Customer Integration and Customer Value: Contingency Roles of Innovation Capabilities and Supply Chain Network Complexity

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Abstract

Purpose - Prior research assumes that customer integration enhances customer value. However, the mechanisms and conditions under which customer integration contributes to customer value are less understood. This study draws insights from the resource-based view to conceptualize customer integration as an input resource that triggers product and process innovation capabilities to enhance customer value. The study further draws on the contingent resource-based view to examine supply chain network complexity conditions under which customer integration contributes to customer value through product and process innovation capabilities.

Design/methodology/approach - The study's conceptual framework is tested on primary data from 335 firms in Ghana. PROCESS and ordinary least square regression analyses were used to test the study hypotheses. Additional analyses were conducted using structural equation modeling and two-stage least square regression analysis.

Findings - The study finds that, beyond the significant direct positive association between customer integration and customer value, product and process innovation capabilities mediate the association between customer integration and customer value. Evidence further shows that the indirect associations between customer integration and customer value through product and process innovations are strengthened when supply chain network complexity increases.

Originality/value - This research validates the presumed relationship between customer integration and customer value, and provides theoretical arguments and empirical evidence to demonstrate how process and product innovation capabilities uniquely and in interaction with supply chain network complexity transform this relationship.

Keywords - Customer integration, customer value, firm innovation, supply chain network complexity, sub-Saharan Africa

Paper type - Research paper

1. Introduction

Growing demographic and lifestyle changes, proliferation of substitute and self-service products, technological advancement, and increased competition within global supply chains have created increasingly demanding, powerful, and value-conscious customers (Steenkamp, 2019; Zeithaml *et al.,* 2020). This phenomenon has rendered firms' ability to create and deliver customer value increasingly challenging and yet highly important (Zeithaml *et al.,* 2020; Min *et al.,* 2019). Customer value fundamentally captures the degree of benefits that customers obtain acquiring and using products and services relative to the cost incurred (Zeithaml *et al.,* 2020; Leroi-Werelds, 2019). Thus, the ability to create and deliver superior customer value helps firms retain existing (and attract new) customers (Leroi-Werelds, 2019; Kim *et al.,* 2013). Research shows that a firm is up to 14 times more likely to sell to an existing customer than to a new customer (Farris *et al.,* 2017), and a report by Reichheld and Schefter (2000) shows that increasing customer retention by 5% is associated with a 25% to 95% increase in profitability. Other studies have shown that existing customers are 50% more likely to purchase a new product and spend up to 31% more than new customers (Huhn, 2019). Given the strong contribution of customer value to competitive advantage and profitability, therefore, many firms (e.g., Amazon, Walmart, and Best Buy) have prioritized investments in customer value creation and delivery (Min *et al.,* 2019).

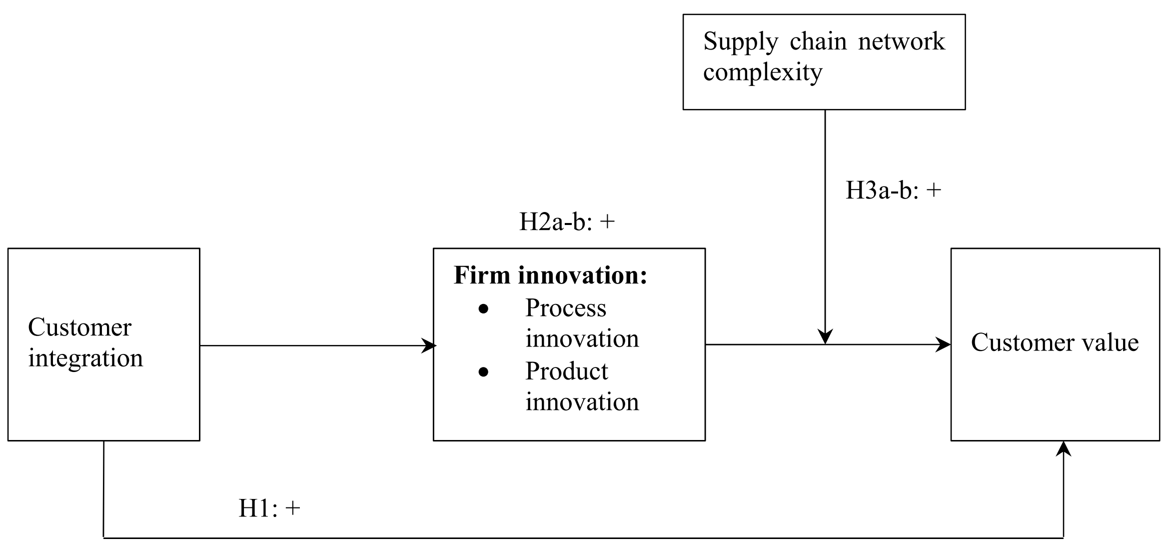
Scholars argue that customer-centric resources could enable firms to address the customer value creation challenge (Zeithaml *et al.,* 2020; Blocker *et al.,* 2011). In particular, supply chain management (SCM) research stresses customer integration as an important determinant of customer value (Cheng *et al.,* 2016; Flynn *et al.,* 2010). Customer integration captures the degree to which firms strategically collaborate with customers in managing supply chain resources, flows, activities, and expectations (Wong *et al.,* 2011). Past studies have used the value creation argument to link customer integration to multiple performance outcomes, including operational performance, customer and market-focused performance, and financial performance (Ataseven and Nair, 2017; Chang *et al.,* 2016). However, the empirical results have been mixed and conflicting (Wiengarten *et al.,* 2019), making the value proposition of customer integration unclear (Zhu *et al.,* 2018). For example, using a series of multi-country data, Wiengarten *et al.* (2019) show that customer integration tends to have mixed effects (i.e., positive, negative, or zero) on quality performance, flexibility performance, cost performance, delivery performance, sales performance, and profitability. Largely, evidence suggests that customer integration may not be universally beneficial (Ataseven and Nair, 2017). Thus, while the customer integration-performance relationship may be complex (Wiengarten *et al.,* 2019), there is a dearth of research that explains the processes and boundary conditions under which customer integration contributes to customer value (Wiengarten *et al.,* 2019; Zhu *et al.,* 2018).

Customer integration is essential but has limited value if a firm cannot successfully convert the market information that it generates into creating value-added processes and products (Ralston *et al.,* 2015). Notably, increasing changes in customer requirements and expectations (Zeithaml *et al.,* 2020; Steenkamp, 2019) make customer value a moving target for firms (Blocker *et al.,* 2011). Therefore, superior customer value creation might be premised on a firm's ability to integrate customer perceptions and perspectives in the development of innovative processes and products (Blocker *et al.,* 2011; Najafi-Tavani *et al.,* 2018). While process innovation captures the ability of a firm to create and improve methods of production and service operations, product innovation explains its ability to introduce new product offerings and improve existing products on the market (Oke *et al.,* 2007; Damanpour, 1991). Literature indicates that new benefits and lower inefficiencies that accompany process and product innovations contribute to customer value (Carmona-Lavado *et al.,* 2019; Al-Sa'di *et al.,* 2017). However, process and product innovations are not innate to firms; rather, firms must deploy relevant knowledge-based resources to build innovation capabilities to create superior value for customers (Al-Sa'di *et al.,* 2017). Previous research further suggests that customer value creation is strengthened when firms collaborate with customers in the process of creating new products and processes (Flynn *et al.,* 2010; Koufteros *et al.,* 2005).

Meanwhile, past studies reveal that the performance effects of innovation capabilities are context-dependent (Rousseau *et al.,* 2016; Rosenbusch *et al.,* 2011). Scholarly and practitioner understanding is that, although supply chain network complexity (SCNC) may generate deleterious consequences for firms (Pant *et al.,* 2021; Chand *et al.,* 2020), it might also facilitate value-creating outcomes of firm-specific resources (Turner *et al.,* 2018) such as innovation capabilities (Wang *et al.,* 2015; Choi and Krause, 2006). Hence, the degree of SCNC may provide an important external environment context to explain when customer integration and innovation capabilities are associated with customer value (Chowdhury *et al.,* 2019; Brandon-Jones *et al.,* 2014). We define SCNC as the numerousness and variety of actors in a firm's supply chain (Chowdhury *et al.,* 2019; Manuj and Sahin, 2011).

Against this backdrop, this study draws insights from the resource-based view (RBV) and the contingent resource-based view (CRBV) to address an important but under-studied research question: how and under what supply chain conditions do customer integration and firm innovation capabilities contribute to customer value? The RBV suggests that customer integration (Chang *et al.,* 2016; Leuschner *et al.,* 2013), and process and product innovation capabilities (Story *et al.,* 2015; Bowen *et al.,* 2010) are important foundations for generating competitive advantage and superior customer value in that these firm-specific resources and capabilities are valuable, path-dependent, difficult-to-acquire, and costly-to-imitate (Barney, 1991). Additionally, from an input-process-output resource perspective of RBV (Lado *et al.,* 1992; Brandon-Jones *et al.,* 2014), customer integration can be viewed as an important input resource for developing innovation capabilities to create and deliver superior value (Lado *et al.,* 1992; Huo, 2012; Koufteros *et al.,* 2007). On the other hand, the CRBV contends that resource and capability deployment should be in alignment with organizational circumstances to generate superior performance outcomes (Sirmon and Hitt, 2009; Brandon-Jones *et al.,* 2014). Accordingly, this study examines the extent to which customer integration contributes to customer value through process/product innovation capabilities under varying conditions of SCNC (see Figure 1). The study extends the supply chain integration literature by using primary data from 335 firms in a sub-Saharan African market – Ghana – to show that the indirect positive associations between customer integration and customer value, through product and process innovations, are strengthened when supply chain network complexity increases in magnitude.

Figure 1: Conceptual model



The article is organized as follows: the subsequent section discusses the conceptual domains of the study constructs and presents the hypotheses and their underlying theoretical lenses; following this, we describe the empirical data and then present the data analyses and results; the last section discusses research contributions and implications as well as limitations and future research avenues.

2. Theoretical Background and Hypotheses

2.1. Customer value

As in marketing (Eggert *et al.,* 2019) and business strategy (Leroi-Werelds, 2019), customer value creation is at the heart of SCM (Min *et al.,* 2019). Slater (1997) argues that "…the creation of customer value must be the reason for the firm's existence and certainly for its success" (p.1667). Additionally, Min *et al.* (2019) assert that customer value creation is the primary goal of SCM. However, previous research is unclear about the conceptual meaning of the customer value construct and how it should be operationalized (Zeithaml *et al.,* 2020; Eggert *et al.,* 2019; Leroi-Werelds, 2019). There are two major approaches to conceptualizing and operationalizing the construct: unidimensional and multi-dimensional/higher-order approaches (Leroi-Werelds *et al.,* 2013). The unidimensional approach focuses on the fundamental meaning of customer value, arguing that the construct can be measured with self-reported indicators (Zeithaml *et al.,* 2020; Leroi-Werelds *et al.,* 2013). An argument is that the indicators may reflect "a cognitive tradeoff between perceived quality and sacrifice" (Dodds *et al.,* 1991, p.316), or represent "…an evaluation of the benefits and sacrifices associated with a product or service" (Zeithaml *et al.,* 2020, p.414). In contrast, the multidimensional approach conceptualizes customer value as a complex construct, with multiple components including but not limited to economic value, social value, relationship value, hedonic value, altruistic value, functional value, symbolic value, and conditional value (Zeithaml *et al.,* 2020; Leroi-Werelds *et al.,* 2013).

Despite the dominance of the two approaches, the SCM literature tends to conceptualize customer value as a unidimensional construct. More precisely, SCM scholars have linked the core principle of SCM (i.e. integration) with the cost-benefit idea of customer value (Cheng *et al.,* 2016; Flynn *et al.,* 2010). Earlier SCM studies that followed the unidimensional approach to measure customer value from the focal firm's standpoint include Wieland and Wallenburg (2012) and Kim *et al.* (2013). Consistent with these studies and business-to-business (B2B) research (Blocker *et al.,* 2010), Gligor *et al.* (2020) operationalize customer value as "the aggregation of benefits that a customer expects or experiences, along with associated undesired consequences" (p.723). In contrast, Zhu *et al.* (2018) examine the link between supply chain integration and customer value by conceptualizing and measuring the customer value construct in terms of customer service performance and innovation performance, contending that these performance dimensions contribute to firms' ability to create value and retain customers. Since this study focuses on isolating the mechanisms that enable customer integration to enhance customer value, we follow a reflective measurement approach to directly measure the customer value construct from a unidimensional perspective.

2.2. Customer integration

The SCM literature identifies supply chain integration as a three-dimensional construct, consisting of customer integration, supplier integration, and internal integration components (Ataseven and Nair, 2017; Chang *et al.,* 2016). Together, these components explain the degree to which a firm "…strategically collaborates with its supply chain partners and collaboratively manages intra- and inter-organization processes" (Flynn *et al.,* 2010, p.59). Issues of interest to supply chain integration are numerous and context-specific (Leuschner *et al.,* 2013; Flynn *et al.,* 2010). Thus, there are no universal scales in the literature that measure the components of the construct (Ataseven and Nair, 2017). Notwithstanding this, typical issues captured in supply chain integration scales include the joint management of intra- and inter-firm resources and systems (e.g., information, technology), processes, and attitudes and behaviors (Mackelprang *et al.,* 2014; Leuschner *et al.,* 2013; Flynn *et al.,* 2010). This study focuses on the customer integration component as it is more customer-oriented (Chang *et al.,* 2016) and nomologically relevant for explaining variation in customer value (Blocker *et al.,* 2011; Vargo, 2008). Customer integration is defined and operationalized in this study as the extent to which a firm strategically engages customers in managing supply chain resources, flows, activities, and expectations in a seamless fashion (Chang *et al.,* 2016; Huo, 2012; Wong *et al*., 2011).

2.3. Firm innovation capabilities

Literature suggests different classifications of firm-level innovation capability, including process innovation versus product innovation, administrative innovation versus technical innovation, and incremental innovation versus radical innovation (Damanpour, 1991; Story *et al.,* 2015). Overall, innovation capability explains firms' ability to generate, develop, and introduce new ideas to the market (Damanpour, 1991). Given that firms' core activities (i.e., operations) and external outputs (i.e., products/services) are closely linked to customer value creation (Porter, 2001), this research focuses on the process innovation versus product innovation typology. Process innovation explains a firm's ability to incorporate new elements (including tools, equipment, methods, and techniques) into its input-output system (Dey *et al.,* 2018; Al-Sadi *et al.,* 2017). Product innovation refers to the ability of a firm to introduce new product/service offerings to the market or improve existing ones (Al-Sadi *et al.,* 2017; Ar and Baki, 2011). These two innovation capabilities are important and could operate differently to determine levels of customer value (Moyano-Fuentes *et al.,* 2018; Al-Sadi *et al.,* 2017).

2.4. Supply chain network complexity

Although the notion of complexity has been increasingly linked to supply chains (Pant *et al.,* 2021; Turner *et al.,* 2018), SCM researchers have conceptualized and measured the complexity construct differently (see Manuj and Sahin, 2011; Bozarth *et al.,* 2009). As Bode and Wagner (2014) argue, two basic qualities define complexity: *structure* and *behavior*. Structural complexity (also labeled static and detail complexity in some studies) refers to the number and variety of components that make up a system. Behavioral complexity (also labeled dynamic or operational complexity in some studies) refers to the degree of interactions between components in a system (Bozarth *et al.,* 2009).

Bode and Wagner (2014) argue that the two complexity types are highly related. For example, firms with supply chains that involve a greater number of diverse suppliers and customers may be required to deal with a high degree of interactions with a variety of supply chain partner behaviors. Accordingly, this study focuses on the structural dimension of complexity to identify and define SCNC as the number and variety of customers and suppliers in a focal firm's supply chain network (cf. Chowdhury *et al.,* 2019).

2.5. Theoretical underpinnings and hypotheses

While prior research has examined several determinants of customer value (Guenzi and Troilo, 2007; Jääskeläinen and Heikkilä, 2019; Zeithaml *et al.,* 2020), scholarly works have drawn arguments from the RBV literature to suggest that firm-specific resources and capabilities may contribute to customer value creation (Barney, 1991; Wernerfelt, 1984). Thus, a firm in possession of a high level of value-enhancing resources is likely to be more competitive than its counterparts in enhancing customer value (Barney *et al.,* 2001). Research shows that customer integration (Chang *et al.,* 2016) and innovation (Rousseau *et al.,* 2016) constitute firm-specific resources and capabilities required to create superior customer value. Customer integration is a valuable resource in that it enables firms to better understand and rapidly attend to specific and changing customer requirements and demands (Chang *et al.,* 2016). Innovation is a firm-level capability in that it affords firms the ability to reduce non-value-addition activities, and develop and introduce new products that meet changing customer requirements and demands (Al-Sadi *et al.,* 2017). Thus, customer integration and innovation may be conceptualized as socially complex, path-dependent, and costly-to-acquire resources and capabilities (Barney, 2012) that may explain variability in customer value.

Furthermore, RBV research suggests that bundles of complementary resources can differentiate firms in terms of customer value as their nature is more complex and causally ambiguous (Lado *et al.,* 1992; Barney, 1991). Resource bundling occurs through a logical integration of different resources to enhance firm capacity to improve customer value (Sirmon *et al.,* 2007). For instance, firms can sequentially bundle relevant input and transformational capabilities to improve customer value (Lado *et al.,* 1992). Lado *et al.* (1992) contend that innovation constitutes an important transformational capability that needs to be developed and maintained using relevant input resources. From these premises, we argue that customer integration serves as an input resource for process and product innovation capability development, such that variation in levels of process and product innovation capabilities may contribute to differences in customer value improvement.

In integrating the RBV and contingency theory, therefore, the CRBV helps to further explain performance heterogeneity among firms in creating and delivering customer value. The CRBV focuses on addressing the question of *when* firm resources and capabilities explain performance differences (Chowdhury *et al.,* 2019; Brandon-Jones *et al.,* 2014). This theory suggests that the value of a firm's resources is context-dependent and that a fit between firm resources and organizational conditions enhances performance (Donaldson, 2006). From this contingency perspective, it is proposed that firms must adapt by developing and deploying resources and capabilities depending on their unique circumstances (Donaldson, 2006). This research, therefore, suggests in Figure 1 that firms should match their innovation capabilities with the right levels of supply chain complexity to derive enhanced customer value from customer integration activities.

2.5.1. Customer integration as a determinant of customer value

Meta-analytic studies suggest that customer integration has significant but differing positive associations with a variety of performance outcomes (Ataseven and Nair, 2017; Chang *et al.,* 2016). However, an empirical assessment of the link between customer integration and a direct measure of customer value is lacking. Past studies have attempted to capture the customer value consequence of supply chain integration by approximating customer value in terms of operations and market-related performance indicators (e.g., Zhu *et al.,* 2018). We contend that, unlike other performance outcomes considered in past research, customer value is unique: it involves a simultaneous assessment of benefits and costs associated with products/services from the perspective of customers (Leroi-Werelds, 2019; Woodruff, 1997). Therefore, more empirical research on the customer integration-customer value link is necessary. We advance three arguments to propose a positive association between customer integration and customer value.

First, a major pre-requisite for enhancing customer value is an improved understanding of customer needs, expectations, preferences, and purchasing power. With such a customer-centric knowledge resource base, customer requirements are better understood and incorporated into the development of market offerings. As customer integration increases, structural and relational gaps between the firm and target customers are narrowed, enabling the firm to better appreciate changing customer requirements and demands (Wong *et al.,* 2011). Greater customer integration may further facilitate effective gathering and analysis of relevant customer information (Flynn *et al.,* 2010), which helps firms monitor and co-manage with customers issues that define value (Eggert e*t al.,* 2019).

Second, greater customer integration helps enhance customization of market offerings, which improves customer assessment and perception of value associated with a firm's market offering (Chang *et al.,* 2016). Additionally, because customer integration is characterized by increased customer engagement and interactions, this may help improve customers' ownership of the value creation process. Increased customer participation and ownership of the value creation process may generate a favorable customer perception of value created by the firm (Blocker *et al.,* 2011).

Third, because greater customer integration bridges the structural and relational gaps between the firm and target customers, it may help firms to be more responsive to addressing customer requirements, thus increasing time utility for customers (Flynn *et al.,* 2010). Furthermore, greater customer integration may help reduce stockout (or overstocking) and its associated costs due to the increased customer involvement in market demand determination (Flynn *et al.,* 2010). These arguments are supported by related prior empirical findings (e.g., Blocker *et al.,* 2011 Chang *et al.,* 2016). For example, Blocker *et al.* (2011) show that customer-focused resources, derived from greater customer orientation, are associated with stronger customer value. Accordingly, we hypothesize that:

H1: Customer integration is positively related to customer value.

2.5.2. Process and product innovation capabilities as transformative mechanisms

Extant literature suggests that an improved understanding of the performance effects of customer integration could be gained if research specifies theoretically relevant processes that link customer integration to its intended performance outcomes (Chang *et al.,* 2016). From a resource-based perspective, it could be argued that possession of a customer-centric resource (i.e., customer integration) may not automatically lead to improved customer value; rather, it needs to be exploited through value-enhancing mechanisms, which may vary across firms. Therefore, failure to specify appropriate causal mechanisms could result in omitted variable bias and undermine the ability to explain how customer integration contributes to customer value (Rindfleisch *et al.,* 2008). Therefore, we draw insights from the input-transformational-output resources framework to suggest that process and product innovation capabilities constitute transformation processes to explain how customer integration drives customer value (Al-Sadi *et al.,* 2017; Rousseau *et al.,* 2016).

Greater customer integration may enable firms to better understand the market in terms of the expressed and latent needs and expectations of customers. Again, customer integration is a relevant conduit for tapping into new ideas from customers as part of a firm's efforts to develop new processes and products that meet their expectations (Flynn *et al.,* 2010; Koufteros *et al.,* 2005). Therefore, emphasis on customer integration may enhance and sustain process and product innovations, enabling firms to achieve superior customer value. Accordingly, this study expects that the value-enhancing potency of process and product innovations would encourage firms that emphasize customer integration to accordingly invest more in process and product innovations to generate superior customer value.

The dynamic capability literature characterizes innovation as a critical aspect of a firm's competitive repertoire and a crucial intermediate mechanism that enables firms to adapt to changing internal and external conditions (Teece, 2014). Customer requirements are dynamic and constantly evolving, with the potency to induce customer value change (Min *et al.,* 2019). Therefore, firms need to develop and deploy adaptive or transformational capabilities to catch up with changing customer requirements. Specifically, modifications to operational routines and supporting structures are required to develop and introduce new products to the market (Najafi-Tavani *et al.,* 2018; Story *et al.,* 2015). Prior research suggests that, due to its ability to improve business operations, process innovation could drive customer value in two ways: (1) reduced process wastes/delays and reduction in cost of operations; and (2) enhanced product/service quality and service levels in terms of lower lead-time (Möldner *et al.,* 2020; Nguyen and Harrison, 2019). On the other hand, research shows that customers may associate value-for-money with or derive superior product advantage from additional and useful product features, and the simplified and improved product design and packaging that often accompany innovative products (Carmona-Lavado *et al.,* 2019). Consistent with these arguments, Nasution *et al.* (2011) argue that greater innovation activities in the areas of operations, administration, and products together strongly drive customer value (including value-for-money, reputation for quality, and prestige). Similarly, Kim *et al.* (2013) demonstrate that relationship-enabled responsiveness mediates the link between strategic supply chain collaboration and customer value. In line with the RBV literature, therefore, we contend that greater customer integration enables firms to generate complex, causally ambiguous, and difficult-to-acquire and duplicate customer-centric informational and relational resources to build process and product innovation capabilities to create innovation-based customer value. Accordingly, we hypothesize that:

H2a: *Customer integration has a positive indirect relationship, through process innovation, with customer value.*

H2b: Customer integration has a positive indirect relationship, through product innovation, with customer value.

2.5.3. Supply chain network complexity as an enabler

Extant literature suggests that SCNC may be a major contingency force that conditions the extent to which firm resources drive performance (Chowdhury *et al.,* 2019; Birkie *et al.,* 2017). Additionally, prior research suggests that the extent to which innovation activities drive customer value may be context-dependent (e.g., Rousseau *et al.,* 2016). However, knowledge of whether and how SCNC moderates the customer-value creation consequence of process and product innovations is underdeveloped. Yet, firms need to collaborate with a variety of supply chain partners to fulfill customer requirements and demands to create value (Manuj and Sahin, 2011). This makes it crucially important to understand how SCNC conditions the interrelations between customer-centric resources, innovation capabilities, and customer value.

In addition to the increased uncertainties that greater SCNC introduces (Brandon-Jones *et al.,* 2014), high levels of SCNC can also increase supply chain disruptions (Bode and Wagner, 2014) and undermine supply chain performance (Chowdhury *et al.,* 2019; Bozarth *et al.,* 2009). Accordingly, Chand *et al.* (2020) suggest that, under conditions of high SCNC, greater innovation is required to drive competitive advantage. Additionally, greater SCNC can threaten organizational stability, increasing requirements for problem-solving and knowledge-based resource and capability development and deployment (Turner *et al.,* 2018). Situations of greater complexity may also trigger the need to increase thresholds of dynamic capabilities (Birkie *et al.,* 2017) as well as the need to recognize the utilities of deploying such resources (Turner *et al.,* 2018; Brandon-Jones *et al.,* 2014). Since high SCNC circumstances may increase the cost of delivering products and services, under such a condition greater innovativeness is required to devise new processes to increase benefits to customers at a lower cost. Despite the costs, firms that operate under conditions of increased SCNC may also benefit from greater access to diverse and complementary external resources (e.g., information, new ideas, funds), which could facilitate the extent to which process and product innovation capabilities contribute to superior customer value (Wang and Hu, 2020).

Additionally, because many unexpected contingencies may arise under conditions of high SCNC, which may frustrate existing processes and erode customer satisfaction, greater investments in process and product innovation capability become strategically imperative (Turner *et al.,* 2018). Conversely, under conditions of low SCNC, increases in process and product innovation efforts may not produce improved customer value outcomes. The logic is that, under such conditions, there is a low intricate level of processes and diversity within the supply chain (Bode and Wagner, 2014) to justify greater investments in innovative new processes and products. Also, as Boso *et al.* (2013) argue, innovation is a resource-draining activity and a high-risk venture. As such, greater investments in innovation capabilities under conditions of low complexity without a compelling need may be a wasteful venture that may potentially produce low customer value. Thus, greater investment in process and product innovation efforts is an unwarranted risk for a firm to take when faced with a low degree of complexity. That said, there might be a limited customer value outcome when firms channel customer integration into boosting innovation capabilities under low SCNC circumstances. Therefore, we propose that:

H3a: The indirect positive relationship between customer integration and customer value through process innovation is moderated by SCNC, to the extent that the indirect positive relationship is strengthened when levels of SCNC are higher.

H3b: The indirect positive relationship between customer integration and customer value through product innovation is moderated by SCNC, to the extent that the indirect positive relationship is strengthened when levels of SCNC are higher.

3. Research Methodology

3.1. Sample and data collection

We use primary data (e.g., Zhu *et al.,* 2018) from Ghana, a developing market in sub-Saharan Africa (cf., Amoako-Gyampah *et al.,* 2020), to test the hypotheses. Ghana has received much attention for its economic transformation (Acquaah, 2007) and the market-based activities of its firms (Boso *et al.,* 2013b). The country's open market economy system has increased entrepreneurial and supply chain activities significantly (Amoako-Gyampah *et al.,* 2020; Boso, Story et al. (2013)). Further, Ghana is a fast-growing economy in sub-Saharan Africa (African Development Bank, 2018) undergoing rapid institutional and structural changes (World Bank, 2017).

Our sample, drawn from the Ghana Statistical Service database, comprises firms in multiple industries (cf., Zhu *et al.,* 2018). The firms operate in the manufacturing, service, agri-business, and construction industries as these industries constitute major economic forces in Ghana's private sector (Ghana Statistical Service, 2017). Using a multi-industry sample allows us to obtain greater heterogeneity in data on predictor, mediator, moderator, and outcome variables to test the robustness of our conceptual model (Bouquet *et al.,* 2009). It is important to indicate that, compared to emerging and advanced market firms, developing market firms largely comprise medium and small businesses (Amoako-Gyampah *et al.,* 2020). Our research focused on firms with at least five full-time employees and which have operated consistently for at least three years. In line with prior supply chain integration research (e.g., Zhu *et al.,* 2018; Flynn *et al.,* 2010), we relied on single key informants in each firm to obtain data. Respondents were from the following categories: Chief Executive Officers (7.5%), General Managers (15.2%), Operations Managers (23%), Marketing/Sales Managers (26%), Supply Chain/ Logistics Managers (14.6%), and Other Managers (13.7%). Eighty percent of the respondents had either a bachelor's degree or a higher degree.

Additionally, the average respondent had approximately six years of managerial experience (standard deviation = 5.396).

Altogether, 670 firms were selected for the study. We first contacted firms by telephone to obtain their consent to participate in the study. We subsequently sent an introductory letter to the firms to explain the research objectives and assure them about confidentiality. In all, 405 out of the 670 firms contacted provided data for the study after several follow-up telephone calls. After analyzing the data for incompleteness/missing data, 335 responses were retained, representing an effective response rate of 50%. As detailed in Table I, the majority of the firms in the sample operate in service (48.66%) and manufacturing (29.25%) industries, employ between five and 100 full-time workers (84.17%), and have operated for between three and 20 years (72.84%).

Table I. Firm demographic results.

Characteristics (group)		Frequency	%
Firm industry	Manufacturing (e.g., food products, rubber & plastics, textiles, furniture)	98	29.25
	Services (e.g., transportation, financial, hospitability, tourism, logistics services)	163	48.66
	Agri-business (e.g., crop and animal production and distribution)	33	9.85
	Mining/extraction	15	4.48
	Others (e.g., construction)	26	7.76
Firm size group	Small firm (5 to 30 full-time employees)	158	47.16
	Medium firm (31 to 100 full-time employees)	124	37.01
	Large firm (101 to 500 full-time employees)	53	15.82
Firm age group	3 to 10 years	129	38.51
	10.01 to 20 years	115	34.33
	20.01 to 30 years	49	14.63
	Between 30.01 and 67 years	42	12.54

3.2. Measures

We drew on prior studies to develop measures for the study constructs. The measures were first subjected to thorough expert assessment and piloting. These exercises were carried out to reduce measurement errors and ensured that the measures were relevant and appropriate for the study context. The details of the measures included in the final data collection instrument are displayed in Table II.

Table II: Measures and validity results.

Construct/Measures (Cronbach's alpha/composite reliability/average variance extracted)	Factor loading	t-value
Customer integration (0.930/0.930/0.625). *For the past 3 years,*		
we have been sharing operational/production plans with our major customers	0.808	Fixed
our major customers have been sharing demand information with us	0.783	16.20
we have been involving our major customers in process/product improvement initiatives	0.801	16.72
we have been collaborating with our major customers in fulfilling their orders/needs	0.811	16.99
we have been having frequent interactions with our major customers	0.787	16.30
we and our major customers have been sharing technical information with each other	0.795	16.52
we and our major customers have shared common long-term goals and strategies	0.798	16.62
we and our major customers have been engaging in joint planning and forecasting	0.743	15.08
Product innovation (0.871/0.872/0.630). *Compared to major competitors in our target market(s),*		
our organization introduces more new products/services	0.792	Fixed
industry experts would say our organization is more prolific when it comes to introducing new products/services	0.808	15.25
our organization keeps up more with the rate at which it introduces new products/services	0.801	15.11
the frequency at which our organization introduces new products/service is higher	0.773	14.53
Process innovation (0.894/0.895/0.586). *Over the past 3 years,*		
my organization has been introducing new methods of carrying out its operations	0.773	Fixed
my organization has pioneered new ways of doing things in our industry	0.762	14.37
my organization has been constantly replacing its conventional processes of delivering products/services	0.752	14.17
my organization has pursued great continuous improvement in operations	0.800	15.21
my organization has developed several new methods of producing products/services	0.768	14.50
my organization has largely been ahead of competitors in introducing processes that add substantial value	0.738	13.85
Supply chain network complexity (0.900/0.900/0.601). *Over the past 3 years,..*		
the number of different customer groups/segments we have served has been…	0.750	Fixed
the number of service providers that we have engaged has been…	0.763	13.95
the number of business agents/intermediaries we have engaged has been…	0.770	14.08
the number of customers we have served has been…	0.763	13.93
the number of suppliers we have worked with has been…	0.811	14.89
the number of different supplier groups we have worked with has been…	0.793	14.55
Customer value (0.869/0.870/0.625). *To what extent does the feedback your organization obtains from customers consistently suggest each of the following?*		
Our products/services offer benefits that outweigh how much customers pay for them	0.777	Fixed
Compared to our key competitors, our organization creates superior value for the market	0.816	15.02
Compared to our key competitors, customers gain significantly in their relationship with us, far above what they sacrifice	0.808	14.89
The prices of our products/services are worth the benefits customers derive from them	0.762	13.98

Table II: Continued.

Construct/Measures (Cronbach's alpha/composite reliability/average variance extracted)	Factor loading	t-value
Slack resource (0.851/0.853/0.540).		
My organization often has uncommitted resources that can rapidly be used to fund new initiatives	0.626	Fixed
My organization usually has enough resources available in the short-run to fund its initiatives	0.710	10.48
My organization is often able to obtain resources at short notice to support new strategic initiatives	0.787	11.26
My organization often has ample resources at the discretion of management for funding initiatives	0.787	11.27
My organization usually has a reasonable amount of resources in reserve	0.751	10.92
Environmental dynamism (0.895/0.896/0.590).		
Our competitors are constantly trying out new competitive strategies	0.694	Fixed
Regulations governing our industry change frequently	0.787	13.11
Terms and conditions in our supply markets change frequently	0.800	13.31
Technologies (i.e., methods and tools) we use in our industry change frequently	0.775	12.92
Government policies and programs for our industry change frequently	0.786	13.10
Customer needs, preferences, and demands are changing rapidly in our industry	0.760	12.70

Customer value: considering the argument that customer value is determined by the customer (Leroi-Werelds, 2019) and consistent with supply chain literature (e.g., Gligor *et al.,* 2020), we followed the traditional unidimensional approach (Zeithaml *et al.,* 2020; Leroi-Werelds, 2019), and utilized feedback from customers to measure customer value. Customer feedback is important data for appraising the value that customers receive from firms, and, in the age of digitalization, firms can receive a greater magnitude of, and less distorted, customer feedback (Birch-Jensen *et al.,* 2020; Nasr *et al.,* 2018). Therefore, we followed Blocker *et al.* (2011) to ask the firms to indicate the degree to which feedback obtained from customers consistently suggested that the firms had created and delivered customer value.

Customer integration: eight items were adapted from Flynn *et al.* (2010) and Wong *et al.* (2011) to measure customer integration. The items captured the degree of collaboration occurring between the focal firm and its customers aimed at managing interests and goals, supply chain flows (e.g., products, information), and supply chain activities (e.g., forecasting, planning, order fulfillment) (Flynn *et al.,* 2010; Huo, 2012).

Process and product innovations: six- and four-item scales were used to measure process innovation and product innovation respectively. The scale for process innovation, adapted from Moyano-Fuentes *et al.* (2018) and Ar and Baki (2011), captured the extent to which firms create and improve methods of production, service, or administrative operations. The items for product innovation were adapted from Story *et al.* (2015) and Koufteros *et al.* (2007) to measure the relative intensity of new products/services a firm introduces to the market.

Supply chain network complexity: we measured SCNC in terms of the *numerousness* and *diversity* of suppliers and customers that the focal firm does business with. A greater number and diversity of supply chain partners imply greater physical flows, information flows, heterogeneity in physical and information flows, and compounded relational issues that ought to be managed or monitored by the focal firm (Bode and Wagner, 2014; Bozarth *et al.,* 2009). Consistent with prior studies (e.g., Chowdhury *et al.,* 2019; Brandon-Jones *et al.,* 2014), we asked the firms to evaluate the number of different customer groups/segments served and the number of different supplier groups the firms had dealt with in the last three years.

Control variables: to reduce omitted variable bias and address any endogeneity concerns, we first controlled for the potential effect of process innovation on product innovation. Additionally, we included internal and external control variables that might influence the predictor, mediator, and outcome variables (Lu *et al.,* 2018). Customer integration, innovation, and customer value are all resource-intensive activities and may be pursued in response to external environment demands. Thus, a firm's decision regarding – as well as the level of attention allocated to – these variables might be determined by resource availability and external environment conditions. Specifically, we included slack resource and environment dynamism as control variables. Five items were adapted from Atuahene-Gima *et al.* (2005) to measure slack resource (sample item: my organization often has ample resources at the discretion of management for funding initiatives). The environment dynamism scale captured the degree of change in a firm's external environment relating to customer needs/requirements, terms and conditions in the supply market, competition, technology, government regulation, and institutional policies (Story *et al.,* 2015; Atuahene-Gima *et al.,* 2005). In addition to these controls, we also controlled for firm size, firm age, and industry type (Ataseven and Nair, 2017). Among other things, strategic orientations, structural and process complexities, and quality and volume resources differ across large and small firms, and also older and younger firms. Our sample consists of two firm types: manufacturing and service firms. The service firms in general differ in several important ways from manufacturing firms. For example, service firms tend to have more direct contact with end customers than manufacturing firms do, and innovation activities in a service environment can easily be duplicated by competitors (Carmona-Lavado *et al.,* 2019). Lastly, in our robustness analysis, we simultaneously controlled for the potential effects of our moderating SCNC on customer integration, process and product innovations, and customer value.

3.3. Survey bias assessment

Considering the large survey responses received and to reduce concerns about missing values, we removed cases that failed to respond to at least 95% of the survey items. Next, we used the expectation-maximization algorithm in SPSS to replace missing values (Hair *et al.,* 2014).

To diagnose nonresponse bias, we qualitatively examined whether the characteristics of the effective sample reflect those of the target population (Wagner and Kemmerling, 2010). We observe that the distributions of these characteristics shown in Table I compare satisfactorily with the results from the recent most comprehensive survey of businesses in Ghana (Ghana Statistical Service, 2015). Specifically, the majority of the sample is into service activities (48.66%), employs between five and 100 full-time employees (95.82%), and has operated for less than two decades (72.84%). Statistically, we investigated nonresponse bias further by examining whether the key demographic variables and also the substantive variables differ significantly between *early* respondents (i.e., questionnaires received within the first 14 days) and *late* respondents (i.e., questionnaires received within the next 14 days). Independent sample t-test results reveal that the respondent groups were similar in terms of size (t= -.782, p = 0.435) and age (t = 1.702, p = 0.090). Except for SCNC (t = 2.932, p = 0.004), similar results were found for the substantive variables: customer integration (t = -0.30, p=0.976), process innovation (t = 0.558, p = 0.577), product innovation = (t = 0.871, p = 0.384), customer value (t = -1.735, p = 0.084, size (t= -.782, p = 0.435). Put together, and given that the study focuses on theory-testing as opposed to seeking a broader generalization of findings, nonresponse bias is unlikely to confound the study's findings (Hulland *et al.,* 2018).

Following Podsakoff *et al.* (2003), several procedural measures were followed to reduce common method bias. For example, we included a cover letter to explain the study purpose and relevance for practitioners, guarantee respondent anonymity, and provide clear direction for the respondents. Further, we conducted a pilot study to improve item clarity and appropriateness for the study context; varied scale anchor labels were employed to measure the construct; and increased the physical distance among the predictor, mediator, and outcome variables. These procedural measures helped minimize the likelihood of the respondents predicting the hypotheses tested in the study.

Additionally, we assessed the extent of common method bias using two statistical procedures. First, we relied on Lindell and Whitney's (2001) marker variable technique. Our survey instrument included a theoretically unrelated variable: people in industry and academia can contribute tremendously to the socio-economic growth of every nation if they begin to engage with each other; which was anchored on a 7-point Likert scale that ranged from "strongly disagree (= 1)" to "strongly agree (= 7)". Results in Table II indicate no significant correlation between the marker variable and the study constructs. Again, using the second-lowest positive correlation between the marker variable and the study constructs (r = 0.040) for marker variable adjustment, we find that the marker variable adjusted correlations are not different from the zero-order correlations in terms of direction and strength. Second, we investigated common method bias further by using confirmatory factor analysis procedures (Podsakoff *et al.,* 2003). We compared our theoretically specified measurement model (a trait-only model, given: χ^2 = 1157.823, df = 681, normed χ^2 = 1.700, RMSEA = 0.046, NNFI = 0.972, CFI = 0.974, SRMR = 0.042) to a method-only measurement model, which had the study measures loaded onto a single latent variable (χ^2 = 8079.53, df = 572, χ^2/df = 14.125, RMSEA = 0.207, NNFI = 0.694, CFI = 0.712, SRMR = 0.169). Results show that not only does the method-only measurement model poorly fit the data but it is also significantly worse than our theoretical measurement model, indicating that a common factor does not underlie the study data. Again, the addition of a common factor linking all the indicators in the trait-only model resulted in marginal improvements in the model fit indices (Flynn *et al.,* 2010): χ^2 = 1014.45, df = 640, χ^2/df = 1.585, RMSEA = 0.042, NNFI = 0.975, CFI = 0.779, SRMR = 0.037). Overall, the statistical assessments suggest that common method bias is unlikely to characterize the findings from the study (Flynn *et al.,* 2010).

3.4. Reliability and validity assessments

We followed covariance-based confirmatory factor analysis (CFA) to assess the reliability and validity of the study measures. Our seven-factor CFA model shows a good fit to data: chi-square (χ^2) = 1157.823, degree of freedom (df) = 681, normed χ^2 = 1.700, root mean square error of approximation (RMSEA) = 0.046, non-normed fit index (NNFI) = 0.972, comparative fit index (CFI) = 0.974, standardized root mean square residual (SRMR) = 0.042 (Bagozzi and Yi, 2012; Hair *et al.,* 2014). As shown in Table II, all factoring loadings are above 0.60 and statistically significant at 1%. The Cronbach's alpha, composite reliability, and average variance extracted values computed for each set of items are all above their recommended minimum thresholds of 0.70, 0.60, and 0.50 respectively (Bagozzi and Yi, 2012; Hair *et al.,* 2014). Collectively, these results demonstrate that scale reliability, unidimensionality, and convergent validity are achieved. Additionally, the average variance extracted values were larger than the shared variances between the constructs, suggesting that discriminant validity of the measures is established (Hair *et al.,* 2014). Per these results, each latent variable was operationalized as an arithmetic average of its measurement items (cf. Flynn *et al.,* 2010; Zhu *et al.,* 2018).

4. Structural Model Assessment

Table II presents the descriptive statistics and correlations for the study variables. We analyzed the conceptual model using multiple analytical tools and strategies to ensure that the hypotheses were evaluated using consistent estimates. The analyses were sequenced to follow the ordering of the hypotheses. The result tables (Table IV, Table V, Table VI, and Table VII) show the variables included in each analysis. Different sets of theoretically relevant controls were included in each analysis and model. Because we are interested in evaluating the main effect paths in the interaction-effect models, we mean-centered all variables used to create multiplicative interaction terms (Aguinis *et al.,* 2017).

Table III: Descriptive and correlation results.

Variables	1	2	3	4	5	6	7	8	9	10	11
1. Customer value		0.374**	0.277**	0.282**	0.086	0.251**	0.190**	0.098	0.036	0.128**	0.023
2. Process innovation	0.399**		0.331**	0.278**	0.245**	0.348**	0.350**	0.076	-0.011	0.026	-0.069
3. Product innovation	0.306**	0.358**		0.245**	0.167**	0.373**	0.217**	0.034	-0.078	0.117	-0.095
4. Customer integration	0.311**	0.307**	0.275**		0.215**	0.204**	0.099	0.120	0.057	0.069	-0.071
5. SCNC	0.123*	0.275**	0.200**	0.246**		0.057	0.244**	0.061	0.088	-0.079	-0.06
6. Slack resource	0.281**	0.374**	0.398**	0.236**	0.095		0.294**	0.114*	-0.048	0.099	0.005
7. Environment dynamism	0.222**	0.376**	0.248**	0.135*	0.274**	0.322**		0.154**	0.053	0.001	0.000
8. Firm size	0.134*	0.113*	0.073	0.155**	0.099	0.149**	0.188**		0.173**	-0.027	-0.06
9. Firm age	0.075	0.029	-0.035	0.095	0.124*	-0.006	0.091	0.206**		-0.003	-0.106
10. Industry (service =1)	0.163**	0.065	0.152**	0.106	-0.036	0.135*	0.041	0.014	0.037		-0.035
11. Marker variable	0.062	-0.026	-0.051	-0.028	-0.018	0.045	0.040	-0.018	-0.062	0.006	
Mean	4.901	4.673	4.221	4.507	4.964	4.198	4.671	3.578	2.570	0.487	5.261
Standard deviation	1.198	1.241	1.375	1.295	1.142	1.300	1.195	1.035	0.750	0.501	1.958

Note:

1. SCNC = supply chain network complexity.
2. Zero-order and marker variable-adjusted correlations are reported below and above the principal diagonal, respectively.
3. $^{*}p < 0.05$ (2-tailed), $^{**}p < 0.01$ (2-tailed).

Table IV: Main and moderating effects: OLS regression results.

	Models and dependent variables			
Regression paths	Model 1: Process innovation	Model 2: Product innovation	Model 3a: Customer value	Model 3b: Customer value
Control paths:				
Slack resource	0.229(4.657)	0.281(4.909)	0.062(1.188)	0.076(1.466)
Environment dynamism	0.246(4.560)	0.071(1.130)	0.043(.781)	0.037(.684)
Firm size	-0.006(-0.101)	-0.018(-0.275)	0.052(.888)	0.050(.870)
Firm age	-0.043(-0.538)	-0.125(-1.380)	0.071(.895)	0.067(.853)
Industry (service firms = 1)	0.024(0.201)	0.262(1.961)	0.230(1.943)	0.187(1.594)
SCNC	0.159(2.891)	0.112(1.787)	-0.040(-.716)	0.020(.355)
Process innovation		0.186(2.987)		
Hypothesized paths:				
Main effects:				
Customer integration	0.177(3.659)	0.135(2.437)	0.253(4.558)	0.232(4.195)
Process innovation (PCINV)			0.151(3.072)	0.135(2.772)
Product innovation (PDINV)			0.105(2.166)	0.086(1.778)
Interaction effects:				
PCINV × SCNC				0.124(3.306)
PDINV × SCNC				-0.011(-.275)
R^2	0.275	0.251	0.241	0.268
F	17.697^{***}	13.631^{***}	11.479^{***}	10.734^{***}

Notes:

1. Unstandardized coefficients along with t-values are presented in the table.
2. Hypothesized paths are evaluated at t-value ≥ 1.645 (5%, 1-tailed). Control paths are evaluated at t-value ≥ 1.96 (5%, 2-tailed).
3. SCNC = supply chain network complexity.
4. $^{*}p < 0.05$, $^{**}p < 0.01$.

Table V: Indirect and conditional indirect effects: PROCESS results.

Paths	Hypothesis	Effect	95% bootstrap confidence interval	Conclusion
Indirect effects:				
Customer integration → PCINV → Customer value†	H1a: +	0.0447	0.0166 to 0.0903	Supported
Customer integration → PDINV → Customer value†	H1b: +	0.0143	0.0008 to 0.0428	Supported
Customer integration → PCINV → PDINV → Customer value†, *		0.0035	0.0002 to 0.0126	
Total*		0.0625	0.0299 to 0.1087	
Moderated indirect effects:				
Customer integration → (PCINV, *at* -1SD SCNC) → Customer value††		0.0186	-0.0110 to 0.0595	
Customer integration → (PCINV, *at* +1SD SCNC) → Customer value††	H2a: +	0.0774	0.0337 to 0.1382	Supported
Index of moderated mediation		0.0258	0.0069 to 0.0523	
Customer integration → (PDINV, *at* -1SD of SCNC) → Customer value††		0.0192	-0.0024 to 0.0586	
Customer integration → (PDINV, *at* +1SD of SCNC) → Customer value††	H2b: +	0.0144	-0.0130 to 0.0606	Not supported
Index of moderated mediation		-0.0021	-0.0228 to 0.0154	

Notes:

1. † = Covariates in both models of mediators and outcome are slack resource, environment dynamism, firm size, firm age, industry (service firms = 1), supply chain network complexity.
2. †† = Covariates in both models of mediators and outcome are slack resource, environment dynamism, firm size, firm age, industry (service firms = 1).
3. * = Post-hoc analysis.
4. PCINV = process innovation; PDINV = product innovation; SCNC = supply chain network complexity; SD = standard deviation.

Table VI: Further analysis: SEM results.

Paths	Model 1[†]		Model 2[†]	
	β(t-value)	R^2	*β(t-value)*	R^2
Slack resource → Customer integration	0.272(3.270)		0.272(3.269)	
Environment dynamism → Customer integration	-0.031(-0.361)	0.131	0.031(-0.361)	0.131
Supply chain network complexity → Customer integration	0.329(3.880)		0.329(3.880)	
Firm size → Customer integration	0.131(1.821)		0.131(1.821)	
Customer integration → Process innovation	**0.175(3.495)**		0.175(3.495)	
Slack resource → Process innovation	0.307(4.279)		0.307(4.279)	
Environment dynamism → Process innovation	0.282(3.911)	0.328	0.282(3.911)	0.328
Supply chain network complexity → Process innovation	0.173(2.462)		0.173(2.461)	
Firm size → Process innovation	-0.028(-0.473)		-0.028(-0.473)	
Process innovation → Product innovation	0.193(2.462)		0.193(2.464)	
Customer integration → Product innovation	**0.139(2.341)**		0.139(2.342)	
Slack resource → Product innovation	0.416(4.650)	0.292	0.416(4.647)	0.292
Environment dynamism → Product innovation	0.058(0.689)		0.058(0.689)	
Supply chain network complexity → Product innovation	0.116(1.402)		0.116(1.404)	
Firm size → Product innovation	-0.053(-0.771)		-0.053(-0.772)	
Customer integration → Customer value	**0.149(2.956)**		**0.132(2.671)**	
Product innovation → Customer value	**0.122(2.146)**		**0.094(1.687)**	
Process innovation → Customer value	**0.271(4.017)**		**0.285(4.278)**	
Slack resource → Customer value	0.083(1.112)		0.099(1.341)	
Environment dynamism → Customer value	0.039(0.551)		0.033(0.475)	
Supply chain network complexity → Customer value	-0.062(-0.895)	0.285	-0.051(-0.748)	0.310
Firm size → Customer value	0.040(0.692)		0.037(0.636)	
Firm age → Customer value	0.084(1.069)		0.073(0.944)	
Industry (service = 1) → Customer value	0.031(0.606)		0.041(0.810)	
(PRINV×SCNC) → Customer value			**0.130(3.465)**	
(PDINV×SCNC) → Customer value			**-0.004(-0.099)**	
Model fit indices:				
χ^2	1397.97		1383.78	
df	855		853	
Normed χ^2	1.635		1.622	
$\Delta\chi^2$			14.19^{***}	
RMSEA	0.044		0.043	
NNFI	0.968		0.969	
CFI	0.971		0.972	
SRMR	0.044		0.043	

Notes:

1. PCINV = process innovation; PDINV = product innovation; SCNC = supply chain network complexity.
2. [†]All structural paths were estimated simultaneously using LISREL 8.80.
3. Hypothesized paths are bolded.
4. Hypothesized paths are evaluated at t-value ≥ 1.645 (5%, 1-tailed). Control paths are evaluated at t-value ≥ 1.96 (5%, 2-tailed).
5. $^{***}p < 0.001$.

Table VII: Robustness analysis for main effects: 2SLS results.

	Models and dependent variables					
Independent variables	Model 1: Customer integration (OLS)	Model 2: Process innovation (OLS)	Model 3: Product innovation (OLS)	Model 4a: Customer value (2SLS)	Model 4b: Customer value (2SLS)	Model 4c: Customer value (2SLS)
Control paths:						
Slack resource[a]	0.193(3.503)	0.229(4.657)	0.281(4.909)			
Environmental dynamism[a]	-0.014(-.225)	0.246(4.560)	0.071(1.130)			
Firm size	0.121(1.791)	-0.006(-.101)	-0.018(-.275)	0.097(1.552)	0.076(1.216)	0.079(1.279)
Firm age	0.080(.876)	-0.043(-.538)	-0.125(-1.380)	0.051(0.604)	0.051(0.611)	0.065(0.722)
Industry (service firms = 1)	0.219(1.623)	0.024(.201)	0.262(1.961)	0.347(2.773)	0.329(2.654)	0.312(2.510)
Supply chain network complexity[a]	0.249(4.055)	0.159(2.891)	0.112(1.787)			
Hypothesized paths:						
Customer integration[†]		0.177(3.659)	0.135(2.437)	0.699(4.650)		
Process innovation[†]			0.186(2.987)		0.554(5.349)	
Product innovation[†]						0.567(5.404)
R^2	0.26	0.275	0.251	0.104	0.122	0.123
F	7.906^{***}	17.697^{***}	13.631^{***}	9.618^{***}	11.450^{***}	11.605^{***}

Notes:

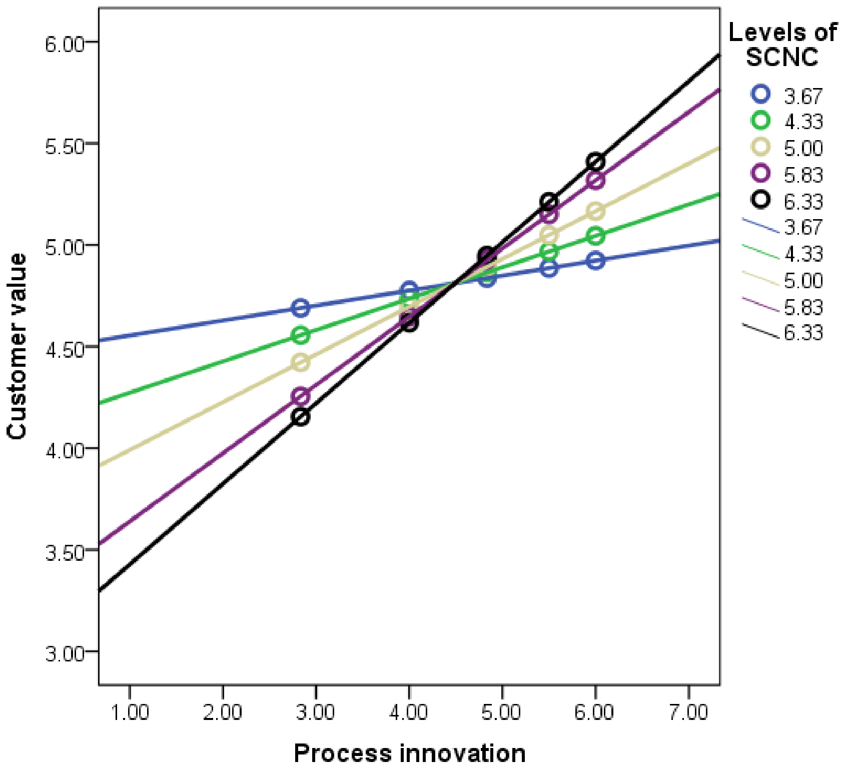
1. Unstandardized coefficients along with t-values are presented in the table.
2. [a]Variables used as instruments for the assumed endogenous variables.
3. [†]Predicted values, entered in turn in the second-stage regression due to high collinearity.
4. Hypothesized paths are evaluated at t-value ≥ 1.645 (5%, 1-tailed). Control paths are evaluated at t-value ≥ 1.96 (5%, 2-tailed).
5. $^{***}p < 0.001$.

4.1. Results

Ordinary least squares regression (OLS) analysis was used to examine the direct effects of customer integration (Zhu *et al.,* 2018) and process and product innovations (Moyano-Fuentes *et al.,* 2018), and the moderating effect of SCNC (Bozarth *et al.,* 2009). Table IV shows that customer integration is positively related to customer value (β = 0.232; t = 4.195), in support of H1. In line with H2a-b, results indicate that customer integration is positively associated with process innovation (β = 0.177; t = 3.659) and product innovation (β = 0.135; t = 2.437), and that process innovation (β = 0.1517; t = 3.072) and product innovation (β = 0.105; t = 2.166) in turn are significantly related to customer value. Table III further shows that the interaction term for process innovation and SCNC (i.e., PCINV × SCNC) is positively associated with customer value (β = 0.124; t = 3.306). This suggests that the indirect positive association between customer integration and customer value, through process innovation, is strengthened when SCNC is high, providing support for H3a. However, results show that the product innovation and SCNC interaction term (i.e., PDINV × SCNC) is not significantly related to customer value (β = -0.011; t = -0.275); hence H3b is not supported at the mean levels of SCNC.

To aid interpretation of, and provide additional insights on, the moderating effect results, we used Johnson-Neyman (J-N) and PROCESS software to explore the slope of the process/product innovation-customer value relationships at varying levels of SCNC (Hayes, 2018). The J-N analysis reveals that the relationship between process innovation and customer value is positive and significant only for high values of SCNC (i.e., 4.124 and above). Similarly, the relationship between product innovation and customer value is positive and significant only for high values of SCNC (i.e., 4.723 and above). Again, for the respective ranges of values of SCNC, we find that the slopes of the relationship between process/product and customer value are stronger. The perceptible analysis reveals similar results (see Figure 2 and Figure 3 for details). Overall, these results lend credence to the study's argument in H3a and H3b that high levels of SCNC amplify the relationship between process innovation and product innovation capabilities and customer value.

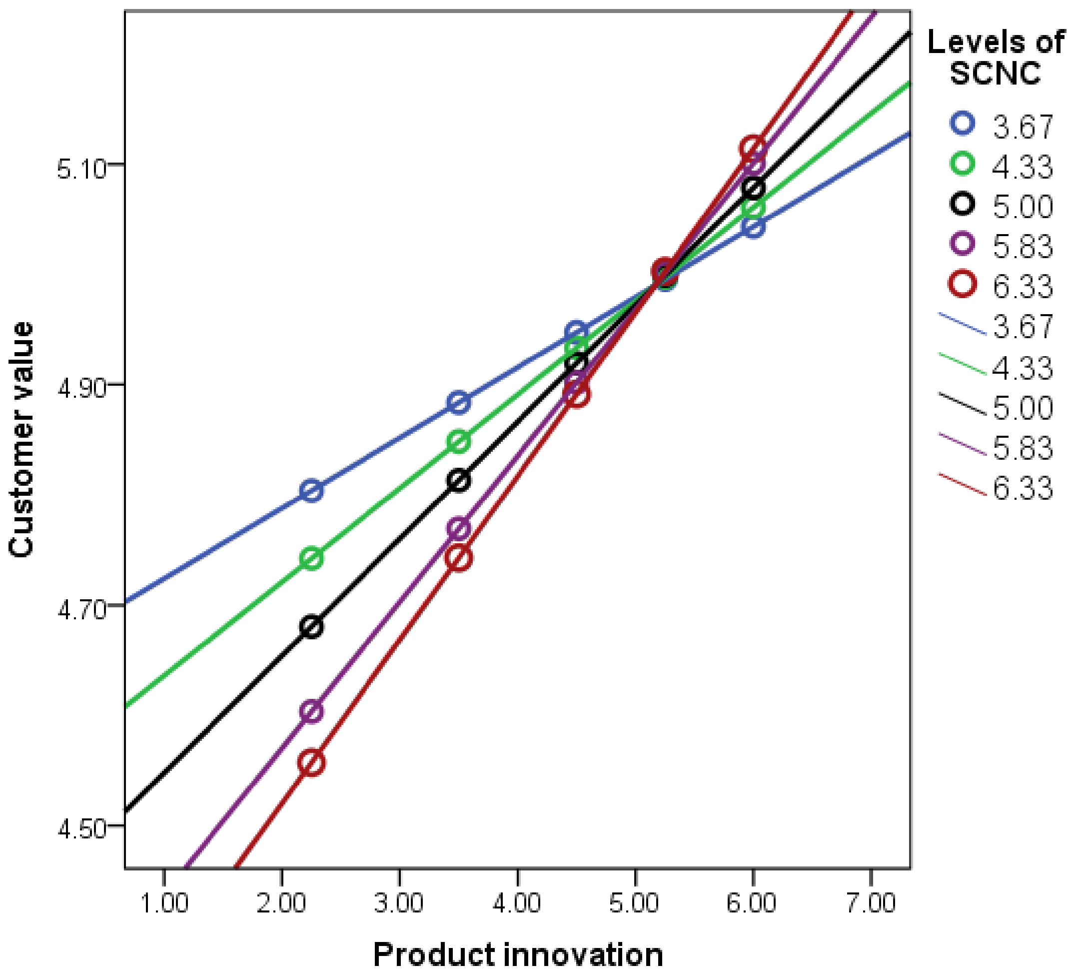
Figure 2: Moderating effect of SCNC on the link between process innovation and customer value.



Note:

1. SCNC = supply chain network complexity.
2. Levels of SCNC are 10th, 25th, 50th, 75th, and 90th percentiles.
3. The relationship between process innovation and customer value is statistically significant at 25th ($\beta = 0.154$, $t = 2.497$), 50th ($\beta = 0.235$, $t = 4.283$), 75th ($\beta = 0.336$, $t = 5.619$), and 90th ($\beta = 0.396$, $t = 5.753$) percentiles of SCNC.

Figure 3: Moderating effect of SCNC on the link between product innovation and customer value.



Note:
1. SCNC = supply chain network complexity.
2. Levels of SCNC are 10th, 25th, 50th, 75th, and 90th percentiles.
3. The relationship between process innovation and customer value is statistically significant at 50th ($\beta = 0.106$, $t = 2.181$), 75th ($\beta = 0.133$, $t = 2.283$), and 90th ($\beta = 0.149$, $t = 2.125$) percentiles of SCNC.

We further utilized the PROCESS technique to analyze the indirect and conditional indirect effects components of the conceptual model as it enables us to directly test the statistical significance of such effects using bootstrapping procedures (Hayes, 2018). Table IV presents the analytical procedures used and the study results. We find that customer integration has significant positive indirect association with customer value through process innovation (indirect effect = 0.0447; 95% bootstrap confidence interval: 0.0166 to 0.0903) and product innovation (indirect effect = 0.0143;

95% bootstrap confidence interval: 0.0008 to 0.0428), in support of H2a and H2b respectively. Further results indicate that customer integration has a significant positive indirect relationship with customer value through the process innovation→product innovation link (indirect effect = 0.0035; 95% bootstrap confidence interval: 0.0002 to 0.0126). In addition, the total indirect effect (i.e., 0.0625) is statistically significant, given 95% bootstrap confidence interval of 0.0002 to 0.0126. Overall, these results support the study's argument that process and product innovation capabilities mediate the link between customer integration and customer value.

The results further reveal that SCNC positively moderates the indirect relationship between customer integration and customer value via process innovation given a moderated mediation index of 0.0258 with a 95% bootstrap confidence interval of 0.0069 to 0.0523. Specifically, the indirect relationship is positive, stronger, and significant under high values of SCNC (i.e., at 1 standard deviation above the mean of SCNC: $\beta = 0.0774$, 95% bootstrap confidence interval of 0.0337 to 0.1382) but weaker and insignificant under low values of SCNC (i.e., at 1 standard deviation below the mean of SCNC: $\beta = 0.0186$, 95% bootstrap confidence interval of -0.0110 to 0.0595), which provides evidence in support of H3a. However, results further show that the positive indirect relationship between customer integration and customer value via product innovation is invariant across high and low values of SCNC.

4.2. Robustness checks

To control for potential measurement errors while simultaneously estimating the complex dependence linkages in our conceptual model, we used a structural equation modeling (SEM) technique to further analyze the relationships (Bagozzi and Yi, 2012). Consistent with the discussion in Section 3.1, we included SCNC, slack resource, environment dynamism, and firm size as covariates in the models of predictor, mediators, and outcome. The model of customer value included two additional variates: firm age and firm industry. All hypothesized and control paths were estimated simultaneously. The results for the hypothesized paths, as reported in Table V, are largely consistent with the OLS and the PROCESS results.

Notwithstanding this, we recognize that the issue of endogeneity may characterize our conceptual model as decisions about customer integration, and process and product innovations are strategic in nature, and may be shaped by forces internal and external to the firm's environment to (Ketokivi and McIntosh, 2017; Bellamy *et al.,* 2014). In particular, although customer integration may, directly and indirectly, contribute to customer value (as argued in H1 and H2), it is also likely that firms providing high customer value may invest more in customer integration and innovation activities (Liu *et al.,* 2016; Bellamy *et al.,* 2014). This possibility can create biased and inconsistent parameter estimates (Ketokivi and McIntosh, 2017). Therefore, following recent methodological recommendations (e.g., Ketokivi and McIntosh, 2017) and empirical studies (e.g., Gligor, 2018; Liu *et al.,* 2016; Bellamy *et al.,* 2014), we used a two-stage least squares (2SLS) estimator to further examine the effects of customer integration, process innovation, and product innovation on customer value.

To conduct the 2SLS regression analysis, there was a need to first identify instrumental variables (IVs) that meet the relevance and exclusion conditions (Gligor, 2018). To do this, we referred to the SEM results and theoretical discussions in Section 3.1 and followed prior research to select environment dynamism, SCNC, and slack resource as potential IVs as they are empirically unrelated to customer value, but theoretically and empirically related to at least one of the assumed endogenous predictors (Gligor, 2018; Liu *et al.,* 2016). Next, we regressed the assumed endogenous predictors on the selected IVs and all other control variables. Table VI shows that the models with the IVs included are significantly superior to those with only the control variables, suggesting that environment dynamism, SCNC, and slack resource can be considered as suitable IVs (Gligor, 2018; Bellamy *et al.,* 2014). Accordingly, we regressed customer value on the assumed endogenous predictors to obtain their corresponding predicted values: customer integration$_{\text{predicted value}}$, process innovation $_{\text{predicted value}}$,, and product innovation $_{\text{predicted value}}$. The second-stage regression examined the effects of customer integration $_{\text{predicted value}}$, process innovation $_{\text{predicted value}}$, and product innovation $_{\text{predicted value}}$ and remaining control variables on customer value. Consistent with the OLS and SEM results, the 2SLS results (Table VI) show that customer integration, process innovation, and product innovation are positively related to customer value. This suggests that our findings do not suffer from endogeneity bias.

5. Discussions

5.1. Theoretical contributions and implications

This research contributes to the supply chain integration literature and its interface with scholarly works on the RBV in several ways. More specifically, the study provides important theoretical contributions on the firm innovation mechanisms and supply chain complexity condition under which customer integration contributes to customer value. First, analysis of the existing supply chain integration literature suggests that there is a tendency of prior research to ignore customer value as an outcome variable, rendering this literature stream incomplete. By focusing on customer value as an outcome of customer integration (an important component of supply chain integration), this research draws insights from the RBV and Zhu *et al.*'s (2018) study to broaden the scope of the theoretical specification of the performance outcomes of supply chain integration (see Mackelprang *et al.,* 2014; Chen *et al.,* 2016; Ataseven and Nair, 2017). We argue that customer value is a unique primary intended outcome of supply chain integration (Min *et al.,* 2019; Flynn *et al.,* 2010) through which strategic as well as economic performance may be enhanced (Chang *et al.,* 2016). Unlike Zhu *et al.* (2018), which approximates customer value to innovation performance and customer service performance indicators. Thus, our analysis focuses on the fundamental meaning of the customer value construct (Leroi-Werelds, 2019; Min *et al.,* 2019).

Second, while prior research has conceptualized supply chain integration as an aggregate multi-dimensional construct that is defined by its three theoretically distinct components (i.e., customer integration, supplier integration, and internal integration), this study focuses on the customer integration component. To this end, the study draws insights from the RBV to conceptualize customer integration as a firm-specific resource that is valuable, path-dependent, difficult-to-acquire, and costly-to-imitate (Barney, 1991). The study argues that variability in customer integration is associated with changes in customer value. From this premise, the study finds a significant direct and positive association between customer integration and customer value. This finding is consistent with prior research that shows that customer-centric resources (e.g., customer-oriented behaviors) enhance customer value (Blocker *et al.,* 2011). This finding further extends assumptions made in previous research that there may be a positive association between the distinct elements of supply chain integration (including customer integration) and customer-related performance outcomes (e.g., Flynn *et al.,* 2010; Cheng *et al.,* 2016). Additionally, the finding that customer integration explains heterogeneity in customer value (cf. Ralston *et al.,* 2015) helps provide empirical validation for the argument that both customer integration and customer value are customer-centric constructs and as such they should be related in a causal chain (Vargo, 2008). The findings further provide empirical validation for the contention that customers' evaluation of value propositions is associated with the extent to which firms involve customers in the value creation process (Blocker *et al.,* 2011).

Third, while our focus on the customer integration dimension of supply chain integration helps to enhance theoretical and empirical clarity (Autry *et al.,* 2014), the contribution from this study is further strengthened by our examination of relevant mechanisms and boundary conditions of the relationship between customer integration and customer value (Ataseven and Nair, 2017; Cheng *et al.,* 2016; Autry *et al.,* 2014). By so doing, the study extends the limited body of studies (e.g., Zhu *et al.,* 2018) that have responded to the long-standing call for research to deepen understanding of the generative processes that explain how supply chain integration is related to performance (Chang *et al.,* 2016). More precisely, this study draws insights from the input-process-output resource perspective of RBV (Lado *et al.,* 1992; Brandon-Jones *et al.,* 2014) to argue that customer integration can be viewed as an important input resource for developing innovation capabilities to create and deliver superior value (Lado *et al.,* 1992; Huo, 2012; Koufteros *et al.,* 2007). Findings from the study provide empirical support for this argument by showing that the relationship between customer integration and customer value is partly conditional upon the intervening roles of process and product innovations. The study finds that greater customer integration is associated with a greater propensity to increase process and product innovation capabilities, with greater degrees of process and product activities related to superior customer value. These findings help extend earlier studies that suggest that supply chain integration variables are important determinants of firm-level innovation capability (Leuschner *et al.,* 2013), which, in turn, contributes to superior customer value creation (Al-Sadi *et al.,* 2017; Rousseau *et al.,* 2016). More broadly, the study's mediating arguments and findings are consistent with prior research findings that contend that realization of greater customer-focused outcomes requires firms to harness supply chain integration resources to expand and defend value-enhancing capabilities (Zhu *et al.,* 2018; Ralston *et al.,* 2015).

Fourth, the study draws on the CRBV to contend that customer value is strengthened when deployment of resources and capabilities is in alignment with organizational circumstances (Sirmon and Hitt, 2009; Brandon-Jones *et al*., 2014). From the CRBV perspective, therefore, this study further advances the existing supply chain integration literature by empirically examining the extent to which customer integration contributes to customer value through process/product innovation capabilities under varying conditions of SCNC. Thus, while empirical evidence regarding the extent to which SCNC impacts on business operations remains equivocal (Pant *et al.,* 2021; Turner *et al.,* 2018), the results from this study, as presented in Figure 2 and Figure 3, show that leveraging customer integration through process innovation drives customer value more when such resource orchestration activity occurs in an environment characterized by greater SCNC. The findings corroborate the contention that the relationship between innovation and performance is context-dependent (Rousseau *et al.,* 2016; Story *et al.,* 2015), and align with the literature that suggests that greater SCNC, while it may be a major source of threat to business survival, facilitates the development and deployment of value-enhancing resources and capabilities (Turner *et al.,* 2018) such as innovation (Wang *et al.,* 2015; Choi and Krause, 2006). Furthermore, our findings enrich existing understanding of how firm resources interconnect with SCNC to determine organizational outcomes (e.g., Chowdhury *et al.,* 2019; Birkie *et al.,* 2017; Brandon-Jones *et al.,* 2014).

Fifth, empirically it can be contended that the study provides a developing economy perspective on supply chain integration. Literature shows that developing economies are noted for severe conditions of institutional weaknesses (Amankwah-Amoah *et al.,* 2018), which makes it increasingly difficult for resource-constrained SMEs to acquire and duplicate resources and capabilities. Additionally, it has been argued that developing economy firms operate in underserved local markets; hence, firms with greater customer integration processes and stronger innovation capabilities have greater chances of creating superior customer value (Cheng *et al.,* 2016). Accordingly, this study broadens prior application of the RBV in supply chain integration research by using the input-transformation-output resources logic (Lado *et al.,* 1992) to answer the question of how customer integration and innovation capabilities should be sequenced to deliver enhanced customer value in developing economy settings. From this perspective, this research emphasizes and demonstrates that the efficacy of customer integration to contribute to customer value is a function of the extent to which it triggers process and product innovation capabilities (Ralston *et al.,* 2015; Lado *et al.,* 1992). This study, therefore, cross-fertilizes the RBV and contingency theory to demonstrate how changing conditions of SCNC explain the extent to which customer integration, operating through innovation capabilities, contributes to customer value.

5.2. Managerial implications

Managers of SMEs in developing economies may find the study's results useful in several ways. First, evidence from this study suggests that SMEs located in developing economies that share similar characteristics to Ghana can improve customer value by increasing investing in customer integration activities. The rationale for doing this is that collaborating with customers can afford SMEs the opportunity to improve understanding of customer requirements for market offerings. This improved understanding can subsequently help SMEs to more clearly define their value propositions in a manner that is close to customer expectations.

Second, while there is a reason for SMEs to expect improved customer value returns for their investments in customer integration activities, there is also an opportunity to leverage customer integration efforts to build internal process and product innovation capabilities to boost customer value. Evidence from this study suggests that SMEs can leverage insights from customer integration activities to strengthen their internal processes to develop and deploy new product offerings to create value for customers.

Third, although SMEs involved in complex supply chain networks may experience some challenges (e.g., managing rising transaction costs and risks), it is also the case that the complexity may offer SMEs the opportunity to strengthen their ability to create value from internally held resources and capabilities. Hence, this study suggests that SMEs can boost their customer value returns when customer integration and firm innovations are deployed in an environment characterized by a high degree of supply chain network complexity.

In conclusion, the study draws insights from the resource-based view and the contingent resource-based view as well as primary data from a sample of 335 SMEs in Ghana to suggest that, beyond the direct association between customer integration and customer value, product and process innovation capabilities provide viable transformative mechanisms through which customer integration contributes to customer value, especially so under conditions of greater supply chain network complexity.

5.3. Limitations and further research directions

It could be argued that customer value should ideally be measured from the customers' standpoint (Leroi-Werelds, 2019). This, however, is a major challenge in studies that analyze the construct at the buyer-firm level. Unlike previous SCM research (e.g., Wieland and Wallenburg, 2012; Kim *et al.,* 2013), we attempted to overcome this challenge by asking buyer-firms to evaluate customer value based on customer feedback. Since not all customers may provide feedback (even when requested by the firm) and while there may be lapses in the firm's customer feedback systems, future research might want to further validate the approach we used to measure the customer value construct. For example, researchers can directly obtain responses from random samples of different segments of a firm's customer base to create composite scores for customer value. Again, a recent development in marketing literature (Zeithaml *et al.,* 2020) suggests that customer value has a broad meaning that transcends the traditional value-for-money view of the construct considered in this study. Therefore, future research should examine how the predictor variables in our conceptual framework are related to other theoretically relevant components of customer value (see Zeithaml *et al.,* 2020; Leroi-Werelds *et al.,* 2013).

Previous research suggests that supply chain integration is a higher-order multi-dimensional construct with conceptual dimensions (i.e., customer integration, supplier integration, and internal integration) that may have unique associations with customer value (Zhu *et al.,* 2018; Chang *et al.,* 2016). However, empirical assessments of this assertion remain limited. While our study focuses on explaining variation in customer value from customer integration for theoretical clarity and parsimony reasons, there is a need for additional research to empirically analyze how supplier integration and internal integration components of supply chain integration are associated with customer value.

Furthermore, in drawing on the input-transformation-output resource perspective of RBV (Lado *et al.,* 1992), this study theorizes process and product innovations as transformational capabilities that translate customer integration into enhanced customer value. However, innovation is a multifaceted construct that may manifest beyond the process and product innovation taxonomy examined in this study (Damanpour, 1991). Future studies could, therefore, model other manifestations of firm innovation (e.g., technological innovation and marketing strategy innovation) and examine their interventions in the customer (as well as supplier and internal) integration–customer value link. In addition to innovation, other transformational processes could be modeled in future research: organizational learning could be one such process that could be explored in future research (Zhu *et al.,* 2018). Additionally, supply chain complexity may be conceptualized as a multi-dimensional construct (Bozarth *et al.,* 2009). While we examined the supply chain complexity construct from a structural perspective (Bode and Wagner, 2014), we suggest that future research should examine other dimensions of the construct. We also encourage future studies to incorporate additional moderators in both the direct and indirect relationships between customer integration and customer value.

Beyond testing our hypotheses on data from a developing market, our sample included only SMEs. While we have controlled for several firm-specific (e.g., size, age) and external task environment (e.g., dynamism and industry type) variables, we recognize that the study is limited due to its inability to account for other potential contextual influences. For example, it could be argued that institutional (e.g., differences in perception of institutional weaknesses), infrastructural (e.g., availability of modern supply chain infrastructure), and economic (e.g., consumer purchasing power) environment contexts under which these firms operate may influence customer value creation and delivery. Similarly, internal firm-specific circumstances (e.g., strategic orientations of top managers) may also explain heterogeneity in customer value creation and delivery. Thus, although our results are consistent with theory, we recommend future studies to further validate our results by accounting for some of these other contextual influences.

Again, while the cross-sectional data used in the study is largely consistent with prior supply chain integration research (e.g., Zhu *et al.,* 2018; Flynn *et al.,* 2010) and enables us to make sense of the relationships studied, it is less suitable for testing mediation models due to difficulties in making causal claims (Aguinis *et al.,* 2017). Future studies can address this limitation by using panel data (Aguinis e*t al.,* 2017). Additionally, we relied on survey data provided by single informants (cf. Zhu *et al.,* 2018; Liu *et al.,* 2016), which may be associated with common method bias (Podsakoff *et al.,* 2012). While we followed relevant procedural and statistical remedies to address common method bias concerns, future research should attempt to utilize multiple sources of data to capture the variables studied (Podsakoff *et al.,* 2012).

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