a non-panic buyer in the
12 first two weeks and slowly realised the supply-demand mismatch and hence started buying
13 more than his needs. In line with these three customers' behaviour supply chain needs to
14 behave as quickly as possible to meet the average demand. In reality, supply of items may not
15 be possible for such a sharp variation in demand. This will create shortage of food items in
16 retail stores and will also increase the panic buying behaviour of customers in their next visit.

17
18 To avoid this situation, the UK Government requested all food suppliers to increase the
19 supply to meet the demand. To avoid shortage, some suppliers tried to reach the optimum level
20 of supply based on the average demand in the first four weeks of the pandemic outbreak. In
21 Figure 4, supply chain behaviour is computed as reflection of expected customer behaviour
22 based on reports of Sainsbury and Iceland during the first weeks of lockdown. Based on the
23 above simulation, we can say that supply chain behaviour is almost stable for the first few
24 weeks (4 weeks in the simulation above) leaving for the UK population under-served as supply
25 was less than the (panic) demand. In the next few weeks, supply chain enhanced its capacity
26 with the support of businesses and invested in capacity increase and outsourcing to meet the
27 local demand.
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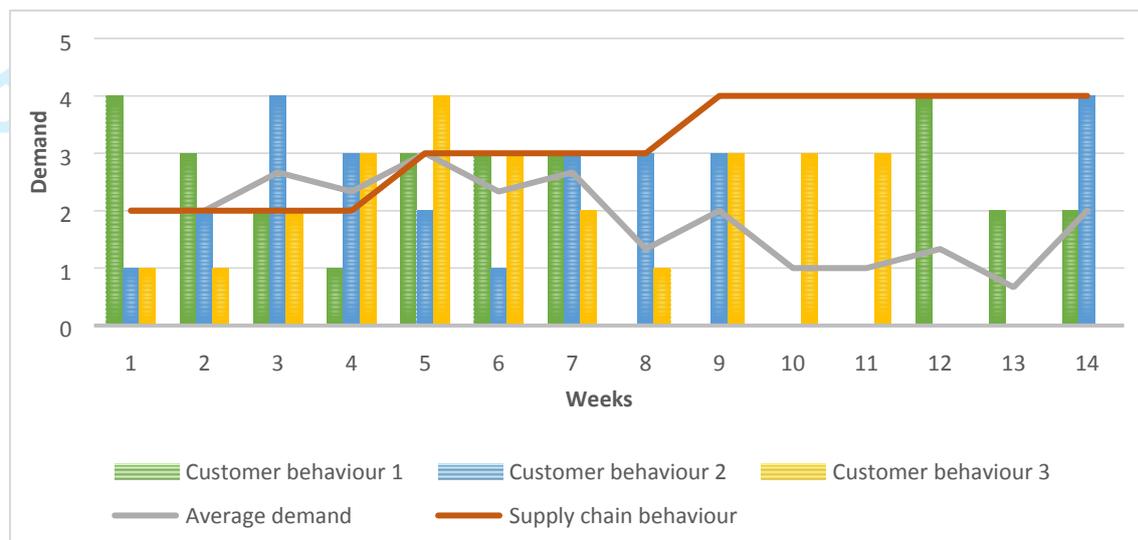


Figure 4: Supply-demand during Covid-19 outbreak

This helped the businesses to retain customers and serve the society. In the subsequent few weeks, increased supply ended in waste of products and resources as the demand was not as high as before due to various factors such as customers heavy purchase behaviour in the first few weeks of lock down left them with enough supply without making any new purchase, people realised there is no need to stock the items as supply is steady. In both the cases the businesses needed to go back to its original capacity or slightly increased capacity but not to the highest level of capacity. In this case, we argue that collective bricolage between supply chains and businesses allowed them to meet unprecedented demands during the first few weeks of the lockdown. The sharing of resources, knowledge and the UK government's invention help mitigate the potential of a food crisis.

4.2 Importance of food sales and distribution during the pandemic outbreak

We now illustrate the importance of food sales at the time of the pandemic with historic statistical data from the Office for National Statistics (ONS), UK. We used ONS retail sales index data from January 2011 to April 2020. We use the data to examine the impact of index of retail sales in various sectors on the overall percentage change in sales using regression analysis. Thus, the dependent variable is the percentage increase or decrease in sales in comparison to previous years' monthly sales data. We considered regression analysis with overall sale increase/decrease in percentage including automotive fuel as independent variable. Dependent variables are retail index values of variables namely Predominantly Food Stores, Nonspecialised Food Stores, Specialist Food Stores, Alcoholic Drinks Other Beverages and Tobacco, Textile, Clothing, Footwear and Leather, Household Goods Stores, Medical Goods,

Automotive Fuel, Computers and Telecoms Equipment and, Sports Equipment, Games & Toys. All variables except predominantly food stores data were considered for the analysis. The resultant linear regression model has high significance with adjusted R-square 0.832. Results are shown in Table 2. The model has explained the increase/decrease in sales index through significant variables namely specialised food stores, alcoholic drinks, textile/clothing, medical stores, cosmetics and computers. Here it is interesting to note that non-specialised food stores, household goods, and sports equipment are not significantly making contribution for overall retail sales. However, the sales of textiles and household goods are also not significantly contributing to the overall sales which is not highly explainable. Please note that specialist food stores and alcoholic drinks are significant predictors of % increase in total retail sales.

Table 2: Regression results (based on retail sales index from Jan. 2011 to Apr. 2020)

	Unstandardized Coefficients
Constant	-33.496***
Non-specialised Food Stores	-0.084
Specialist Food Stores	.206***
Alcoholic Drinks, Other Beverages and Tobacco	-.031**
Textile, Clothing, Footwear and Leather	.309***
Household Goods Stores	0.001
Medical Goods	-.058***
Cosmetic & Toilet Articles	-.034*
Computers & Telecomms Equipment	.065***
Sports Equipment, Games & Toys	0.003
R Square	0.846
Adjusted R Square	0.832
F Change	62.191***
Dependent Variable: Percentage increase on a year earlier-All Retailing, Including Automotive Fuel	
*p<0.10; ** p<0.05; *** p<0.001	
n = 111	

Figure 5 represents the comparison of percentage of increase or decrease in retail sales index in various sector in comparison to the sales in the previous year on the same month for years 2017 to 2020 for the first four months of every year. During Covid-19 pandemic lock down period, the overall retail sales has not improved but for the drinks, including alcohol, the sales index has increased compared to any other years in the month of March. Similarly, the sales of both specialised and non-specialised food stores performed very well due to high demand in March 2020. The sales figure of textile, clothing and leather products have dipped in the month of March 2020. This is mainly due to the fact that people were worried about stocking their

food reserve than fashion and non-functional products. Figure 5 reflects the customers purchase behaviour clearly at the time of lockdown, during crisis. This demands a great attention from businesses in terms of investment and resilience during supply chain interruptions.

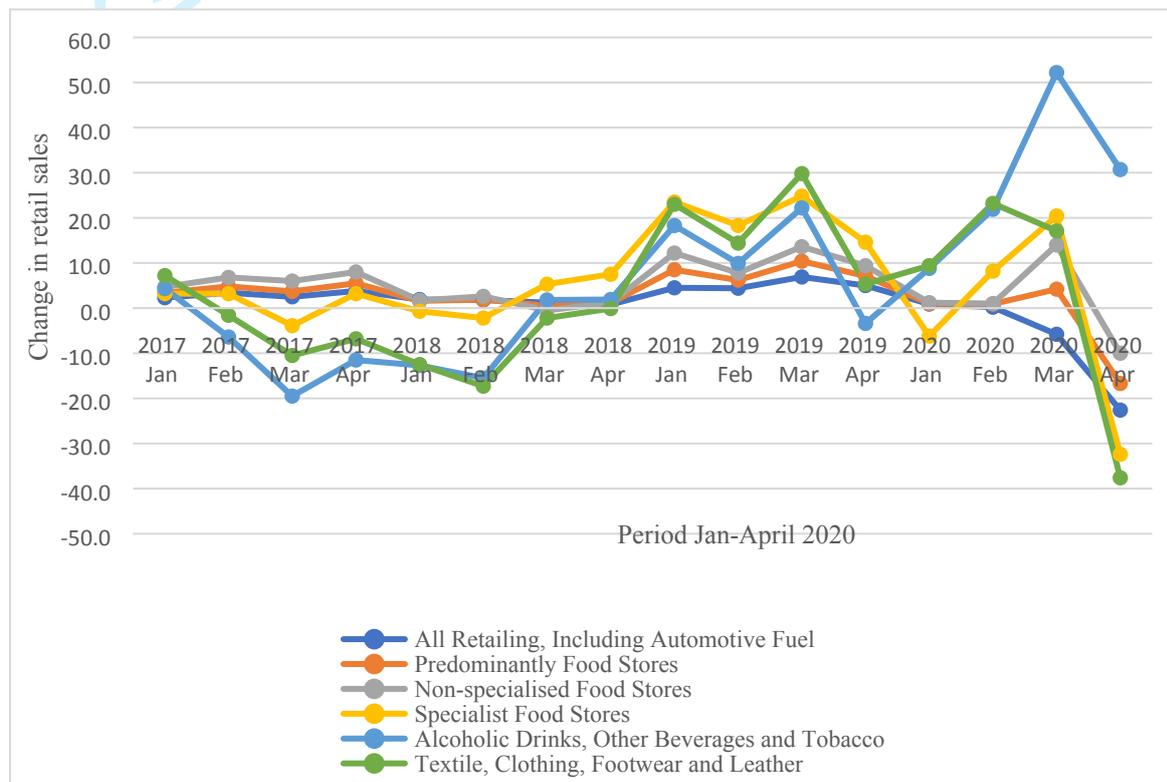


Figure 5: Percentage change in sales during pandemic compared to previous three years

5. Discussion

In this paper, we have made a comprehensive analysis of Covid-19 related data with respect to sales and customer purchase behaviour. The research context presented in Section 3 and the simple model in Section 4 provide some interesting insights on how businesses can respond to changes in supply chains due to the pandemic. The need for self-isolation and its impacts on product demand has affected good and non-food businesses in different ways in various countries. The context of the UK discussed in Section 4.2 has brought the relative importance of multiple ranges of businesses such as specialised food stores, alcoholic drinks, textile/clothing, medical stores, cosmetics, and computers on sales growth. Given that the impacts of the pandemic have been felt differently in different businesses, we provide a summary of responses from business entrepreneurs under various scenarios in Table 3. Thus, the response could differ based on the type of businesses. The second column outlines the business strategy before the onset of the pandemic, but the responses after the pandemic vary depending on type. While collaboration is the key for food-based SMEs, companies in the non-food sector such as sports equipment or fashion suffered sudden loss of business (as highlighted by exit of giants like Debenhams) that are experiencing slow revival due to the impact of the pandemic.

Table 3: A summary of possible business entrepreneur's response to supply chain behaviour in response to Covid-19 outbreak

Type of business	Before pandemic	During pandemic	After pandemic
Non-specialised food (basic food)	For-profit business	Collaborate with other businesses to serve the society	Maintain collaboration to create win-win situation
Specialised food	For-profit business with niche market	Consolidate existing supply chain due to increased demand	Maintain collaboration but support corporate social responsibility
Food supply chains	Collaborate for profit	Searching for survival	Maintain and strengthen existing collaboration, seize on bricolage opportunity to diversify to areas that thrive during or immediately after the pandemic (e.g., ventilators, personal protective equipment, masks, hand sanitisers, gel, etc.)
Sports Equipment	For-profit with some focus on health and fitness	Sudden loss of business, look for alternative business options linking with food business	Slow revival with stronger bricolage opportunity to link with the food sector

Fashion	For-profit business	Socially responsible business	Diversified business seizing on bricolage opportunities.
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The summary presented in Table 3 has both theoretical and managerial implications. The theoretical implications arise because the idea of bricolage has helped extend the domain and value of the supply chain resilience theory. We have established that bricolage, which is the ability to combine resources to deal with new problems and gain further growth, has a special significance in the context of pandemic situations such as the Covid-19 crisis. With food businesses potentially supporting non-food opportunities and non-food businesses exploring further opportunities with food businesses, the idea of bricolage has extended the supply chain resilience theory. The contingency management theory has also been extended because the pandemic has yielded new leadership opportunities, especially by pooling resources for supply chain resilience. All businesses operating globally can develop resilience against risk by having contingency plan to tackle any SC issues arising through natural calamities will save businesses and also the society.

The managerial implications of our study are also clearly explained in Table 3. We believe that the ability of businesses to bricolage seizing new opportunities that will emerge after the pandemic will provide them with significant competitive advantage. As we have highlighted in the last column, food businesses will do well if they seize on bricolage opportunity to diversify to areas that thrive during or immediately after the pandemic (e.g., ventilators, personal protective equipment, masks, hand sanitisers, gel, etc.). Similarly, non-food businesses should exploit new opportunities to work along with food businesses.

6. Conclusions and future research

This research paper considered various options for businesses in the context of the Covid-19 pandemic. This paper also suggested some interesting approaches for businesses who are dealing with food supply chains in the UK (see Table 3). Our findings extend current understanding of the importance of bricolage (Baker and Nelson 2005) in building supply chain resilience. In particular, we add to existing literature as we highlight the importance of collective bricolage that can help SMEs navigate disruptions caused by natural disasters. Furthermore, by identifying the priorities and resilience strategies, Table 3 helps us to answer our research questions and make significant new contribution to knowledge on resilience in pandemic situations. As we cannot change the consumer behaviour it may be a good idea to align the supply with demand especially at this time of difficulty. Co-creation among businesses

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3 and supply chains may help to rebuild the economy (Sharma, 2021). Businesses can reposition
4 their role of business when natural calamities erupt (such as pandemic or flood) to serve the
5 common good of a society. This may involve collaborating with other small businesses in main
6 supply chain activity irrespective of their type of business to create a strong force to meet the
7 demand. Businesses may be losing its profit at one point in time, it will create a social integrity
8 and build resilience (Behzadi et al., 2017). Businesses will start realising importance of working
9 collaboratively to achieve win-win situation.

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15 Current literature suggests that responses of businesses to a disruption is dependent on their
16 risk and reward assessment of the disruption (Herbane 2010), and their own resources
17 (Polyviou et al. 2019). On the one hand, when the perceived risk of a crisis event is high
18 regardless of the perceived reward, businesses (including SMEs) allocate resources to mitigate
19 the negative consequences of the crisis. On the other hand, when the risk of the crisis is low
20 and potential reward is high (for example increases in product demand), SMEs will distribute
21 resources to maximise opportunities created as a result of the crisis. And this will create some
22 great opportunities for all SMEs in developing economies (Asamoah et al., 2020). The financial
23 and emotional costs from a crisis can inform how entrepreneurs react to a crisis event. Ivanov
24 (2021) suggests a lean approach of resource management at the time of crisis.

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33 From current findings we further suggest that *collective bricolage*, that is, the utilisation of
34 resources from external partners and together co-creating a joint initiative that can help reduce
35 the impact of a major disruption like Covid-19. Specifically, the bricolage opportunity working
36 jointly with the government by sharing resources so as to meet the unprecedented demands
37 caused by the pandemic has been stressed in our analysis.

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Our data analysis and results show that people's basic needs (food and essential products)
contribute to nation's economy than any other luxury or non-essential items during pandemic.
This opens a floor for debate on how businesses react to these situations and what could be
their focal areas of business strategies. Current literature suggests that dynamic capabilities
such as businesses' internal social capital play an active part in building a resilient response to
disruptive events (Martinelli et al. 2018; Polyviou et al., 2019; Duchek, 2018) and support
sustainability (Barreiro-Gen et al 2020). Our reserach paper adds to this finding by
demonstrating the importance of collaborative bricolage, which involves businesses supporting
each other to meet increased demands for basic necessities during a pandemic. This position
aligns with Wieland and Wallenburg (2013) who argue that relational competencies help firms
enhance their resilience and can also contribute to their competitive advantage. Our findings

are also consistent with those of Sullivan and Branicki (2011), who argue that business resilience has direct impact on their business potential.

The Covid-19 left a great impact in socio-economic condition of global nations. Building resilience with strong risk management capabilities will help to rebuild the nations. At this difficult time, society should come forward together to show their strength and integrity. The social integrity of UK was highly evident from local support for frontline workers through charity events and weekly appreciations. Overall, this study has implications that extends beyond the Covid-19 pandemic by emphasising the importance of collaborative bricolage as a means to build resilience and respond to natural disasters that disrupts the flow of supply chain.

This article has some limitations mainly due to lack of historical data. In presence of multiple data from various sources, data envelopment analysis can be used effectively to see the performance of retail sales having input and output variables. Although this pandemic situation has put global nations in very high critical economic situations, extra human effort after the pandemic can help the society to recover faster than usual. For example, the working hours of fixed time employees can be extended 10 percent per day which will compensate the lockdown period downfall in the next year. Similarly, employees working part time and self-employed can work for 10% more time for the same salary. In this case, every employee will be sacrificing some of their wages for the benefit of society which in turn will save us from falling due to economic slide. The impact of such an increase in working hours on business resilience can be an interesting study for any future research.

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Supply chain resilience and business responses to disruptions of the Covid-19 pandemic

Thanks to the Editor and the reviewers for their positive comments and feedback. We thank Reviewer-1 for accepting the article. We have addressed Reviewer-2's comments and accordingly the article is revised with new references from COVID related recent articles. We hope this final version of our article is ready to publish in Benchmarking: An International Journal.

Reviewer: 2

Recommendation: Minor Revision

Comments:

Author(s) have submitted their revised work on "Supply chain behaviour and business responsibility in response to Covid-19". The paper has improved, however certain issues need to be addressed.

The relevant literature on supply chain resilience during Covid-19 can further strengthen the manuscript. Author(s) can refer the below mentioned literature in the revision which are recent and relevant to the manuscript.

- <https://doi.org/10.1080/00207543.2020.1750727>
- <https://doi.org/10.1016/j.techfore.2020.120447>
- <https://doi.org/10.1108/IJPDLM-12-2020-0434>
- <https://doi.org/10.1504/IJISM.2020.107780>
- <https://doi.org/10.1108/IJLM-11-2020-0448>
- <https://doi.org/10.1108/IJLM-02-2021-0094>

Response: Thanks for acknowledging that the paper has been improved in its quality. In the revised version, we have included some relevant articles from the suggested literature and also added a few literature from BIJ.

Discussion section can be more organized, where author(s) can indicate the implications for theory and practice. The implications for theory can contribute to literature, what is known and what is not and how this research is unique in which settings?

Response: We have considered this suggestion very positively and organised the discussion section (Page 17, Section 5) relating with the theories we discussed in section 2.

Implications for practice should describe the factors those needs to be considered by professionals of supply chain, what should be the approach of businesses, how they should look at it in future?

Response: In the revised version (section 6, pages 17-18), we have highlighted practical implications and how the businesses can tackle difficult situation such as pandemic, with entrepreneurial orientation.

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4 As a note, I will advise author(s) to highlight the changes this time in the revision, so they are
5 easily visible.
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7 **Response:** In the revised article, we have highlighted the changes explicitly.
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10 To make it more meaningful, it is expected that author(s) cite 8-10 references from BIJ in
11 addition to above.

12 **Response:** In the revised version we have added several references from BIJ and highlighted
13 the same.
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