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COVID-19-related supply chain disruptions: resilience and vulnerability of micro, small and medium enterprises

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ABSTRACT

The COVID-19 outbreak created a global public health crisis to which governments responded with several measures, including a lockdown on social and economic activities. This study assessed: (1) the supply chain disruptions caused by the lockdown, (2) the supply chain disruption effects on the performance of micro, small and medium enterprises (MSMEs), (3) the resilient strategies (responses) MSMEs adopted to overcome the disruption challenges and (4) how the supply chain disruption affected the performance of MSMEs and how their responses varied across different MSME and supply chain characteristics. Using descriptive statistics and *t*-tests, the study found that the COVID-19 lockdown reduced the quantity, quality and order lead time of goods supplied. It also halted the supply of some other goods. Disruptions in the supply chain affected MSMEs' performance by reducing quantity, quality, variety of goods stocked, reliability to customers and customer base. MSMEs responded to the supply chain disruptions by changing their purchase arrangement, reducing the number of employees, increasing product prices, closing businesses temporarily and diversifying businesses supplying essential products such as foods and sanitary materials. Performance and responses of MSMEs varied depending on the age, size, location, registration status, product and industry.

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1. Introduction

Supply chain risk management is generating interest among businesses, academics and other entities because of the increasing prevalence of disruption risks. The risks have become one of the four important emerging issues, alongside systemic financial risks, food security and energy security (Blanke, 2008). In business, supply chain disruptions have impacted the performance of many companies (Ho et al., 2015). Disruption risks denote the major disruptions that are caused by hazards such as earthquakes, floods, hurricanes and outbreaks of a pandemic, terrorist attacks, wars, sudden economic crises or strikes (Szuster & Lotko, 2022). This study focuses on a disruption risk associated with Coronavirus (COVID-19) pandemic. Globally, the world has been befallen by the COVID-19 pandemic since December 2019. As a response, many governments, including the Government of Uganda imposed social and economic lockdowns to ensure social distancing which has been considered a better strategy for controlling the spread of the virus. The COVID-19 lockdown significantly disrupted supply chains. Consequently, normal operations of the business were affected as the production of goods and services reduced, customer demand decreased, the workers could not return to work and there was a shortage of materials to protect employees against the infection (Arndt et al., 2020; Moosavi et al., 2022).

The extent to which supply chain disruptions impact the performance of businesses depends on their vulnerability and resilience. However, the effects of vulnerability and resilient strategies on business performance during the COVID-19 crisis are less understood because of limited and conflicting literature. First, studies of resilience in developing countries (DCs) and among MSMEs are still limited. 'Limited work

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has been done to know about the company's resilience in the face of numerous and recurrent challenges observed in DCs' (Saad et al., 2021, p. 24). While it is rising, Saad et al. observed that resilience research with an overt focus on SME is still recent and having great potential for more research. For Saad et al., even the existing studies lack conceptual and empirical research on SMEs' resilience.

Second, there is mixed information on business resilient strategies adopted during the COVID-19 pandemic. While some responded using more effective measures such as virtual connection, innovative e-commerce and increasing working hours, others adopted less effective measures like decreasing work hours and laying off workers temporarily (Anakpo & Mishi, 2021). Many firms had no strategies and guidance to cope with disruptions and maintain resilience during the COVID-19 pandemic (Hosseini & Ivanov, 2022; Moosavi & Hosseini, 2021). Consequently, they responded late and ineffectively, resulting in high coordination efforts and long shortage periods (Ivanov, 2020; Miroudot, 2020; Singh et al., 2021).

Third, the effects of MSMEs' vulnerability and resilient strategies (responses) on their performance during the COVID-19 pandemic are particularly less understood because of the ambivalent and equivocal nature of MSMEs. While some scholars view MSMEs as less resilient and vulnerable to disasters, others consider them as resilient. For example, Skouloudis et al. (2023, p. 93) argue that small and medium enterprises are 'highly vulnerable to natural disasters and unaware of resilience-building measures'. Skouloudis et al. also assert that the resilience capacity of these enterprises is hampered by their limited financial capacity. Similarly, García-Villagrán et al. (2020) attribute the vulnerability of micro, small and medium enterprises (MSMEs) to having few reserves, limited cash and access to credit or capital markets. On the contrary, García-Villagrán et al. consider MSMEs as often resilient during the economic crisis. They are credited for having characteristics that ensure their survival during a crisis. Their smaller sizes and sometimes informality make them more flexible in decision-making and operations (Eggers, 2020; Samantha, 2018). For Eggers, MSMEs' flexibility and closeness to their customer base enable them to cope with threats and exploit opportunities arising from crises. In particular, Eggers argues that these characteristics are very useful for exploiting market opportunities that require innovative and proactive postures.

This study assessed how vulnerable and resilient MSMEs had been to COVID-19-related supply chain disruptions and how MSMEs responded to the disruptions in the context of Northern Uganda. Specifically, it assessed: (1) the supply chain disruptions caused by the COVID-19 lockdown, (2) the supply chain disruption effects on MSMEs' performance, (3) the resilient strategies (responses) MSMEs adopted to overcome the supply chain disruption challenges and (4) how the supply chain disruption effects on the performance of MSMEs and their resilient strategies varied across different MSME and supply chain characteristics. The study, therefore, contributes to the debates about the vulnerability and resilience of MSMEs to shocks and their associated supply chain disruptions. It also broadens our understanding of the role of MSMEs' resilience in absorbing and responding to shocks in developing countries. This study focused on MSMEs because they constitute more than 95% of registered businesses worldwide and over 35% of the national income and nearly 50% of employment in the developing world (World Bank, 2017). The subsequent sections of the paper cover conceptual framework, materials and methods, results and discussion as well as conclusion and recommendation.

2. Conceptual framework

A conceptual framework presented in Figure 1 shows that the COVID-19 lockdown disrupted internal operations, demand-side and supply-side of supply chains. The extent of these disruptions depends on the vulnerability of the chain. In turn, the disruptions affect MSMEs' performance directly and indirectly by triggering MSMEs' responses. How supply chain disruptions affect the performance of MSMEs depends on their vulnerability or characteristics.

2.1. Disasters and supply chain disruptions

Supply chain disruptions can occur inside organizations (Internal disruptions) as well as on the supply side (Supply-side disruptions) and customer side (customer-side disruptions) of the supply chains. These

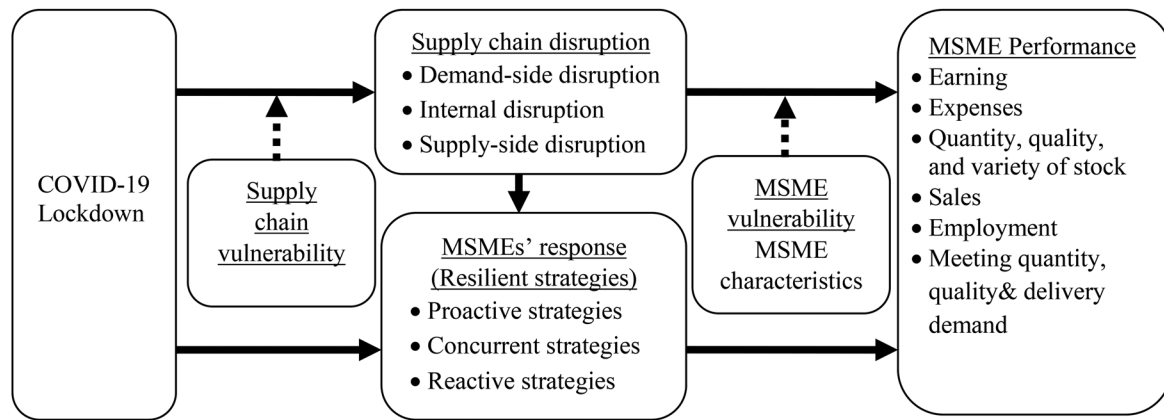


Figure 1. A conceptual framework, showing linkages between COVID-19 lockdown and supply chain disruption, MSMEs performance and responses (resilient strategies).

disruptions include stoppages where flow is completely halted and reductions in the material flow where the flow slows down or is not delivered in the anticipated time or quantity (Habermann et al., 2015). The COVID-19 lockdown significantly disrupted supply chains. It affected the customer side by reducing consumer demand for goods, consumer spending on services; demand from other firms and exports (Wang et al., 2020). Wang et al. also reported reductions in business hours and access to imported inputs on the supply side. These resulted in internal disruptions, including liquidity problems and reduced outputs, inputs and labor (Ibid). Specifically, it reduced the quantity and quality of goods supplied, leading to a shortage of essential items like food, medicine, diagnostics equipment, clinical cure and PPE (Singh et al., 2021). In India, for example, product availability fell by 10% for vegetables, fruits and edible oils (Mahajan & Tomar, 2020). The lockdown also reduced imports of pork and the supply of corn and breeding stock to hog farms in China (Wang et al., 2020). Shenge et al. (2021) found a higher level of dissatisfaction with goods and services in Nigeria.

2.2. COVID-19-based supply chain disruptions and MSMEs' performance

MSMEs' performance can be measured by several parameters. These include production and revenue levels, sales volume, customer base, business size, financial condition and employee satisfaction and motivation (Hamzani & Achmad, 2016). COVID-19-related supply chain disruptions reduced outputs and sales and created an inability to pay creditors and workers and to maintain workforce levels (Wang et al., 2020). In California, for example, the COVID-19 lockdown reduced sales among businesses hit by mandatory lockdowns and those with high levels of person-to-person contact (Fairlie & Fossen, 2021). In contrast, Fairlie and Fossen reported a significant growth in online sales during the crisis. They noted reduced sales in large and densely populated counties, but an increase in small rural counties. The income of informal workers in both agriculture and nonagriculture in Indonesia reduced (Pitoyo et al., 2020).

2.3. Resilience

Resilience is a critical attribute that businesses require for their survival during a crisis. Resilient businesses have both short-term coping capacities to recover from violent disturbances and long-term adaptive and innovative abilities that may change their post-crises business models (Li et al., 2021). Business resilience is 'the ability to respond productively to significant changes and to cope with unanticipated dangers' (Ritter & Pedersen, 2020, p. 222). Dahles and Susilowati (2015) also defined resilience as a 'business's ability to survive, adapt and innovate in the face of the turbulent environment'. This definition implies that a business's resilience is a firm's ability to restore its operation and capacity to the pre-crisis perceived normality, a 'business's ability to introduce gradual changes and new business concepts that naturally arise through the improvement of existing products, procedures and operation' and transformative effects of a crisis where businesses are forced to adopt changes that are urgent, unplanned and

drastically different from existing business models, resulting in new markets, products, services, operations and partnership networks or leadership (Dahles & Susilowati, 2015; Li et al., 2021).

Regarding small and medium enterprises, 'resilience is often described in the literature by firm survival, minimizing vulnerability, fast recovery, sustainability, performance growth, responsiveness and development of new capabilities and opportunities within a challenging environment' (Saad et al., 2021, p. 8). Saad et al. associate business's resilience to firm's capability to adapt, maintain positive performance and to seize business opportunities amid disruptions. In this study, MSMEs' resilience was considered as the capability to maintain positive performance.

2.3.1. Resilience strategies

Business resilience can be enhanced by many strategies. These strategies fall into three major categories: pro-active, concurrent and reactive strategies. Proactive strategies are those needed in the pre-disruption phase and they entail planning for, anticipating, alerting and preparing for the disruption (Ambulkar et al., 2015; Day, 2014; Ponomarev & Holcomb, 2009). Concurrent strategies comprise quick reactive thinking and first-response abilities to cope with disturbances during the disruption phase (Hollnagel, 2011; Sheffi & Rice, 2005). They are associated with coping with change, adapting and responding to unexpected events (Carvalho et al., 2011; Knemeyer et al., 2009; Wu et al., 2013). Reactive strategies are those required in the post-disruption phase to recover by bouncing back from disruption and returning to the original or desired state (Brandon-Jones et al., 2014; Schmitt & Singh, 2012; Urciuoli, 2015). This study focused on concurrent resilience strategies. The concurrent resilience of businesses can be enhanced by four major factors, namely: flexibility, agility, collaboration and redundancy.

Flexibility is the 'ability of a firm to respond to long-term or fundamental changes in the supply chain and market environment by adjusting the configuration of the supply chain' (Parast & Shekarian, 2018, p. 380). It promotes supply chain resilience by ensuring prompt adaptability during turbulence (Christopher & Holweg, 2011). Firms need to observe flexibility in sourcing, flexibility in manufacturing processes or resources, flexibility in transportation mode, flexibility in order fulfillment, flexibility in products and flexibility in pricing (Fiksel et al., 2015).

Agility is the ability to efficiently change operating states as a response to environmental uncertainty or volatile market conditions (Faisal et al., 2020; Lim-Camacho et al., 2017; Narasimhan et al., 2006; Parast & Shekarian, 2018; Prater et al., 2001). Gligor et al. (2015) defined a firm's agility as its 'ability to quickly adjust its supply chain tactics and operations'. Business agility also refers to the ability of a business to 'adapt quickly to market dynamics and respond appropriately and flexibly to customer demands' (Suprapti & Suparmi, 2022). For Suprapti and Suparmi, business agility pertains to having not only the ability to adapt to changes and to detect existing opportunities and threats but also the ability to utilize the company's knowledge and resources to make changes (innovations) faster than competitors. Shekarian and Mellat Parast (2021) argue that a firm's agility enables it to respond rapidly to market changes and potential or actual supply chain disruptions. Suprapti and Suparmi also consider business agility as a source of business competitive advantage.

Parast and Shekarian also define Supply chain collaboration as the 'ability to work efficiently with other entities for mutual benefit in areas such as forecasting, postponement and risk sharing'. Scholten and Schilder (2015) associate collaboration with information-sharing, goal congruence, joint decision-making, resources-sharing, incentive alignment, collaborative communication and joint knowledge creation among supply chain partners. By promoting open communication and working together to share information among supply chain partners, collaboration improves supply chain visibility, reduces supply chain uncertainty and overall cost and enhances competitiveness (Chen et al., 2013; Jain et al., 2017; Parast & Shekarian, 2018).

Similarly, Parast and Shekarian refer to redundancy as the 'strategic and selective use of spare capacity and inventory that can be invoked to cope with a crisis, such as demand surges or supply shortages'. Kamalahmadi and Parast (2017) demonstrated how three types of redundancy strategies (inventory, backup suppliers and protected suppliers) can improve a firm's performance in a turbulent and complex business environment that involves supply chain disruption. These strategies include excess capacity in production or transportation or resources, multiple suppliers, safety stock, strategic inventory,

emergency backup/storage facilities and low capacity utilization (Ambulkar et al., 2015; Azadeh et al., 2014).

2.3.2. Resilience of micro, small and medium enterprises

Resilience is an important attribute for MSMEs. They are resilient because of their flexibility, dynamism and innovation in times of crisis (Thoo et al., 2017). However, their resilience varies depending on many factors. These factors include the background and entrepreneurial orientation of enterprise owners, entrepreneur's human capital, social capital (SC) and internal factors.

Entrepreneurs' background of significance to resilience includes age, gender and lifestyle of entrepreneurs (Biggs et al., 2012; Sköld & Tillmar, 2015). Biggs et al. found the influence of the age of entrepreneurs and lifestyles on the level of business resilience. Sköld and Tillmar also found a rise in the number of women-owned businesses despite being faced with disruptions. However, limited research exists on how resilience varies with gender differences in developing countries where there is a more vulnerable setting for women-owned SMEs (Saad et al., 2021).

Human resources play an important role in the resilience of small and medium enterprises to disruptions (Saad et al., 2021). This is especially true for human resources having requisite skills and experience (Biggs et al., 2015). Pal et al. (2014) associate human capital with the improvement of the entrepreneur's management efficiency in the face of disruptions. However, the effect of an entrepreneur's human capital on business success remains inconclusive as Nichter and Goldmark (2009) question the human capital effect on a company's performance.

Entrepreneurial orientation improves business resilience. Ates and Bititci (2011) associate entrepreneurial orientation with building SMEs' resilience. For Wiklund et al. (2009), entrepreneurial orientation dimensions such as innovativeness, proactiveness and risktaking, play a significant role in business success. However, Lumpkin and Dess (1996) and Wales et al. (2013) argued that business success depends not only on entrepreneurial orientation but also on the environment of their operation. Wales et al. also consider the effect of entrepreneurial orientation on business resilience inconclusive as most entrepreneurial orientation research focused on developed countries paying less research attention to developing countries.

Social networks enhance resilience in many ways. They cushion SMEs in the face of adversity (Biggs et al., 2015; Gunasekaran et al., 2011). They also provide avenues for increased mobilization and transfer of knowledge and dissemination of innovative activities (Demmer et al., 2011). In particular, networking with government organizations expands resources that can be drawn on, learned from and the capacity to respond to challenges (Chiesi, 2014; Pal et al., 2014). Social networks, therefore, promote resilience by facilitating access to resources.

Firm internal attributes such as physical and financial capital are vital for resilience (Wedawatta et al., 2010). While financial access matter a lot for resilience, securing finance is challenging for SMEs in general and subsistent firms operating in developing countries in particular (Tognazzo et al., 2016). Tognazzo et al. also reported a tendency for SMEs with larger sizes, slack resources and good access to finance, to be most resilient during the economic crisis. However, McGuinness and Johnson (2014) consider an SME's financial position at the onset of a crisis as more important than the firm's age or size in determining the impact of the crisis on the firm.

2.3.3. Resilience strategies (responses) during COVID-19-based supply chain disruptions

During the COVID-19 crisis, MSMEs responded to supply chain disruption in many ways. Some businesses increased the prices of products (Wang et al., 2020). In China, the reduced imports of pork and the supply of corn and breeding stock to hog farms led to an increase in pork prices and reduced pork consumption (Wang et al., 2020). Although the COVID-19 lockdown reduced the availability of vegetables, fruits and edible oils in India, there was a minimal effect on the prices of these food items because the government policy prevented unreasonable price increases during the COVID-19 lockdown (Mahajan & Tomar, 2020).

Other businesses adopted online businesses and increased collaboration with other entrepreneurs (Fabeil et al., 2020), laid-off employees and focused on and shifted to supplying products that emerged

essentially during the COVID-19 crisis (Fabeil et al., 2020; Singh et al., 2021). In Malaysia, Fabeil noted many online businesses including selling products via e-bazaar on Facebook Page, promoting and receiving orders via Mobile Apps like Whatsapp and other e-mailing applications. Collaboration in Malaysia took place through association, involving sharing market information, marketing and product delivery (Fabeil et al., 2020; Singh et al., 2021). In India, automotive manufacturers shifted towards making ventilators, testing kits and testing cylinders; the textile and fashion industry started making PPE, masks, gloves and hospital furnishing products; chemical industries shifted to making sanitizers, cleansers and oxygen (Singh et al., 2021).

2.4. Vulnerability of MSMEs to supply chain disruption

While MSMEs are resilient, they are also vulnerable. They are exposed to contextual forces that hinder their performance and survival and make them vulnerable (Canevari-Luzardo, 2019). These forces include limited internal resources, insufficient access to finance and information, high dependence on external business and policy cycles and unfavorable power struggles (Crick et al., 2018; Kuruppu et al., 2014; Smith & Deslandes, 2014). However, Canevari-Luzardo observed that vulnerability levels vary between MSMEs, depending on their location, sector and size and the business-network operational environment in which they are embedded.

In terms of location, urban areas are more vulnerable to hazards and disruption than rural areas. This has been the case during COVID-19 crisis (Acharya & Porwal, 2020; Imdad et al., 2021). The vulnerability of the urban areas is attributed to their dense population. Similarly, MSMEs are considered more vulnerable in developing countries than in developed countries (KPMG, 2016).

Some sectors are more vulnerable than others. For example, Wedawatta et al. (2010) suggest that the construction sector SMEs are more vulnerable to natural hazard disruptions than other sectors. During the COVID-19 crisis, the construction and tourism sectors were more vulnerable than the foods and medicine sectors, which are considered essential sectors or commodities.

The smaller the firm, the more vulnerable it is to internal and external events (Durst et al., 2021; Eggers, 2020). Samantha (2018) argue that smaller businesses have fewer financial and technical resources necessary for reducing and coping with risk and lack risk management mechanisms. This is especially serious in developing countries where most of the MSMEs do not practice disaster risk management mechanisms such as insurance; diversify their supply and customer bases and social protection for their employees (KPMG, 2016). In contrast, extant research posit that characteristics of small firms such as being flexible and disposing of adaptive capacity during the crisis as decision-making tend to be shorter and faster (Branicki et al., 2018). However, Durst et al. (2021) argued that the small business' tendency toward resilience or vulnerability depends on experience, mindset and resources.

Networking and collaboration are crucial not only for resilience but also for overcoming vulnerability. MSMEs can reduce their vulnerability to disaster-related supply chain disruptions by enhancing horizontal and vertical coordination (Prasad et al., 2015; Stecke & Kumar, 2009).

2.5. Vulnerability of supply chains to disruptions

The vulnerability of supply chains to disruptions depends on many factors, including the length of the supply chain as well as flexibility and the number of exposure points in the supply chain. Vulnerability increases with an increase in the length of and many exposure points in supply chains but reduces with increasing flexibility (Habermann et al., 2015; Hobbs, 2021; Stecke & Kumar, 2009). Increased geographical distances increase the supply chain complexity, leading to higher disruption risks, but proximity or co-location of supply chain partners, increases the reliability and decreases the disruption risk (Habermann et al., 2015; Hobbs, 2021). Globalization, which includes offshore sourcing, manufacturing and assembly, increases the number of geographical regions that a product passes through, thereby increasing the number of climatic and political catastrophes that may disrupt a supply chain.¹ Outsourcing, globalization and decentralization also add to the vulnerability of a supply chain as they increase the distance

(and/or time) the material takes to travel between the supply chain echelons.² This has been the case during the COVID-19 crisis where the reduction in product availability was more severe in long-distance food supply chains in India (Mahajan & Tomar, 2020). Practices such as sole sourcing increase the vulnerability by decreasing flexibility in the supply chain.³

3. Materials and methods

3.1. Study area

Figure 1 shows that this study took place in Northern Uganda, particularly, in Gulu City and neighbouring districts of Amuru, Gulu and Omoro. The main economic activities in these areas are agriculture and trade. While agriculture constitutes the main economic activity in the neighboring districts, trade dominates the economy of Gulu City followed by the service sector, industry and construction. Most Gulu City residents derive their livelihoods from formal and informal commercial activities operated as wholesale and retail businesses of diverse products.

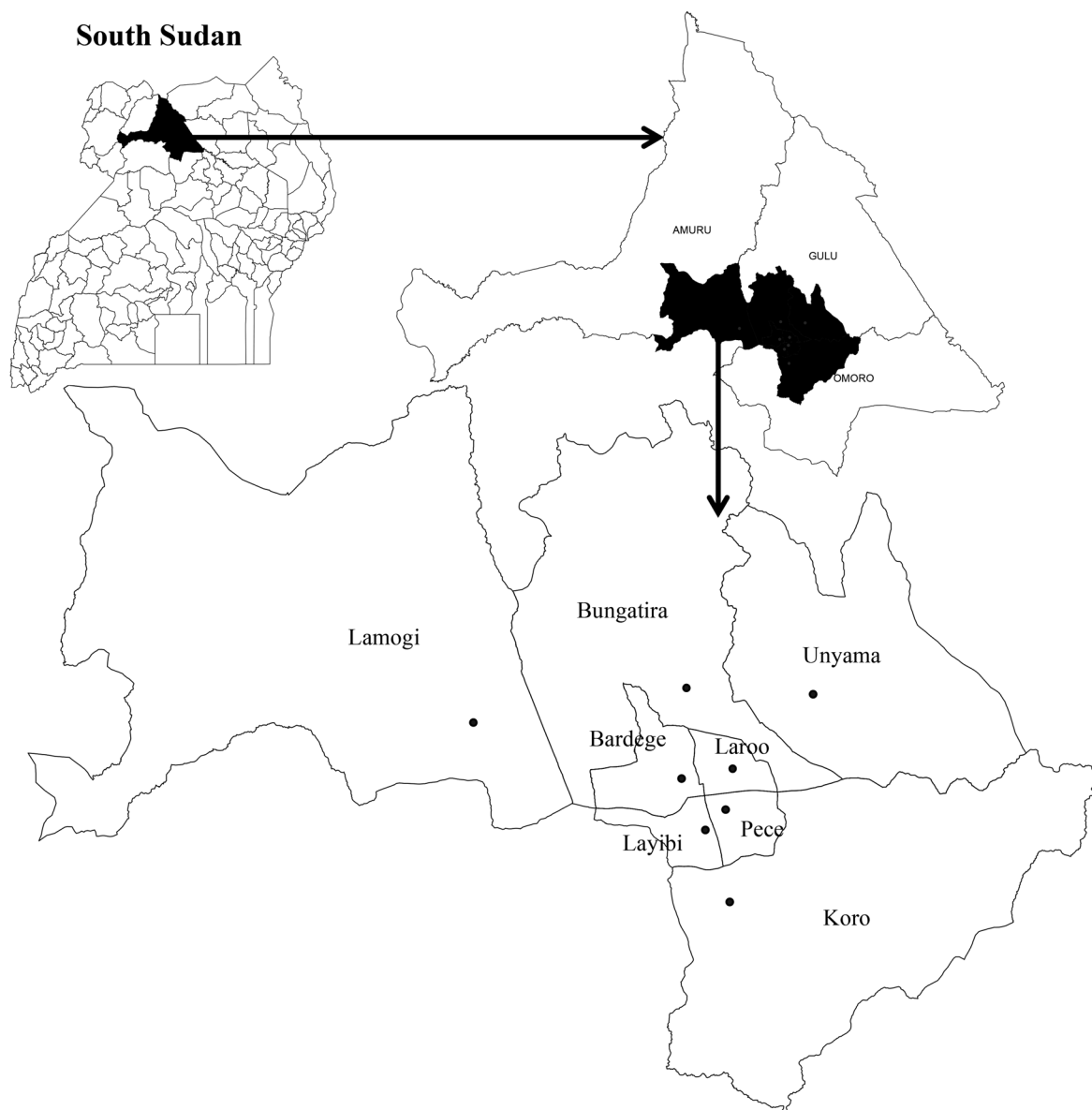


Table 1. Measurement of key variables.

Concepts	Measurements
Supply chain disruption	<ul style="list-style-type: none"> • Experienced stoppages (complete halt of flow) = 1; 0, otherwise • Products untimely delivered = 1; 0, otherwise • Quantity of goods reduced = 1; 0, otherwise. • Quality of goods reduced = 1; 0, otherwise
MSME performance	<ul style="list-style-type: none"> • Quantity of goods stocked reduced = 1; 0, otherwise • Quality of goods stocked reduced = 1; 0, otherwise • Variety of goods stocked reduced = 1; 0, otherwise • Disruption caused good spoilage = 1; 0, otherwise • Meeting quantity demand reduced = 1; 0, otherwise • Meeting quality demand reduced = 1; 0, otherwise • Reliability to customers reduced = 1; 0, otherwise • Customer base reduced = 1; 0, otherwise • Expenses increased = 1; 0, otherwise • Sales reduced = 1; 0, otherwise • Income reduced = 1; 0, otherwise
MSME responses to supply chain disruptions	<ul style="list-style-type: none"> • Number of employees reduced = 1; 0, otherwise • The percentage of employees reduced • Increased prices = 1; 0, otherwise • Diversified into unrestricted products = 1; 0, otherwise • Closed business temporarily and stayed home = 1; 0, otherwise • Closed business temporarily and went to village = 1; 0, otherwise

3.2. Data collection

This study relied entirely on primary data. The data was collected from 305 respondents operating MSMEs. The sample was drawn from 8 divisions using a stratified sampling technique. A geographical criterion was employed to segment the study area into 8 strata corresponding to Laroo, Pece, Layibi, Bardege, Bungatira, Unyama, Koro and Lamogi Divisions. While Laroo, Pece, Layibi and Bardege Divisions are located in Gulu City, Bungatira, Unyama, Koro and Lamogi Divisions are located in districts bordering Gulu City. This was meant to compare research findings from urbanized areas with more rural areas. Within each stratum, respondents were selected using a simple random sampling where the second nearest business entity was always chosen for an interview. Respondents were interviewed using a questionnaire administered by research assistants.

3.3. Measurements

Data measurement involved the operationalization of the conceptual framework presented in Figure 1. Major concepts from the conceptual framework, including supply chain disruption, characteristics, performance and responses of MSMEs were measured. Indicators or elements of these concepts were identified and measured as dummy variables. Details of how these concepts were operationalized and measured are presented in Table 1.

3.4. Analytical framework

Descriptive statistics were generated using STATA to describe the sample and how: (1) COVID-19 disrupted supply chains, (2) supply chain disruption affected the performance of MSMEs and (3) how MSMEs responded to supply chain disruption. Inferential *t*-statistics were also employed to assess how: (1) supply chain disruption, (2) performance of MSMEs during the COVID-19 lockdown and responses of MSMEs to supply chain disruption vary with business age, business size, business location, business registration status, product type supplied by the business and industry of the business (retail and wholesale trade). Equally, *t*-statistics were used to assess differences in the number of employees and suppliers as well as sources of supply and purchasing arrangements before and during the COVID-19 lockdown.

4. Results and discussion

4.1. Description of the sample

Table 2 shows that the majority of respondents are retail traders and business owners who are involved in the day-to-day management of their businesses. Most of the businesses are micro, registered, not

Table 2. Descriptive statistics of the sample.

Variables	%	Variables	%
Owner/co-owner of the business	63.9	Medium enterprises (50–100 employees)	3.0
Manage the business	59.3	General merchandise	11.2
Business is within the city	41.6	Essential products	65.3
Registered business (Formal)	52.8	Other products	23.6
Business age is more than 3 years	39.7	Retail trade	66.9
Microenterprise (1–4 employees)	68.2	Wholesale trade	21.6
Small enterprise (5–49 employees)	28.9	Other industries	11.5

Notes: % is a percentage; sample size = 305; essential products include foods, human drugs, agro-inputs and finance.

Table 3. COVID-19 Lockdown and supply chain disruption.

Variable	Frequency	Percentage	Sample size (n)
Quantity of goods supplied reduced	141	46.2	305
Quality of goods supplied reduced	178	58.4	305
Order lead time increased	152	49.8	305
Halted supply of some goods	209	68.5	305

Table 4. Sources of supply before and during COVID-19 lockdown.

Variable	Before COVID-19 lockdown	During COVID-19 lockdown	t-value
Number of suppliers	3.31	1.91	7.77***
Suppliers within district	0.84	0.65	5.71***
Suppliers from nearby districts	0.42	0.25	4.35***
Suppliers from far districts	0.39	0.34	1.34*

Notes: $n = 305$, *** $p < .01$, * $p < .1$.

older than 3 years and located outside Gulu City. The majority of these enterprises supply products, which are considered by the Government of Uganda as essential.

4.2. COVID-19 lockdown and supply chain disruption

The COVID-19 lockdown disrupted supply chains in some ways. Table 3 shows that the lockdown reduced the quantity, quality and order lead time of goods supplied. It also halted the supply of some other goods. This is especially true for the imported products.

The reduction in the quantity and quality of products supplied and the stoppage of some products resulted from the reduction of sources of supply upon placing the whole country under lockdown. This is evidenced in Table 4, which shows a significant reduction in sources of supply from within, nearby and far districts upon the establishment of the COVID-19 lockdown.

4.3. Supply chain disruption and performance of micro, small and medium enterprises

Supply chain disruptions negatively affected the performance of MSMEs. Table 5 shows that the disruption in the supply chain reduced the quantity, quality and variety of goods stocked. As a result, compliance with quantity and quality requirements was reduced. The reliability of customers and customer base also reduced. All these reduced sales and increased expenses, resulting in lower income as presented in Table 5. Tables 5 and 6 show that the COVID-19 lockdown and the subsequent supply chain disruption affected the performance of MSMEs differently depending on the age, size, location, registration status, product traded and industry of the business. The reduction in quantity stocked is more prevalent among older (>3 years) than younger enterprises, among firms located in and outside the city, among small and medium enterprises than micro-enterprises and formal than informal enterprises. While the reduction in quantity stocked is more prevalent among enterprises located in than outside the city; reduction in meeting quantity and quality demand, reliability to customers, customer base and income and increase in expenses are more common among firms located outside than in the city.

Problems of reduced stock quantity, difficulty in meeting quality demand, reduced reliability to customers and reduced customer base are less prevalent among informal than formal enterprises because most informal enterprises trade in essential products. This follows from a strong correlation that exists between

Table 5. MSMEs' performance by business age, business size, business location and registration status.

Variable	Overall	Business age			Business size			Business location			Registration status		
		0–3 years	>3 years	t-value	Micro	Not Micro	t-value	City	Not City	t-value	Formal	Informal	t-value
1	46.2	0.41	0.54	−2.14**	0.41	0.57	2.52**	0.55	0.39	−2.65***	0.56	0.35	−3.65***
2	49.5	0.48	0.52	−0.72	0.49	0.51	0.24	0.50	0.49	−0.03	0.53	0.45	−1.44
3	58.0	0.57	0.60	−0.42	0.56	0.62	0.92	0.61	0.56	−1.01	0.62	0.54	−1.53
4	43.9	0.49	0.41	−1.38	0.44	0.44	0.10	0.49	0.41	−1.45	0.45	0.43	−0.29
5	64.9	0.64	0.66	−0.35	0.64	0.66	0.26	0.59	0.69	1.82*	0.67	0.63	−0.60
6	62.6	0.60	0.67	−1.26	0.62	0.64	0.32	0.54	0.66	2.55**	0.68	0.56	−2.19**
7	68.2	0.68	0.69	−0.12	0.66	0.73	1.28	0.61	0.73	2.16**	0.75	0.61	−2.53**
8	71.8	0.70	0.74	−0.81	0.71	0.73	0.37	0.65	0.77	2.39**	0.77	0.66	−2.15**
9	58.7	0.58	0.60	−0.47	0.60	0.56	−0.73	0.52	0.64	0.73**	0.62	0.55	−1.28
10	100	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
11	73.8	0.73	0.75	0.34	0.76	0.70	−0.99	0.64	0.81	3.40***	0.75	0.72	−0.58

Notes: 1=Quantity of goods stocked reduced, 2=Quality of goods stocked reduced, 3=Variety of goods stocked reduced, 4=Caused good spoilage, 5=Meeting quantity demand reduced, 6=Meeting quality demand reduced, 7=Reliability to customers reduced, 8=Customer base reduced, 9=Expenses increased, 10=Sales reduced, 11=Income reduced, Sample size = 305.

Table 6. MSMEs' performance by product type and industry.

Variable	Overall	General merchandise			Essential products			Retail trade			Wholesale trade		
		Yes	No	t-value	Yes	No	t-value	Yes	No	t-value	Yes	No	t-value
1	46.2	0.5	0.46	−0.47	0.47	0.45	−0.24	0.43	0.54	1.79*	0.52	0.45	−0.97
2	49.5	0.38	0.51	1.40	0.54	0.42	−2.05**	0.50	0.50	0.00	0.56	0.46	−1.20
3	58.0	0.74	0.56	−1.95*	0.60	0.54	−1.10	0.56	0.61	0.83	0.73	0.54	−2.76***
4	43.9	0.34	0.47	2.56**	0.49	0.34	−2.33**	0.45	0.43	−0.34	0.38	0.46	1.12
5	64.9	0.77	0.64	−1.50	0.65	0.64	−0.20	0.66	0.62	−0.65	0.61	0.66	0.83
6	62.6	0.71	0.62	−1.02	0.61	0.66	0.90	0.61	0.65	0.69	0.68	0.61	−1.05
7	68.2	0.82	0.66	−1.89*	0.67	0.70	0.44	0.66	0.73	1.34	0.83	0.64	−3.02***
8	71.8	0.79	0.71	−1.04	0.71	0.74	0.50	0.70	0.76	1.21	0.82	0.69	−2.05**
9	58.7	0.47	0.60	1.46	0.59	0.59	0.00	0.60	0.56	−0.81	0.53	0.63	1.05
10	100	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00	1.00	1.00	0.00
11	73.8	0.71	0.74	0.45	0.73	0.76	0.49	0.76	0.69	−1.25	0.76	0.73	−0.41

Notes: 1=Quantity of goods stocked reduced, 2=Quality of goods stocked reduced, 3=Variety of goods stocked reduced, 4=Caused good spoilage, 5=Meeting quantity demand reduced, 6=Meeting quality demand reduced, 7=Reliability to customers reduced, 8=Customer base reduced, 9=Expenses increased, 10=Sales reduced, 11=Income reduced, Sample size = 305.

informal enterprises and trading in essential products ($\chi^2 (1, N=305) = 9.874, p=.002$). MSMEs trading in essential products such as foods and medicine have fewer problems of low customer demand because these products are basic requirements for human lives. Stocking an adequate quantity of goods, meeting quality demand and reliability to customers also pose less challenge to suppliers of essential products. This is because the majorities (76%) of the essential products are foods, which are mainly procured locally.

In terms of registration, the reduction in quantity stocked, meeting quality demand, reliability to customers and customer base is more prevalent among formal than informal enterprises. This implies that the formal enterprises were more vulnerable and less resilient than the informal enterprises. The results concur with Pitoyo et al. (2020) who found a lower impact of the COVID-19 lockdown on the informal sector in Indonesia. Pitoyo et al. argue that the economic activities of the informal sector are so flexible and easier to carry that they can absorb shocks during crises. The finding, therefore, confirms the optimistic view of the informal sector.

Cases of product spoilage and reduced stocking of the quality product were higher among essential than nonessential products. This indicates that MSMEs dealing in essential products were more vulnerable and less resilient than those engaged in the trading of nonessential goods. The results support Selam (2020) who reported a reduction in the quality of sanitizers sold on the street in Ethiopia. Product quality seems to have reduced as a response to the increased demand for cheap and low-quality products. During pandemics such as COVID-19, consumers reduce spending to survive by reducing product quantity and quality (Abigail & Zheng, 2021; Qelch & Jocz, 2009; Shama, 1978). Product spoilage and reduced quality could have also resulted from the long period of storage. This suggestion is in line with Bulgari et al. (2021) who reported a reduction in the quality of fruits and vegetables because the unsold produce was stored for a long time during the COVID-19 lockdown. Even essential products such as food and medicines have a shorter expiry period. Therefore, the reduced sales arising from the economic

lockdown seemed to have reduced their turnover rate, leading to spoilage. The finding concurs with Canevari-Luzardo's (2019) observation that vulnerability levels vary between MSMEs, depending on their sectors.

However, cases of reduction in product variety, reliability to customers and customer base are more prevalent among wholesale traders than retail and other traders. The results show that wholesale traders were more vulnerable and less resilient than retail and other traders. This appears to be because wholesalers were more affected by the COVID-19 lockdown than retailers. This explanation concurs with Erlina and Elbaar (2021), Kang et al. (2021) and Handfield et al. (2020). Erlina and Elbaar (2021) found more impact of supply disruption on wholesalers and distributors than other traders because they supply and transport goods across many areas in Indonesia. Kang et al. (2021) noted in the United States that 'Drug wholesalers were consistently out of stock of most preferred and alternative agents'. Handfield et al. (2020) attribute the reduced stock of goods among wholesalers to the reduced demand for products from retailers and consequently from wholesalers. The finding contradicts Tognazzo et al. (2016) argument that small and medium enterprises with larger sizes tend to be most resilient during the economic crisis. However, it concurs with Canevari-Luzardo's (2019) observation that vulnerability levels vary between MSMEs, depending on their sizes.

4.4. MSME responses to supply chain disruptions

Tables 7 and 9 show that MSMEs responded to supply chain disruptions in five main ways. They changed their purchase arrangement (0.45%), reduced the number of employees (42.3%), increased product prices (56.1%), closed business temporarily (37.4%) and diversified in businesses dealing in essential products such as foods and sanitary materials (41.3%). The reduction in employees and change in purchase arrangement can further be supported by results presented in Table 8, which shows that the number of employees and prevalence of purchases by the order is lower than before the COVID-19 lockdown.

Tables 7 and 9 also show that responses of MSMEs to supply chain disruptions differ depending on the age, size, location, registration status, product traded and industry of the business. The percentage of employee reduced is higher among formal than informal enterprises, among small and medium enterprises than micro-enterprises and among younger (0–3 years) than older (>3 years) enterprises. However, diversification is more prevalent among microenterprises than small and medium enterprises. Temporary closure of business has been more prevalent among enterprises in than outside the city. While the reduction in the number of employees is more prevalent among retailers than nonretailers, it is higher among wholesalers than nonwholesalers. Diversification is higher among retailers than nonretailers.

More employees were laid off by formal than informal enterprises and by small and medium enterprises than microenterprises because they are less affected COVID-19 lockdown. Flexibility, smaller size and limited resource requirements of micro and informal enterprises enable them to survive crises (Drucker, 1985; Pitoyo et al., 2020). The results concur with Fabeil et al. (2020) who found less employee

Table 7. MSMEs' responses by business age, business size, business location and registration status.

Variable	Overall	Business age			Business size			Business location			Registration status		
		0–3 years	>3 years	t-value	Micro	Not Micro	t-value	City	Not City	t-value	Formal	Informal	t-value
1	42.3	0.50	0.37	−2.34**	0.39	0.50	1.74*	0.44	0.41	−0.54	0.43	0.42	−0.21
2	22	25.3	20.3	−2.52**	19	29	4.50***	22.6	22.1	−0.28	24.5	19.8	−2.42**
3	56.1	0.53	0.60	−1.22	0.55	0.59	0.65	0.53	0.58	0.98	0.55	0.57	0.29
4	41.3	0.44	0.37	1.18	0.46	0.31	−2.53**	0.45	0.39	−1.07	0.37	0.46	1.52
5	37.4	0.41	0.31	1.75*	0.37	0.38	0.19	0.44	0.33	−2.06**	0.39	0.35	−0.67

Notes: 1=Reduced number of employees, 2=Percentage of employees reduced, 3=Increased prices, 4=Diversified into unrestricted products, 5=Closed business temporarily and stayed home, Sample size = 305.

Table 8. Number of employees and purchase arrangement before and during COVID-19 lockdown.

Variable	Before COVID-19 lockdown	During COVID-19 lockdown	t-value
Number of employees	3.27	2.02	6.50***
Purchase arrangement	0.55	0.45	2.52**

Notes: *** $p < .01$, ** $p < .05$.

Table 9. MSMEs' responses by product type and industry.

Variable	Overall	General merchandise			Essential products			Retail trade			Wholesale trade		
		Yes	No	t-value	Yes	No	t-value	Yes	No	t-value	Yes	No	t-value
1	42.3	0.29	0.44	1.62	0.44	0.40	-0.69	0.38	0.51	2.05**	0.53	0.39	-2.00**
2	22	26.35	21.77	-1.46	22.19	22.45	0.13	19.37	28.16	4.30***	29.56	20.27	-3.96***
3	56.1	0.50	0.57	0.75	0.54	0.59	0.86	0.54	0.59	0.83	0.59	0.55	-0.56
4	41.3	0.38	0.42	0.39	0.44	0.36	-1.41	0.47	0.31	-2.67***	0.33	0.44	1.49
5	37.4	0.35	0.38	0.27	0.39	0.34	-0.90	0.38	0.37	-0.19	0.27	0.40	1.92*

Notes: 1=Reduced number of employees, 2=Percentage of employees reduced, 3=Increased prices, 4=Diversified into unrestricted products, 5=Closed business temporarily and stayed home, 6= Closed business temporarily and went to the village, Sample size = 305.

reduction among microenterprises during the COVID-19 lockdown in Malaysia. This finding also confirms the observation that the formal and larger size MSMEs were more vulnerable and less resilient than the informal and smaller size MSMEs.

Young enterprises have a higher reduction in the number of employees than older enterprises because they have more challenges, including financial resources. This means that younger or new enterprises are more vulnerable and less resilient than older ones. New ventures often face the problem of limited financial resources because they heavily rely on external finances (Atieno, 2009; Brown & Rocha, 2020). However, access to external financing tends to be limited during the period of crisis. New enterprises also face challenges of high competition and a low customer base (Fatoki & Smit, 2011). These challenges affect the performance of new firms, leading to the laying off of some employees as a means of reducing costs during the crisis period ridden with low sales. This finding concurs with Durst et al. (2021) argument that the tendency of small businesses toward resilience or vulnerability depends partly on their experience.

Diversification of business activities is more prevalent among microenterprises than small and medium enterprises. This implies that microenterprises are more resilient than small and medium enterprises. They exhibit diverse organizational forms (Storey, 1994; Walls et al., 2001), high operational flexibility (Clark et al., 1999; Munoz, 2010; Piore & Sabel, 1984; Pitoyo et al., 2020) and low entry barriers or requirements which enable them to function across diverse sectors (Clark et al., 1999; Lee, 2008; Munoz, 2010). These attributes appeared to have made it possible for microenterprises to easily diversify into more viable businesses. The finding is in line with Branicki et al. (2018) observation that characteristics of small firms such as being flexible and disposing of adaptive capacity during crisis as decision-making tend to be shorter and faster.

Temporary closure of business was more prevalent among enterprises in than outside the city. This implies that enterprises in the city were more vulnerable to COVID-19 than those in the rural areas. The observation is consistent with Acharya and Porwal (2020), Imdad et al. (2021) and Fairlie and Fossen (2021). Fairlie and Fossen noted reduced sales in large and densely populated counties, but an increase in small rural counties in the United States. The finding also confirms Canevari-Luzardo's (2019) observation that MSMEs' vulnerability levels vary across their location. The finding could be attributed to more stringent COVID-19 measures and enforcement in the city because their dense population makes them vulnerable to the spread of the virus.

The reduction in the number of employees is more prevalent among wholesalers than nonwholesalers (retailers). This also implies that wholesalers were more vulnerable to and affected by COVID-19-related supply chain disruptions than retailers. This could also be because retailers had fewer numbers of employees before the COVID-19 lockdown than wholesalers ($t = -6.45$, $p < .01$). Since retailers had fewer numbers of employees, the reduction in employee numbers was also smaller than that among wholesalers.

Diversification is higher among retail than nonretail traders. This is because retailers are more flexible than nonretail businesses. It follows from Table 7, which shows that diversification is less prevalent among non-microenterprises than micro-enterprises, which are more flexible compared to non-microenterprises. The result gains support from Hobbs (2021), which argues that smaller firms have more flexible production systems than larger ones. However, the result shows no difference in diversification between businesses located within and outside the city. This is contrary to Yoshida and Yagi (2021), which reported increasing farm diversification in developed countries with decreasing distance to cities.

The diversity in MSMEs' responses to COVID-19 supply chain disruption concurs with Anakpo and Mishi (2021). Anakpo and Mishi (2021) found that responses to crises involved more and less effective

measures. In this study, while business diversification and changing purchase arrangements were more effective resilient (response) strategies; hiking product prices and closing businesses were less effective resilient strategies.

5. Conclusion and recommendations

The study assessed how the COVID-19 lockdown disrupted supply chains, affected MSMEs' performance and how MSMEs responded to supply chain disruption. The lockdown reduced the quantity, quality and order lead time of goods supplied. It also halted the supply of some other goods. Disruptions in the supply chain affected MSMEs by reducing quantity, quality, variety of goods stocked and reliability to customers and customer base. These effects vary depending on the age, size, location, registration status, product traded and industry of the business. The reduction in quantity stocked is more prevalent among older (>3 years) than younger (0–3 years) enterprises, among firms located in than outside the city, among small and medium enterprises than micro-enterprises and formal than informal enterprises. While the reduction in quantity stocked is more prevalent among enterprises located in than outside the city; reduction in meeting quantity and quality demand, reliability to customers, customer base and income and increase in expenses are more common among firms located outside than in the city.

MSMEs responded to the supply chain disruptions by changing their purchase arrangement, reducing the number of employees, increasing product prices, closing business temporarily and diversifying in supplying essential products like foods and health materials. Diversification is more prevalent among microenterprises than small and medium enterprises and retailers than nonretailers. Temporary business closure has been more prevalent among enterprises in the city than those outside the city. The reduction in the number of employees is more prevalent among retailers than nonretailers and wholesalers than nonwholesalers.

The findings of this study conform to the results of many studies conducted on COVID-19 effects. The study awakens conflicts between the optimistic and pessimistic views on the ability of the informal economy as well as micro and small enterprises to survive during a crisis. Generally, the findings of the study support the optimistic view. This is contrary to other studies arguing that the informal sectors as well as micro and small enterprises are more vulnerable and resilient to disaster than formal and larger enterprises. The study has three main implications. First, the findings that some businesses closed but others survived during the COVID-19 lockdown by diversifying in businesses of essential products have a managerial implication. They highlight the importance of building resilience capacity, notably: flexibility and agility. Second, the study has research implications. This study focused on concurrent resilient strategies, involving coping with change, adapting and responding to disturbances during the disruption phase. Future studies need to assess MSMEs' reactive resilient strategies, which are those required in the post-disruption phase to recover by bouncing back from disruption and returning to the original or desired state. This study also assesses disruptions in supply chains generally. There is a need to narrow the scope of this study to specific supply chains and conduct rigorous impact evaluation studies to refine the effects of COVID-19 on supply chain disruptions, MSMEs' performance and how the performance has been affected by their vulnerability and resilient strategies. The policy implication of the study is that government intervention during pandemics and supply chain disruption can protect consumers from the exploitation of unfair and unjustified price increments.

Notes

1. Stecké and Kumar (2009102).
2. Ibid.
3. Stecké and Kumar (2009102).

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Disclosure statement

No potential conflict of interest was reported by the author.

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