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The proliferation of motor tricycle usage in precarious transportation contexts and the performance of micro and small manufacturers

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A R T I C L E I N F O

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A B S T R A C T

Micro and small businesses (MSBs) in developing countries increasingly use motor tricycles to navigate transportation-induced supply chain disruptions. However, there is a lack of empirical understanding of whether and when these resources benefit such firms. This study draws on the contingent resource-based theory to examine how motor tricycle deployment relates to the performance of MSBs under varying conditions of supply chain dynamism in a developing country. The study tests its hypotheses on primary data from 267 micro and small manufacturers in Ghana using moderated regression analysis. The results indicate that motor tricycle deployment positively relates to MSB performance in Ghana ($\beta = 0.024$, SE $= 0.007$, $p = 0.001$). The results further show that supply chain dynamism positively moderates the relationship between motor tricycle deployment and MSB performance ($\beta = 0.008$, SE $= 0.004$, $p = 0.035$). In contributing to the limited literature on the firm-level performance implications of the increasing use of motor tricycles among micro and small businesses in developing countries, this study's results underscore the importance of adopting a contingency-based approach to understand the complexities inherent in the relationship between motor tricycle deployment and firm performance in these settings.

1. Introduction

An efficient transportation system is crucial for firms to succeed (Albertzeth, Pujawan, Hilletofth, & Tjahjono, 2020; Tongzon & Cheong, 2014). However, there are major deficiencies and bottlenecks in transportation systems in developing countries that interrupt supply chain and business operations (Kuteyi & Winkler, 2022; El Baz, Laguir, & Stekelorum, 2019). Micro and small businesses (MSBs) may face more significant challenges in dealing with transportation disruptions in developing countries. These firms have limited financial resources (Lu, Liu, & Yu, 2022) to acquire conventional vehicles or access various transportation services to navigate transportation disruptions effectively (Mohammed & Bunyaminu, 2021). The lack of options and flexibility for MSBs to deal with the precarious transportation systems in developing economies is a significant concern for research and policy (El Baz et al., 2019; Gurara et al., 2017). The reason is that MSBs are not only the dominant players in the private sector in developing countries but are critical drivers of entrepreneurial, innovation, employment, and developmental activities in such societies (Adobor, 2020; United Nations, 2022).

Extant literature indicates that motor tricycles have become major improvisational resources enabling MSBs in developing countries to manage transportation turbulences and failures (Afukaar, Damsere-Derry, Peters, & Starkey, 2019; Jack, Amoah, Hope, & Okyere, 2021; Kuteyi & Winkler, 2022). As with other cargo cycles (e.g., motorcycles and cargo bikes), motor tricycles carry smaller payloads, and their operation requires less space and energy (Narayanan, Gruber, Liedtke, & Antoniou, 2022). They are also operationally more flexible and responsive (Sheth, Butrina, Goodchild, & McCormack, 2019) and ideal for last-mile delivery activities (Narayanan et al., 2022; Moncef &

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Dupuy, 2021; He, 2020). However, the overall efficiency benefit of such vehicles is in question (Narayanan & Antoniou, 2021; Conway, Cheng, Kamga, & Wan, 2017). In using case studies and simulations, earlier studies offer little insight into the firm-level performance outcomes of cargo cycles (e.g., He, 2020; Jack et al., 2021; Jing, Dzoagbe, Amouzou, & Ayivi, 2019; Ormond, Telhada, & Afonso, 2019). Therefore, how and when MSBs' use of motor tricycles affects their performance is unclear and underexplored.

In addressing this knowledge gap, this study employs the resource-based view (RBV) and the contingency theory to examine the relationship between motor tricycle deployment and the performance of MSBs in a developing sub-Saharan African country, Ghana. In keeping with the resource deployment logic of RBV, we define motor tricycle deployment as the extent to which MSBs utilize motor tricycles to perform inbound and outbound freight transportation operations in their supply chains (Sirmon, Gove, & Hitt, 2008). On the other hand, MSB performance refers to the extent of MSBs' market and financial performance relative to the industry average (Wu, 2008; Yang, Lu, Haider, & Marlow, 2013). In underdeveloped and disruptive transportation contexts, motor tricycles can ensure less interrupted and flexible transportation operations, which can enhance on-time product delivery, delivery flexibility and reliability, efficient operations, and customer satisfaction (Marujo et al., 2018; Narayanan et al., 2022; Ormond et al., 2019; Sheth et al., 2019). Thus, we argue that motor tricycle deployment can drive MSB performance in a developing country.

However, the strategic management literature suggests that resource deployment is not universally advantageous to the extent that task environment factors may foster or limit the effectiveness of resource deployment activities (Sirmon et al., 2008; Sirmon & Hitt, 2009). The value of motor tricycle deployment lies in its capacity to enhance operational flexibility and responsiveness (Carrington, 2021; Narayanan et al., 2022). Accordingly, we turn to the contingency theory to identify supply chain dynamism as a critical boundary condition factor that may moderate the relationship between motor tricycle deployment and MSB performance in a developing country. Supply chain dynamism refers to the extent of changes in conditions (e.g., actors and their requirements) within a firm's supply chain (Yu, Jacobs, Chavez, & Yang, 2019). Following the contingency theory's argument that an alignment between resources and the environment in which they are deployed boosts firm performance (Sirmon et al., 2008; Van de Ven, Ganco, & Hinings, 2013), we develop and test the proposition that motor tricycle deployment may contribute more to MSB performance in dynamic supply chain environments (Srinivasan & Swink, 2018; Zhou, Mavondo, & Saunders, 2019).

On this front, the study addresses two questions: (*1) how does motor tricycle deployment relate to MSB performance in a developing country?;* (2) *How does supply chain dynamism moderate the relationship between motor tricycle deployment and MSB performance in a developing economy?* By addressing these questions, the study advances the underdeveloped literature on cargo cycles as drivers of competitive advantage and superior performance, especially in MSBs in developing countries. Specifically, this study articulates how motor tricycle deployment underlies the ability of MSBs in developing countries to concurrently pursue multiple competitive priorities to enrich their position in the marketplace, particularly under increasing supply chain dynamism conditions. Additionally, the study extends the existing methodologies for analyzing the value of cargo cycles (e.g., case studies and simulation) (He, 2020; Moncef & Dupuy, 2021; Schliwa, Armitage, Aziz, Evans, & Rhoades, 2015; Schünemann, Finke, Severengiz, Schelte, & Gandhi, 2022; Sheth et al., 2019) by using survey methodology to shed empirical insights on the link between motor tricycle deployment and MSB performance. To this end, the study advances the underdeveloped knowledge of logistics and supply chain issues in the MSB literature and Africa (Essuman, Anin, & Muntaka, 2021).

2. Literature review

Motor tricycles are critical aspects of cargo cycles. Lately, the roles of cargo cycle usage in transportation and logistics systems have attracted keen interest among scholars and policymakers globally (Narayanan et al., 2022). The market value of cargo cycles is increasing rapidly (Research & Markets Report, 2020). As with MSBs, large businesses (e.g., UPS, DHL Express, FedEx, and Coca-Cola) have shown interest in using cargo cycles (Sheth et al., 2019). Estimates are that cargo bikes can perform about 51% of all freight operations in European cities (Wrighton & Reiter, 2016). In addition, other continents (e.g., North America, Africa, and Asia) have experienced a growing trend in cargo cycle usage (Jing et al., 2019; Qiu, Jin, He, & Mao, 2022). Accordingly, there has been a ramp-up in the global supply of cargo cycles to minimize shortages (Narayanan & Antoniou, 2021; Research and Markets Report, 2020).

A major force behind the increasing deployment of cargo cycles is the growing environmental, social, and economic sustainability concerns and campaigns (Afukaar et al., 2019; He, 2020; Marujo et al., 2018; Qiu et al., 2022). Past research suggests that cargo cycles contribute better to sustainability outcomes in logistics and transport systems (Carrington, 2021; He, 2020; Moncef & Dupuy, 2021; Narayanan et al., 2022; Sheth et al., 2019). However, unlike in developed economies, motor tricycles and motorcycles are primarily utilized in developing countries in response to precarious transportation issues, such as underdeveloped and deteriorating transportation infrastructure, limited transportation modes, limited and inflexible transportation networks, limited transportation service providers, high operational bottlenecks, and frequent transportation network and service failures (Afukaar et al., 2019; Jack et al., 2021; Kuteyi & Winkler, 2022).

Past studies indicate that cargo cycles are drivers of competitive advantage and operational excellence (He, 2020; Sheth et al., 2019). However, this literature is limited to case studies and simulations (Afukaar, Peters, & Damsere-Derry, 2017; He, 2020; Jack et al., 2021; Jing et al., 2019; Ormond et al., 2019). Furthermore, such studies do not answer whether and when differences in the deployment of such vehicles account for firm performance heterogeneity, as they ignore firm-level analysis. We contend that answering this question using data from MSBs in developing countries is crucial because of the proliferation of cargo cycles in such contexts (Kuteyi & Winkler, 2022; Jack et al., 2021; Galyuon et al., 2019; Afukaar et al., 2019).

3. Theoretical foundation and hypothesis development

3.1. Contingent resource-based view

This research applies the contingent RBV, an integration of the RBV and the contingency theory, to examine *how* and *when* motor tricycle deployment relates to MSB performance in a developing country. The RBV has long been a mainstream theoretical perspective for explaining performance heterogeneity among firms (Barney, Ketchen Jr, & Wright, 2021; Furr & Eisenhardt, 2021). RBV recognizes firm resources as important variables that may account for differences in firm performance. Within the framework of RBV, resources represent “tangible and intangible entities available to the firm that enable it to produce efficiently and/or effectively a market offering that has value for some market segment(s)” (Hunt, 1997, p. 64). RBV argues that competitive advantage and economic performance improvement accrue to firms possessing and controlling valuable yet rare resources (Barney, 1991). Recent theoretical and empirical developments in the RBV literature suggest that valuable and idiosyncratic firm resources are essential, but their potential for enhancing competitive advantage and financial performance can be realized when they are channeled to support or drive value-creation activities (Sirmon, Hitt, & Ireland, 2007; Sirmon, Hitt, Ireland, & Gilbert, 2011). Accordingly, we apply this resource deployment logic of RBV to theorize and examine how MSBs' deployment of motor tricycles to perform inbound and outbound freight transportation operations relates to their performance in a developing country. As detailed in the subsequent section, we argue that motor tricycle deployment can enhance MSB performance in developing countries.

One major shortcoming of the RBV is that it ignores the contextual differences under which firms deploy resources (Brandon-Jones et al., 2014). The cargo cycle literature suggests that the benefits of motor tricycle deployment may vary across contexts (Moncef & Dupuy, 2021; Narayanan & Antoniou, 2021). Thus, to clarify the boundaries of the motor tricycle deployment – MSB performance relationship, we extend the contingency theory to the RBV to argue that this relationship may differ across varying conditions of supply chain dynamism (Fianko, Essuman, Boso, & Muntaka, 2022; Brandon-Jones et al., 2014; Sirmon & Hitt, 2009). The contingency theory argues that superior firm performance may accrue when there is a 'fit' between resources and the context in which they are deployed (Donaldson, 2006; Van de Ven et al., 2013). Thus, the contingent RBV, which emphasizes matching resource deployment with contextual factors, suggests that conditions that facilitate the effectiveness of resource deployment can boost firm performance (Fianko et al., 2022; Sirmon & Hitt, 2009). In extension, we argue that dynamic supply chain environments may be more conducive to and enhance the benefits of motor tricycle deployment in a developing country.

3.2. Motor tricycle deployment and MSB performance

Motor tricycle deployment refers to the extent to which MSBs deploy motor tricycles to perform inbound and outbound freight transportation functions in supply chains, such as the transportation of supplies to factories and the transportation of finished goods to customer markets (Afukaar et al., 2017; Jack et al., 2021; Jing et al., 2019). While transportation allows firms to create market value (e.g., place and time utility), motor tricycles can facilitate supply chain value creation activities in developing countries, where traditional transportation modes and vehicles are in short supply, inaccessible, or less efficient and effective. We argue that in such transportation situations, motor tricycle deployment can help MSBs pursue multiple competitive priorities, such as efficiency, quality, delivery, flexibility, and environmental sustainability (Kroes & Ghosh, 2010; Ward, Duray, Keong Leong, & Sum, 1995).

Cost-efficient operations can improve a firm's market and financial performance outcomes, and firms that manage or control cost drivers can gain a cost advantage over their competitors (Jia & Wang, 2019). Motor tricycle deployment can allow MSBs in developing countries to fulfill this requirement since motor tricycles are associated with high fuel efficiency, low emission, and cheaper maintenance costs. Ormond et al. (2019) found that cargo cycles result in 31% savings in operating costs in Sao Paulo city. Similarly, Marujo et al. (2018) found cargo cycle with mobile-depot-based delivery to offer cost advantage over traditional distribution setups. Thus, increases in motor tricycle deployment can result in low total operating costs, which can translate into lower service charges to the customer.

Beyond their cost-efficiency value, motor tricycle deployment can facilitate agility and make firms responsive to customers' delivery needs as they offer a quicker and more flexible transportation. Such speed and flexibility of distribution reduce the delivery time of products and enable customers to receive orders timely, enhancing customer value and loyalty. More critically, motor tricycles can deliver products to customers in remote locations because of their unique design and maneuverability. Furthermore, the deployment of motor tricycles can address many salient concerns associated with conventional truck/van distribution, such as prolonged delivery times due to traffic congestion and deteriorated road infrastructure. Thus, motor tricycles offer a more convenient and flexible transportation option that guarantees delivery speed, customization, and reliability and enables firms to adapt to customers' delivery needs. This makes them ideal for last-mile deliveries and for improving MSB performance (Bastug & Yercan, 2021; Idris & Naqshbandi, 2019).

Moreover, with their low carbon footprint, motor tricycles also can contribute to environmental stewardship goals and reduce the risk of negative externalities (Carrington, 2021), thereby improving the firms' corporate image and competitiveness. Hence, motor tricycles offer an effective and efficient logistics and transportation system through which firms can gain a competitive advantage. The logic is that using motor tricycles in the physical distribution of products reduces the total cost of production and order cycle time, which is a crucial element of order winner and competitive advantage.

In sum, deploying motor tricycles can allow MSBs in developing countries to leverage efficiency, flexibility, and responsiveness to compete effectively in the market. In today's business environment, where customers desire reliable and fast delivery of products and services at low prices, we argue that motor tricycle deployment can be a crucial order-winner factor, enhancing MSB performance. We expect this argument to hold in developing countries where motor tricycles have the leverage due to the overwhelming transportation barriers. Specifically, hypothesize as follows:

H1. Motor tricycle deployment is positively related to MSB performance in a developing country.

3.3. The boundary condition role of supply chain dynamism

Environmental dynamism factors have been recognized as crucial elements that influence the performance outcomes of a firm's resources and how these resources are deployed (Sirmon & Hitt, 2009; Schilke, 2014). Environmental dynamism broadly refers to instability and unpredictability in a firm's task and general environment (Miles, Covin, & Heeley, 2000). Building on the environmental dynamism literature, supply chain management scholars have proposed the 'supply chain dynamism' concept to elucidate and analyze the rate of change and instability in supply chain conditions (Yu et al., 2019). In the supply chain, dynamism can take several forms, including changes in supply requirements, production requirements, customer requirements, and transportation needs (Lee, Seo, & Dinwoodie, 2016; Yu et al., 2019). The unpredictability associated with the transportation and distribution requirements, demands, and needs of channel members (e.g., distributors, wholesalers, and retailers) and demand and supply market conditions increase operational uncertainty and complexity (Srinivasan & Swink, 2018). We argue that supply chain dynamism may moderate the relationship between motor tricycle deployment and MSB performance.

Increasing levels of supply chain dynamism present both threats and opportunities. It takes firms that can neutralize the threats and or exploit the opportunities that accompany such an environment to be more successful (Srinivasan & Swink, 2018; Zhou et al., 2019). For example, greater conditions of supply chain dynamism interfere with existing operating routines and can make firms inefficient (Schilke, 2014). Further, complexities and uncertainties which increase in dynamic supply chains render logistics and supply chain operations very challenging (Yu et al., 2019), requiring the deployment of the right resources to succeed and gain competitive advantage in such situations (Srinivasan & Swink, 2018). Prior studies suggest that firms' ability to initiate flexible and rapid responses to demands emerging from dynamic supply chain contexts can create a first-mover advantage, enhancing firm competitiveness (Shepherd, Mooi, Elbanna, & Rudd, 2021; Srinivasan & Swink, 2018; Zhou et al., 2019). For instance, when customer order volume and demand patterns exhibit unpredictability, it can amplify the operational advantages associated with having a more flexible and responsive delivery system.

The arguments for H1 suggest that motor tricycle deployment can drive operational agility and flexibility in a developing country, enabling MSBs to exploit and capture greater market value in dynamic supply chains. That is, under increased supply chain dynamism, motor tricycles, with their advantage of delivering smaller to medium-sized packages in shorter distances, can be expected to benefit MSB performance more than in a more stable environment. To summarize, because there is little or no need for flexibility in stable supply chain environments, and increasing motor tricycle deployment has cost implications, we expect motor tricycle deployment to benefit MSB performance more in dynamic supply chains. Formally, we test the following hypothesis:

H2. Supply chain dynamism moderates the relationship between motor tricycle deployment and MSB performance, such that the relationship is positive and stronger under increasing supply chain dynamism conditions.

4. Methods

4.1. *Empirical setting and sample*

The study's sample comprises micro and small-sized manufacturers in Ghana. As a developing country, Ghana's logistics and transportation infrastructure and systems are underdeveloped (FM Global, 2022; The World Bank, 2018), undermining supply chain and economic activities (African Development Bank Group, 2022). Accordingly, there has been a steady growth in the use of motor tricycles as alternative vehicles in rural and urban centers in the country for transporting individuals, farm produce, consumer and industrial goods, and waste products (Afukaar et al., 2019; Armoh et al., 2023; Jack et al., 2021; Jing et al., 2019). Recent research reveals that the increased demand for motor tricycles and cycles in Ghana can be attributed to the low cost of operating these vehicles, poor road networks, high road congestion, and time constraints (Jack et al., 2021). Moreover, in their study of a rural community in northern Ghana, Afukaar et al. (2017) found that over 40% of small freights were transported using motorcycles and tricycles. Motor tricycles, the subject of this study, come in varied designs and are termed differently (e.g., Motor King, Pragya, Motto Kia, Yellow-Yellow, Mahama Camboo) (Jing et al., 2019). As these vehicles are increasingly integrated into Ghana's freight transportation systems and help the youth earn a livelihood, the government, through the Microfinance and Small Loans Centre's (MASLOC) activities, has been supporting the youth in acquiring these vehicles for commercial purposes (Jing et al., 2019).

We focused on micro and small manufacturers due to their high inclination to use motor tricycles to perform upstream and downstream freight transportation operations. Geographically, we focused on firms whose manufacturing plants are in northern or middle Ghana, where motor tricycles are used more (Afukaar et al., 2019). The activities of MSBs are poorly documented in Ghana; therefore, we could not obtain a sampling frame for the study. Coupling the lack of information about the addresses of the MSBs with the need to visit these firms in person to elicit their interest in participating in the study, we followed the examples of past studies in similar contexts to apply convenience sampling to administer the questionnaires (e.g., Essuman, Anin, & Muntaka, 2021). Only firms that met our sampling criteria were included: 1) the firm is primarily into manufacturing, has <50 full-time workers, and has been in operation for at least three years; 2) the firm has an educated top/senior manager (e.g., owner-manager) who would willingly consent to participate in the study. Through on-site visits, the study identified 341 firms that consented to participate in the study. Of this figure, 267 provided effective responses, representing a 78.3% response rate.

Table 1 shows the profile results of the sample and the key informants. Notably, the sample comprises multi-sector manufacturing firms. On average, the firms employ approximately 11 full-time workers (standard deviation = five approx.) and have been in operation for 9.3 years (standard deviation = 4.66). Most of the data were provided by the CEO/owners or managing director/general manager. A *t*-test reveals that data provided by such top-level managers and functional-level senior managers are not statistically different: MSB performance (mean difference = 0.024, t = 0.833), motor tricycle deployment (mean difference = −0.127, t = 0.909), supply chain dynamism (mean difference = −0.169, t = 0.326). The informants have an average managerial experience of six years. Following previous research (e.g., Essuman, Asamoah, & Anin, 2021), we further examined the competence level of the informants in four areas: knowledge about the survey items, interest in the survey, confidence about responses, and confidence that the responses provided reflect the firms' situation. The items were evaluated on a seven-point scale ranging from strongly disagree (=1) to strongly agree (=7). The mean scores were above 5.80 (Table 1), suggesting that an average informant is largely competent in providing data for the study (Essuman, Asamoah, & Anin, 2021).

Table 1
Profile information.

	Frequency	Percent	Mean	SD
Manufacturing sector:				
Food products (water and drinks)	93	34.8		
Furniture	40	15.0		
Rubber & plastics	5	1.9		
Toiletries	39	14.6		
Textile products	45	16.9		
Chemical products	17	6.4		
Electronic and hardware products	5	1.9		
Others	23	8.6		
Firm's geographical scope of operation:				
Northern Ghana	80	30		
Middle Ghana	187	70		
Informant position:				
CEO/owner-manager	64	24.0		
Managing director/general manager	55	20.6		
Operations manager	90	33.7		
Marketing/sales	39	14.6		
Supply chain/logistics	3	1.1		
Transportation manager	2	0.7		
Others	14	5.2		
Firm size (number of full-time employees)			10.50	4.907
Firm age (number of years of operation)			9.30	4.656
Informant's managerial experience (years)			6.07	2.984
Informant's competence:				
The questionnaire deals with issues I am very knowledgeable about			5.91	0.930
The questionnaire deals with issues that I am very interested in			5.83	0.941
I am completely confident about my answers to the questions			5.92	0.850
I am confident that my answers reflect the organization's situation			6.00	0.924

4.2. *Survey design and administration*

The fieldwork began with the development of a survey questionnaire. As explained in the next section, we drew on extant literature to identify measurement items to capture the constructs in the study. We applied a two-stage approach to improve the face and content validity of the measurement items and their contextual relevance. In stage one, we relied on review comments from two independent supply chain researchers with prior experience in the study's setting to revise the measurement items and the initial questionnaire. In stage two, we piloted the revised questionnaire on five MBA students who held senior management positions in MSBs. Their responses and feedback reveal no significant concerns regarding the measurement items or the questionnaire.

A face-to-face survey design, employing a paper-based questionnaire and trained data collection personnel, was used to collect data (cf. Donkor, Papadopoulos, & Spiegler, 2021; Essuman, Anin, & Muntaka, 2021). This design enabled us to elicit informant consent while enhancing the response rate. Due to the lack of appropriate infrastructure (e.g., postal address and robust internet connectivity) in Ghana and the contact information of the key informants, a face-to-face survey design is more desirable relative to mail and electronic surveys. We conducted the main field study in July 2021 after we secured an ethical clearance from the third author's institution.

4.3. Measurement items

4.3.1. Motor tricycle deployment

Past studies operationalize resource deployment as the extent to which firms channel resources into value-creation activities (e.g., Sirmon & Hitt, 2009). We followed this logic to measure motor tricycle deployment. We identified distinct transportation activities within supply chains and asked the firms to indicate the degree to which they have utilized Aboboyaa/Motorking (local names for motorized tricycles) to perform such activities in the last three years: (1) transportation of finished goods to customers, (2) transportation of finished goods to storage points (e.g., warehouses, distribution centers, depots), (3) transportation of supplies to the factory/manufacturing plants, (4) transportation of supplies to storage points (e.g., warehouses), (5) freight consolidation/forwarding in the downstream supply chain/distribution channels, (6) freight consolidation/forwarding in the upstream supply chain/supply market, (7) reverse transportation in the upstream supply chain (i.e., moving products/materials from the manufacturer to suppliers due to, say, defective and wrong supplies), (8) reverse transportation in the downstream supply chain (i.e., moving products/materials from channel members and customers to the manufacturer/supplier due to, say, defective and wrong supplies). Each item was rated on a six-point scale: not at all =1, to a slight extent = 2, to a moderate extent = 3, to a large extent = 4, to a larger extent = 5, to the largest extent = 6. Given the uniqueness of these transportation activities, removing any undermines the domain of the construct; therefore, we operationalized the construct as the unweighted linear sum of the eight items (Diamantopoulos & Winklhofer, 2001). The mean motor tricycle deployment was 25.51 out of 48.00, with a standard deviation of 9.02, suggesting that most of the firms, to a large extent, deploy motorized tricycles to undertake transportation activities within their supply chains.

4.3.2. Supply chain dynamism

Drawing on environmental dynamism research (e.g., Shepherd et al., 2021) while considering the context of motor tricycle deployment, we identified five items that capture supply chain dynamism as the pace at which the variables (i.e., actors, their relationships, or requirements) within the focal firm's supply chain change: (1) our transportation and distribution needs/requirements keep changing rapidly; (2) the needs of our channel members (e.g., distributors, wholesalers, retailers) keep changing rapidly, (3) what our channel members (e.g., distributors, wholesalers, retailers) expect from us is difficult to predict, (4) conditions and requirements in our supply markets are very dynamic, (5) we keep changing how we want our supply chain to compete in the marketplace. The items were evaluated on a seven-point scale: strongly disagree = 1, disagree = 2, somehow disagree = 3, neither agree nor disagree = 4, somehow agree = 5, agree = 6, strongly agree = 7. The composite reliability, Cronbach's alpha, and average variance extracted values for the indicators are 0.856, 0.856, and 0.546. Accordingly, the items were averaged to represent supply chain dynamism (mean = 3.66, standard deviation = 1.39).

4.3.3. MSB performance

MSB performance was measured with four items that capture the market and financial performance of the focal firm compared to the industry average (Wu, 2008; Yang et al., 2013). Given that our sample comprises MSB in a developing economy, we could not obtain objective or secondary data to capture this performance construct. In line with the study's operational definition and drawing on past studies (e.g., Gelhard, von Delft, & Gudergan, 2016; Wu, 2008), MSB performance was measured with four indicators: overall profitability, net profit margin, growth in sale revenue, and growth in market share. Using a five-point scale (far below industry average = 1, below industry average = 2, equal to industry average = 3, above industry average = 4, far above industry average = 5), we asked the firms to indicate their performance in each of the four performance areas in the last two years relative to the performance of their immediate industry (i.e., a group of firms that serve your target customer markets). The composite reliability, Cronbach's alpha, and average variance extracted values for the indicators are 0.900, 0.901, and 0.695. Accordingly, the items were averaged to represent MSB performance (mean = 2.86, standard deviation = 0.92).

4.3.4. Control variables

To obtain consistent estimates while minimizing the potential endogeneity concerns, we included relevant control variables (Lu, Ding, Peng, & Chuang, 2018). MSB performance might be a function of industry characteristics as well as firm-specific factors. Although our data comes from manufacturing firms, they operate in different competitive spaces, given the differences in their products and target customers (see Table 1). We attempted to control for industry effects by creating several firm sector dummy variables for sectors with enough cases: food products = 1, otherwise = 0; textile products = 1, otherwise = 0; furniture products = 1, otherwise 0. We additionally note that there are significant differences in the business environment factors (e.g., quality of logistics infrastructure, access to institutional support, and competitive intensity) between the middle and northern parts of Ghana, where we obtained our data. Such variations in external environmental factors that characterize the two geographical parts of the country may covary with motor tricycle deployment, supply chain dynamism, and firm performance. While motor tricycles are widely used in Northern Ghana, the supply chain environment in this context may be less benign. A dummy variable was created to control for the potential geographical effect: northern Ghana = 1, otherwise = 0. Furthermore, we controlled for the likely firm size and firm age effects on MSB performance. Though motor tricycles are relatively cheap, the financial capacity to acquire and deploy them can increase with increases in firm size. Moreover, firm size can facilitate strategies that drive competitive advantage. It is also likely that older firms may have greater business and industry experience, which can be leveraged to harness firm competitiveness. We operationalized firm size and firm age as the natural logarithm transformation of the total number of full-time workers and the number of years a firm has been in operation, respectively. The study results show the control variables significantly account for 18% variance in MSB performance ($F = 9.48$, $p < 0.001$) (Table 4).

4.4. Reliability and validity assessment and variable construction

MSB performance and supply chain dynamism were measured with multi-scale reflective measures, whereas multi-scale formative measures were used to measure motor tricycle deployment. We conducted a covariance-based confirmatory factor analysis (CFA) using Mplus 7.4 to evaluate the reliability and validity of our reflective measures (Muthén & Muthén, 2017). Covariance-based CFA accounts for measurement errors and allows researchers to examine how well a theoretical measurement model, which includes multiple reflective items, explains the covariances in a piece of observed data. Therefore, it provides a more rigorous approach for validating reflective measurement items (Bagozzi & Yi, 2012).

We estimated a two-factor CFA model that included items related to MSB performance and supply chain dynamism. The model provided a satisfactory fit for the data: Chi-square (χ^2) = 64.30, degree of freedom = 26, non-normed Chi-square = 2.47, root mean square error of approximation = 0.07, comparative fit index = 0.97, non-normed fit index = 0.96, standardized root mean square residual = 0.05 (Bagozzi & Yi, 2012; Hair, Black, Babin, & Anderson, 2019). As shown in Table 2,

Table 2
Measures and validity results.

Constructs and measures	Standardized loading	T-value	Cronbach's alpha	Construct reliability	Average variance extracted	Variance inflation factor[b]
Supply chain dynamism*			0.856	0.856	0.546	
SCD1	0.78	a___				
SCD2	0.86	14.344				
SCD3	0.68	11.020				
SCD4	0.60	9.631				
SCD5	0.75	12.306				
MSB performance*			0.900	0.901	0.695	
Perf1	0.85	a___				
Perf2	0.82	16.250				
Perf3	0.85	16.408				
Perf4	0.82	15.320				
Motory tricycle deployment (MTD)**						
MTD1						2.21
MTD2						1.74
MTD3						2.19
MTD4						1.95
MTD5						2.11
MTD6						2.37
MTD7						2.57
MTD8						2.19

Note: * = Reflective construct; ** = Formative construct; a = the path is scaled to 1.00. [b] = the items were regressed on MSB performance. The item statements are provided in the measurement section.

the measures have strong and significant loadings. The Cronbach's alpha, compositive reliability, and average extracted values of the measures are above the minimum thresholds of 0.70, 0.60, and 0.50, respectively. These results demonstrate the reliability and convergent validity of the measures (Bagozzi & Yi, 2012; Hair et al., 2019). The measures were additionally found to exhibit discriminant validity in that their average variance extracted values far exceed their shared variance (Voorhees, Brady, Calantone, & Ramirez, 2016).

Collinearity analysis was conducted to examine whether redundancies exist in the formative measures (Diamantopoulos & Winklhofer, 2001). Table 2 shows variance inflation factors below 2.60, suggesting that multicollinearity does not adequately characterize the indicators (Diamantopoulos & Winklhofer, 2001).

4.5. Common method bias mitigation and assessment

To minimize common method bias, we implemented additional *ex-ante* remedies (Podsakoff, MacKenzie, & Podsakoff, 2012), such as using different scales to evaluate the measures, placing the measures of interest wide apart in the questionnaire, administering the questionnaires to literate and knowledgeable senior managers, and guaranteeing respondent anonymity and confidentially. Moreover, we incorporated a marker variable into the questionnaire to examine common method bias (Podsakoff et al., 2012). We captured the negative affectivity of the key informants and used it as the marker variable. The measures and data for this variable fulfill the two requirements of ideal marker variables: (1) the measures are theoretically unrelated to motor tricycle deployment, supply chain dynamism, or MSB performance (2) and the data shows high internal consistency (i.e., Cronbach's alpha = 0.856) (Lindell & Whitney, 2001). As shown in Table 3, the results show that negativity affectivity does not correlate significantly with the variables of interest. Additionally, we computed marker variable-adjusted inter-construct correlations using the smallest positive correlation between the marker variable and the constructs of interest (Malhotra, Kim, & Patil, 2006). The results (Table 3) reveal no qualitative difference between the marker variable-adjusted correlations and the zero-order correlations in terms of the direction of association and level of statistical significance, suggesting the common method bias is less likely to describe the study (Malhotra et al., 2006).

5. Hypothesis testing and results

We used moderated regression analysis to test the study's hypotheses as they include a moderation term. Since we hypothesized the main effect of motor tricycle deployment (MTD), and to mitigate the potential multicollinearity, we mean-centered MTD and supply chain dynamism (SCD) before creating the interaction term (MTD × SCD) (Aguinis, Edwards, & Bradley, 2017). To isolate the effects of the control variables, the main effects of the substantive variables, and the effect of the moderation term, we analyzed the following three regression models:

Table 3
Descriptive statistics and correlations.

Variables	1	2	3	4	5	6	7	8	9	10
1. Firm age (log)		0.13*	−0.37**	0.17**	0.10	−0.14*	−0.16**	−0.22**	−0.19**	−0.23**
2. Firm size (log)	0.14*		−0.04	−0.01	−0.17**	−0.15*	0.02	−0.30**	−0.31**	−0.07
3. Food products	−0.36**	−0.03		−0.34**	−0.32**	0.25**	0.21**	0.19**	0.28**	0.10
4. Textile products	0.18**	0.00	−0.33**		−0.20**	−0.11	−0.16**	−0.15*	−0.17**	−0.06
5. Furniture products	0.11	−0.16**	−0.31**	−0.19**		0.06	0.14*	0.10	0.15*	0.02
6. Northern Ghana	−0.13*	−0.14*	0.26**	−0.10	0.07		0.32**	0.41*	0.37**	0.17**
7. MSB performance	−0.15*	0.03	0.22**	−0.15*	0.15*	0.33**		0.39**	0.37**	0.00
8. Motor tricycle deployment	−0.21**	−0.29**	0.20**	−0.14*	0.11	0.42**	0.40**		0.58**	0.07
9. Supply chain dynamism	−0.18**	−0.30**	0.29**	−0.16*	0.16**	0.38**	0.38**	0.58**		0.10
10. Negative affectivity	−0.22**	−0.06	0.11	−0.05	0.03	0.18**	0.01	0.08	0.11	
Minimum	1.10	1.10	0.00	0.00	0.00	0.00	1.00	8.00	1.00	1.00
Maximum	3.22	3.64	1.00	1.00	1.00	1.00	5.00	48.00	7.00	7.00
Mean	2.11	2.27	0.35	0.17	0.15	0.30	2.86	25.51	3.66	2.81
Standard deviation	0.50	0.40	0.48	0.38	0.36	0.46	0.92	9.02	1.39	1.45

Notes: Values below and above the principal diagonal are zero-order correlations and marker-variable adjusted correlations; $*p < 0.05$ (2-tailed); $**p < 0.01$ (2-tailed).

Model 1: MSB performance $= \beta_0 + \beta_1 FA + \beta_2 FS + \beta_3 FP + \beta_4 TP + \beta_5 FNP + \beta_6 NG + \varepsilon$

Model 2: MSB performance $= \beta_0 + \beta_1 FA + \beta_2 FS + \beta_3 FP + \beta_4 TP + \beta_5 FNP + \beta_6 NG + \beta_7 SCD + \beta_8 MTD + \varepsilon$

Model 3: MSB performance $= \beta_0 + \beta_1 FA + \beta_2 FS + \beta_3 FP + \beta_4 TP + \beta_5 FNP + \beta_6 NG + \beta_7 SCD + \beta_8 MTD + \beta_9 SCD \times MTD + \varepsilon$

Where β_0 and ε are constants and error terms, respectively. β_{1-9} represent regression coefficients. FA stands for firm age, FS for firm size, and FP, TP, and FNP are sector dummy variables for food, textile, and furniture product manufacturers, respectively. NG is a geographic location dummy variable for firms in Northern Ghana. SCD is supply chain dynamism, MTD is motor tricycle deployment, and SCD × MTD is the interaction between SCD and MTD.

Table 4 presents the results for Model 1, Model 2, and Model 3. Each model explains significant variations in MSB performance. We relied on the results from Model 3 to evaluate the hypotheses as this model includes all the variables and explains more significant variation in MSB performance (Aguinis et al., 2017). The results ($\beta = 0.024$, SE $= 0.007$, $p = 0.001$) support *H1*, which posits that motor tricycle deployment has a positive relationship with MSB performance. Additional results ($\beta = 0.008$, SE $= 0.004$, $p = 0.035$) support *H2*, which states that supply chain dynamism positively moderates the link between motor tricycle deployment and MSB performance. Fig. 1 illustrates that the positive relationship between motor tricycle deployment and MSB performance amplifies as supply chain dynamism increases.

6. Discussion and conclusion

While manufacturing MSBs in developing countries face significant transportation challenges, they increasingly utilize motor tricycles to support their supply chain operations. However, theoretical models and empirical understanding of the supply chain value propositions and firm performance consequences of the use of such vehicles are lacking. The present study builds on and advances the few previous studies on the value creation and competitive advantage roles of cargo cycles (e.g., Melo & Baptista, 2017; Sheth et al., 2019). Departing from previous studies grounded in simulations, case analyses, and comparative analyses, we use a survey methodology to test a theoretical model that considers the firm as the level of analysis. Specifically, we extend existing conceptualizations of the relationships between cargo cycles and competitive advantage through the lens of resource deployment. This perspective allows us to theorize and empirically analyze the MSB performance outcome of motor tricycles without necessarily comparing such vehicles to conventional vehicles.

In acknowledging that motor tricycles are valuable firm resources for MSBs in developing countries, we drew on the resource deployment logic of the resource-based literature to contend that it is instead of the heterogeneity in motor tricycle deployment that explains variability in MSB performance in such countries (Sirmon et al., 2011). Whereas the overall cost advantage of cargo cycles remains questionable (Narayanan & Antoniou, 2021; Conway et al., 2017), the study's results indicate that MSB performance increases with increases in motor tricycle deployment, in support of the resource deployment logic (Sirmon et al., 2011). As argued in this study, motor tricycle deployment can enable firms to pursue multiple competitive priorities. More broadly, the study's results tend to support the contention that cargo cycles may be sources of competitive advantage (Carrington, 2021; Narayanan et al., 2022; Sheth et al., 2019), even in developing economies where such vehicles are used primarily to navigate road transportation challenges (Jack et al., 2021; Kuteyi & Winkler, 2022).

This study shifts the extant literature focus to cargo tricycles as potential sources of competitive advantage (Narayanan & Antoniou, 2021; Conway et al., 2017), shedding light on how MSBs' deployment of motor tricycles for inbound and outbound freight transportation operations within their supply chains in developing countries is critical for achieving competitive advantage. Due to the peculiarity of their operating contexts, motor tricycles can be an important force behind responsive and efficient supply chains for MSBs in developing countries. In addition, they contribute to place and time utility for customers, enriching the firm's market position. While MSBs tend to transport less-than-truckload freights, their emphasis on motor tricycle deployment in developing countries can improve their market and financial performance.

This study further contributes to the literature on the boundary conditions of the value of cargo cycles (Marujo et al., 2018; Narayanan & Antoniou, 2021; Sheth et al., 2019) by identifying supply chain dynamism as a critical moderator of the motor tricycle deployment – MSB performance link. The contingency theory argues that "resource-context fit" is crucial for attaining superior firm performance (Donaldson, 2006; Sirmon & Hitt, 2009). Accordingly, we proposed that because motor tricycle deployment facilitates operational flexibility and agility, its firm performance benefits may increase in dynamic supply chain environments. The study's results support this proposition and align with previous research findings that an effective and rewarding decision is to deploy rapid and dynamic operational responses in dynamic environments (Shepherd et al., 2021; Srinivasan & Swink, 2018; Zhou et al., 2019). The practical implication of this finding is that owner-managers of MSBs in developing countries should understand that the benefits of motor tricycle deployment are partly defined by the rate and magnitude of changes occurring within their supply chains. Therefore, they need to know when to prioritize and emphasize motor tricycle deployment. Specifically, there should be an emphasis on motor tricycle deployment in more pronounced supply chain dynamism conditions to gain a first-mover advantage.

Table 4
Moderated regression analysis (*dependent variable = MSB performance*).

Independent variables:	Model 1			Model 2			Model 3		
	β	SE	*p*	β	SE	*p*	β	SE	*p*
Firm age (log)	−0.167	0.114	0.143	−0.100	0.108	0.356	−0.113	0.107	0.291
Firm size (log)	0.278	0.135	0.041	0.494	0.133	0.000	0.473	0.132	0.000
Food products	0.361	0.136	0.009	0.239	0.132	0.072	0.221	0.132	0.094
Textile products	−0.018	0.156	0.908	0.012	0.147	0.933	0.022	0.146	0.880
Furniture products	0.568	0.166	0.001	0.431	0.160	0.007	0.426	0.159	0.008
Northern Ghana	0.537	0.120	0.000	0.266	0.122	0.029	0.226	0.122	0.066
Supply chain dynamism (SCD)				0.112	0.046	0.016	0.089	0.047	0.062
Motor tricycle deployment (MTD)				0.027	0.007	0.000	0.024	0.007	0.001
SCD × MTD							0.008	0.004	0.035
Constant	2.210	0.389	0.000	1.718	0.376	0.000	1.752	0.374	0.000
R^2	18.0%			27.7%			28.9%		
ΔR^2				9.7%			1.2%		
F of R^2	9.48***			12.36***			11.63***		
F of ΔR^2				17.39***			4.48*		

Notes: β = unstandardized regression coefficient; SE = standard error; *$p < 0.05$; ***$p < 0.001$.

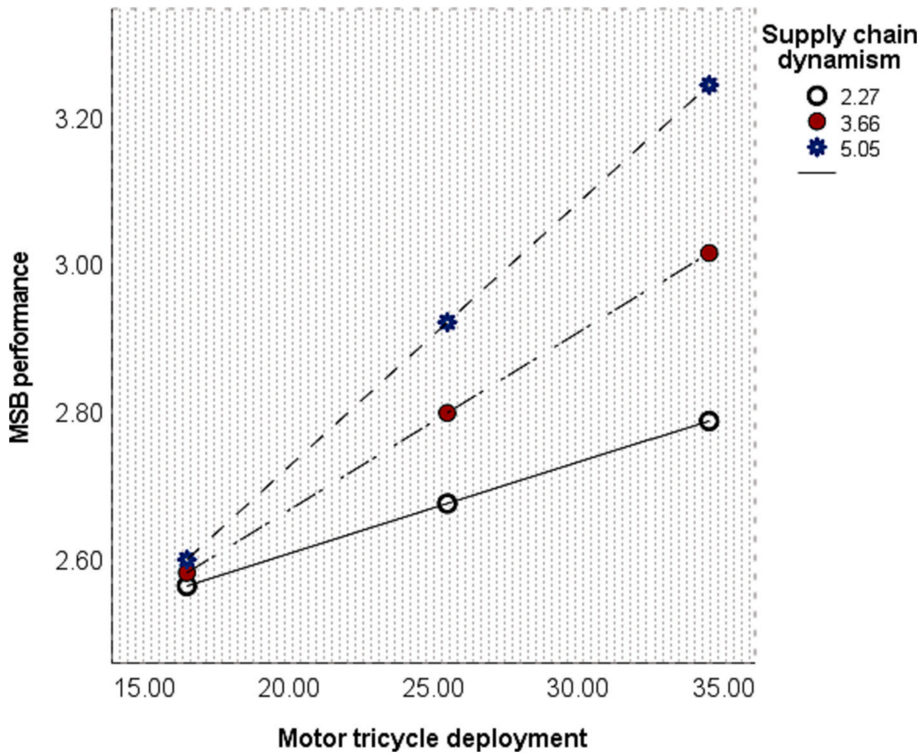

Fig. 1. The moderating effect of supply chain dynamism.
Notes:

- Levels of supply chain dynamism are −*1* standard deviation, mean, and + *1* standard deviation values.
- The relationship between motor tricycle deployment and MSB performance is significant *at* and *above* the mean level of supply chain dynamism.

Our empirical data allows us to advance the underdeveloped academic literature on cargo cycle issues in developing economies (Narayanan & Antoniou, 2021). However, the results need to be interpreted considering the empirical setting. For instance, relative to developed economies, the competitive priorities mechanisms (e.g., delivery, flexibility, and cost) of motor tricycle deployment that explain MSB performance may be more salient in developing economies due to their weaker road transportation infrastructure and networks. Such concerns raise the question of and call for more research on whether our argument and results for *H1* will hold in different settings. Importantly, future studies are encouraged to explicitly account for how variability in input resources embedded in the external environment (e.g., quality of transportation system, and access to bank loans) or the internal environment (e.g., financial slack) connect motor tricycle deployment to differing levels of MSB performance. Moreover, our argument and analysis for *H2* can be extended to capture how financial resources or environmental munificence interact with supply chain dynamism to moderate motor tricycle deployment and MSB performance. This is important as financial resources and environmental munificence increase managerial discretion and can, therefore, enable firms to correct wrong strategic and operational responses quickly (Shepherd et al., 2021),

The study's methodology has some limitations worth acknowledging. Although robust theoretical perspectives explain our results, the cross-sectional data used still undermines the ability to make causal inferences. Moreover, the study's context prevented us from obtaining secondary or objective data to measure some study variables. Again, it is important to note that the data for this study come from micro and small manufacturers in Ghana. Therefore, the findings may not apply to businesses in different settings, such as medium and large firms in Ghana or elsewhere or micro and small businesses in other countries. The large scale of operations of medium and large manufacturers suggest they will likely transport full-truck load freights. Also, there are multiple freight transport modes and advanced transportation networks and infrastructure in developed countries. Therefore, emphasizing motor tricycle deployment in medium and large manufacturing firms or developed countries may result in inefficiencies, cancelling its flexibility advantages. Furthermore, though we followed recommended procedural and statistical remedies to mitigate common method bias and enhance measurement validity, we believe using multiple and objective data can be helpful in future research.

In conclusion, in advancing the limited knowledge of the role of cargo cycles in driving firm performance, the study demonstrates the relevance of a contingent-resource deployment conceptualization of the link between motor tricycle deployment and MSB performance in a developing country. The study shows that while motor tricycle deployment may benefit the performance of MSBs in a developing country, emphasis on motor tricycle deployment in dynamic supply chain situations tends to be more beneficial. We hope future research will further develop such a theoretical perspective while addressing the above-listed theoretical and methodological limitations.

CRediT authorship contribution statement

Frederick Yinbil Awuni: Conceptualization, Methodology, Data curation, Writing – original draft. **Dominic Essuman:** Writing – original draft, Formal analysis, Writing – review & editing, Supervision. **Henry Ataburo:** Writing – original draft, Writing – review & editing. **Emmanuel Kwabena Anin:** Writing – original draft, Supervision. **Ishmael Nanaba Acquah:** Writing – original draft, Methodology.

Declaration of Competing Interest

The authors of this manuscript certify that they have no conflict of interest. Each author made a substantial contribution to the work reported in the manuscript. Again, they all agreed to the content of the manuscript and the order of authorship. We further certify that no support (e.g., funding) was received from any institution or individual for this research.

Data availability

The data supporting this study's findings can be accessed from the corresponding author upon reasonable request.

Appendix: Questionnaire

Section A

This section presents different scales for evaluating different sets of statements. Using the respective scales, kindly tick/circle a number that represents your opinion on each statement.

Kindly use the following scale to evaluate the statements in the next table:

Not at all	To a slight extent	To a moderate extent	To a large extent	to a larger extent	To the largest extent
1	2	3	4	5	6

In the last 3 years, to what extent has your company utilized tricycles (e.g., Aboboyaa/Motorking) in each of the following transportation situations?	Not at all				To the largest extent	
1. Transportation of finished goods to customers	1	2	3	4	5	6
2. Transportation of finished goods to storage points (e.g., warehouses, distribution centers, depots)	1	2	3	4	5	6
3. Transportation of supplies to the factory/manufacturing plants	1	2	3	4	5	6
4. Transportation of supplies to storage points (e.g., warehouses)	1	2	3	4	5	6
5. Freight consolidation/forwarding in the downstream supply chain/distribution channels	1	2	3	4	5	6
6. Freight consolidation/forwarding in the upstream supply chain/supply market	1	2	3	4	5	6
7. Reverse transportation in the upstream supply chain (i.e., moving products/materials from the manufacturer to suppliers due to, say, defective and wrong supplies)	1	2	3	4	5	6
8. Reverse transportation in the downstream supply chain (i.e., moving products/materials from channel members and customers to the manufacturer/supplier due to, say, defective and wrong supplies)	1	2	3	4	5	6

Kindly use the following scale to evaluate the statements in the subsequent tables.

Strongly disagree	Disagree	Somehow disagree	Neither agree nor disagree	Somehow agree	Agree	Strongly agree
1	2	3	4	5	6	7

	Strongly disagree					*Strongly agree*	
Our transportation and distribution needs/requirements keep changing rapidly	1	2	3	4	5	6	7
The needs of our channel members (e.g., distributors, wholesalers, retailers) keep changing rapidly	1	2	3	4	5	6	7
What our channel members (e.g., distributors, wholesalers, retailers) expect from us is difficult to predict	1	2	3	4	5	6	7
Conditions and requirements in our supply markets are very dynamic	1	2	3	4	5	6	7
We keep changing how we want our supply chain to compete in the marketplace	1	2	3	4	5	6	7

Kindly use the scale below and consider your *industry* (i.e., a group of firms that serve your targeted customer markets) to evaluate how well your company is performing on the indicators in the subsequent table:

Far below industry average	Below industry average	Equal to industry average	Above industry average	Far above industry average
1	2	3	4	5

Performance indicator:	Far below industry average	Below industry average	Equal to industry average	Above industry average	Far above industry average
Overall profitability	1	2	3	4	5
Net profit margin	1	2	3	4	5
Growth in sale revenue	1	2	3	4	5
Growth in market share	1	2	3	4	5

Section B

This section collects profile information about you and your company.

>> *Which of the following products does your company produce/manufacture? (tick all that apply)*
☐ Water (sachet/bottle) ☐ Drinks other than water (e.g., fruit juice) ☐ Furniture ☐ Rubber & plastics ☐ Other products (kindly indicate): ____________________

>> *Which of the following parts of Ghana is your company or head office located?*
☐ Northern belt (e.g. Northern Region) ☐ Middle belt (e.g., Ashanti Region) ☐ Southern belt (e.g., Greater Accra)

>> *How many years (approximately) has your company been in existence/ operation?* ________years

>> *How many people has your company employed on a full-time basis?* ____________________

>> *What is your position in your company?* ☐ CEO ☐ Managing director/general manager ☐ Operations manager ☐ Marketing/Sales manager ☐ Supply chain/logistics manager ☐ Transportation manager ☐ Other (kindly indicate)
____

>> *How long (in years) have you held this current position*? About ____________________years

To what extent do you disagree or agree with the following statements?	***Strongly disagree***						***Strongly agree***
The questionnaire deals with issues I am very knowledgeable about	1	2	3	4	5	6	7
The questionnaire deals with issues that I am very interested in	1	2	3	4	5	6	7
I am completely confident about my answers to the questions	1	2	3	4	5	6	7
I am confident that my answers reflect the organization's situation	1	2	3	4	5	6	7

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