Food quality and supply chain networks in dynamic business environments: Evidence from the Nigerian shrimp subsector

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Abstract

Purpose: Research efforts aiming to improve understanding of how various organisational relationships contribute to better food quality (FQ) in a constantly changing business environment are limited. This study examines the effects of supply chain organisations on the quality of food products throughout multi-tiered segments with dynamic business situations.
Design/methodology/approach: Guided by a conceptual research framework based on contingency theory and netchain analysis, moderation-based partial least squares structural equation modelling was used to analyse multi-tiered data from 405 shrimpers and 238 women processors in Akwa-Ibom, Lagos, and Ondo states in Nigeria.
Findings: Our findings show that unpredictable business environments such as market turbulence, power asymmetry, and distrust not only directly influence supply chain organisations but also moderate how organisational networks contribute to improved FQ. Further results reveal that closer vertical ties such as relational contracts are prerequisites for small-scale actors to guarantee improved FQ along multiple nodes of the food system.
Originality/value: This is the first study to examine, from a contingency and multi-tiered perspective, how small-scale actors can maintain FQ across interdependent nodes of a food chain in a developing country context and to explore the complex interplay between supply chain networks and the quality of highly perishable food products in unpredictable business environments. Relevant theoretical and policy implications are discussed.

Keywords: food supply chain, perishable food products, contingency theory, netchain approach, food quality, Nigeria, fishery sector

1. Introduction

Food quality (FQ) and safety are crucial to consumers, regulatory agencies, and other industry players in the global food system due to increased consumer awareness of healthy diets and the environmental footprints of food production and distribution (van Rijswijk and Frewer, 2008; Manzini *et al*., 2014; Petrescu *et al*., 2022). Present-day consumers attach importance to extrinsic (e.g., brand, price, and packaging) and intrinsic (e.g., colour, freshness, and taste) attributes when evaluating food product quality (Chamhuri and Batt, 2015; Barbancho-Maya and López-Toro, 2022; Petrescu *et al*., 2022). Therefore, to meet consumer FQ requirements, multi-tiered supply chain (SC) actors throughout the food system need to coordinate their activities to ensure the distribution and delivery of fresh, safe, and healthy food products.

However, small-scale SC actors (e.g., producers and processors) in developing countries, whose food products end up in high-value urban markets, usually encounter significant obstacles in maintaining FQ (Arinloye and Boeke, 2016; Arshad *et al*., 2023). These actors operate in rapidly changing business settings characterised by unpredictable changes in market, organisational, and economic conditions, which consequently drive the quality of food products below national and international regulatory standards (Zhao *et al*., 2021). While the effects of such disruptions can be devastating, systems for highly perishable food such as fruits and fishery products are the most affected (Siddh *et al*., 2015, 2017; Adekambi *et al*., 2016; Arinloye and van Boeke, 2016; Siddh *et al.,* 2018; Siddh *et al.,* 2022).

The need to understand how changing business contingencies affect the quality of perishable food products (Siddh *et al.,* 2015, 2017), and the possible pathways through which such business contingencies affect FQ, have been underscored and conceptualised in the literature, respectively by Manzini *et al*. (2014); Adekambi *et al*. (2016); and Arora *et al*. (2016). Notably, SC disruptions such as market dynamism, power asymmetry, and distrust adversely affect organisational relationships and logistics (Huang *et al.,* 2014; Mutonyi *et al*., 2016; Odongo *et al*., 2016; de Brauw and Bulte, 2021; Barrett *et al*., 2020; Afraz et al., 2021; Adetoyinbo *et al.,* 2023; Besik *et al.,* 2023; Chatterjee *et al*., 2023), which, in turn, affect the quality of food products in diverse ways (Leuschner *et al*., 2013; Arora *et al*., 2016; Fu *et al*., 2017; Ramirez *et al*., 2021; Zhao *et al*., 2021). Akin to other performance measures (Otter *et al*., 2014; Adetoyinbo *et al.,* 2023; Adetoyinbo and Mithöfer, 2023), Bijman and Bitzer (2016) argued that SC actors can address business contingencies whilst improving FQ if they restructure their organisational networks.

The growing body of literature on potential strategies to improve FQ in various segments of the food value chain has emphasised three prime areas (van Rijswijk and Frewer, 2008; Wang *et al*., 2017; Zhao *et al*., 2021). The first strand of literature focuses on factors influencing how consumers and firms view FQ and how FQ and safety jointly contribute to food chain integrity (e.g., food crime, fraud, transparency, and authenticity) (Chamhuri and Batt, 2015; Petrescu *et al*., 2019; Roy and Srivastava, 2022). Using data from Belgium and Romania, Petrescu *et al*. (2022) analysed how consumers evaluate the relevance of environmental-social indicators to FQ. Barbancho-Maya and López-Toro (2022) found firm size and the cost of food safety and quality standards to be contingencies and barriers, respectively, which drive the adoption of food quality and safety standards. The second strand of research uses mathematical programming, simulations, and game theory to model quality deterioration and perishability in food SCs, and research attention has shifted toward multi-tiered networks rather than single-tiered segments (Jonkman *et al.,* 2019; Lejarza and Baldea, 2022). The third strand focuses on how SC organisational networks affect FQ. For instance, Fynes *et al*. (2005) demonstrated that participating in transaction-specific investments leads to

better product quality and reduced product cost. Also, Fu *et al.* (2017) showed that farmers' organisational trust influences their organisational integration and commitment, which, in turn, positively impact quality performance. Likewise, quality performance among agri-food actors was found to be affected by SC quality management (Hong *et al*., 2020; Soares *et al*., 2017).

While these studies highlighted the nexus between SC organisation and FQ across multiple nodes of food chains, we have identified three research gaps. First, prior studies have limited our understanding of how specific organisational relationships contribute to better FQ by focusing only on the relationship between SC integration (e.g., vertical and horizontal) and FQ (Wang *et al*., 2015; Maertens and Vande Velde, 2017), even though SC actors adopt complex organisational networks that entail several relationships across multi-tiered SC structures (Adetoyinbo *et al.,* 2023; Besik *et al.,* 2023; Otter *et al.,* 2014). Second, limited conceptual explanation and empirical evidence exist on how individual actors adapt and deploy their intricate organisational structures to deliver high-quality food products along constantly disrupted food value chains (Adekambi *et al*., 2016). Although Besik *et al.* (2023) recently analysed the interplay between SC disruptions and FQ in multi-tiered agri-food networks, revealing that market disruptions arising from the collapse of SC relationships, disaster, or labour shortages lower FQ and market prices, the study was unable to account for the role of various organisational relationships in ensuring improved FQ. Third, there is less empirical evidence for how FQ can be maintained along highly perishable food SCs (e.g., the fishery sector) in developing countries (Siddh *et al*., 2017; Adetoyinbo and Otter, 2020), compared to developed countries (Siddh *et al*., 2021). Comprehensive conceptual frameworks and nuanced analysis of several interactions among small-scale actors in multi-tiered SC networks are necessary to comprehend how FQ can be efficiently maintained throughout highly perishable food systems in developing countries.

In this study, we propose a conceptual model to evaluate the multi-tiered effects of SC organisational networks on FQ in a highly perishable food sector amidst dynamic business environments. We investigated the following research questions: (1) How do business contingencies influence organisational structures? (2) Which organisational relationship contributes to better FQ? (3) How do unstable business contingencies affect the interplay between organisational relationships and FQ performance? Our study expands the existing literature in three ways. First, we extend previous FQ models (Jonkman *et al.,* 2019; Lejarza and Baldea, 2022; Besik *et al.,* 2023) and the 'efficiency-based' research models of Otter *et al*. (2014) and Adetoyinbo *et al.* (2023), which incorporate contingency theory (Lawrence and Lorsch, 1967) and netchain analysis (Lazzarini *et al*., 2001), by considering FQ as the main performance indicator and by evaluating the moderating effects of business contingencies on the interplay between complex SC organisational networks and FQ. This study argues that business contingencies do not only influence SC organisations but further moderate how SC networks contribute to better FQ. Second, we employ moderation-based partial-least squares structural equation modelling to provide the first empirical evidence for how various organisational instruments can be leveraged to improve FQ amidst unpredictable business situations such as market turbulence, power asymmetry, and distrust. Third, whilst prior studies (Fu *et al*., 2017; Ramirez *et al*., 2021; Zhao *et al*., 2021) narrowly focused on single agri-food nodes in developing and emerging countries, we analyse two mutually-reliant tiers to show how FQ can be enhanced across multiple nodes of the food chain in a developing country. Our analysis is based on data from 405 shrimpers and 238 women processors in the shrimp subsector of Nigeria. Shrimp is the most germane fish resource in the Nigerian fishery sector. However, most artisans are resource-constrained and challenged by the high perishability of produce, unstable weather and market conditions, and lack of modern technologies (Adetoyinbo and

Otter, 2020). These challenges not only adversely affect artisans' productivity and the quality of shrimp products across different segments (Adetoyinbo and Otter, 2022), but also limit their ability to commercialise and integrate into high-value markets characterised by high-quality standards. Although effective organisational structures could resolve these challenges, unpredictable business environments appear to weaken the effects that enhanced coordination mechanisms could have on shrimp quality across tiers (Adetoyinbo and Otter, 2020).[1]

The rest of the study is organised as follows. The methodology is presented in section 2. Section 3 presents the results and section 4 discusses the results of the study. Section 5 provides the conclusion and implications of the study.

2. Methodology

2.1. Conceptual framework and hypotheses

This study follows a conceptual framework (see Figure 1) based on the contingency theory (Lawrence and Lorsch, 1967; Donaldson, 2001) and the netchain approach (Lazzarini *et al*., 2001). Contingency theory highlights organisational designs and the need for firms to adapt to their ever-changing business environments to maintain or maximise performance. The theory proposes business situation, response, and performance as indicators to explain how firms adapt their organisational structures in maintaining or raising performance in unstable business environments (Otter *et al*., 2014).

Business situations, herein referred to as contingencies such as market turbulence (MT), power asymmetry (PA), and distrust (DT) throughout the food value chain (Brown *et al*., 1995; Saenger *et al*., 2014; Mutonyi *et al*., 2016; Barrett *et al*., 2020; de Brauw and Bulte, 2021), are external SC characteristics and environments that are not controlled by individual shrimpers but which continually influence how they interact with other actors and stakeholders throughout the food system (Donaldson, 2001). Market turbulence is unpredictability in market conditions (Gnizy *et al*., 2017; Adetoyinbo *et al.,* 2023). Power in SCs denotes an actor's capacity to enforce its will on other actors (Mintzberg, 1983; Reimann and Ketchen, 2017), while power asymmetry indicates an unequal distribution of power among SC actors as a result of differences in expertise, firm size, resource base, and dependence (Nyaga *et al*., 2013). Trust among SC actors is the belief that partners will deliver their obligations and engage in operations that contribute to positive outcomes (Nielsen, 2004; Eckerd *et al*., 2021).

Netchain responses are organisational reactions to the contingencies experienced by actors in their decisions and strategies. Akin to Adetoyinbo *et al.* (2023), we incorporated lateral relationships (LAR) that depict network interaction between SC actors and external stakeholders following stakeholder theory (Freeman, 2010), in addition to vertical relationships (VER) and horizontal relationships (HOR). We therefore created an analytical interdependence between SC and the various network interactions. Previous literature has posited that firms respond to business contingencies by deploying their inter-organisational instruments (Nyaga *et al*., 2013; Otter *et al*., 2014; Arora *et al*., 2016; Song and Yang, 2019), and that SC actors would shift toward higher coordination mechanisms (e.g., relational contracts with customers, stronger HOR, and closer LAR), in order to pool resources and the support needed to adapt to high market uncertainty, power asymmetry, and distrust (Otter *et al*., 2014; Kayser *et al*., 2015; Adetoyinbo *et al.,* 2023). Hence, we hypothesise the following:

H1: High business contingencies influence the formation of closer SC organisations

According to Lazzarini *et al*. (2001), firms tend to consider the features of other alliances when deciding on appropriate adaptation strategies. This makes relational dependence more pronounced when markets shift to stricter governance structures, thereby necessitating cooperative membership and closer interaction with external stakeholders to allow for flexible transactions, shared learning, and economies of scale (Weaver, 2010; Nyaga *et al*., 2013). Therefore, we posit the following:

H2: All inter-organisational relationships are strongly interdependent

In this study, *business performance* denotes FQ, which is made up of an individual's perception of product safety and health, and sensory properties such as taste, appearance, and shelf-life, product convenience and reliability (intrinsic attributes), as well as compliance with extrinsic quality standards such as brand, price, and packaging (van der Vorst, 2006; Aramyan *et al*., 2006, 2007). Since higher performance is achieved when firms forge effective SC network structures that extend beyond market governance (Ding *et al*., 2014; Fu *et al*., 2017; Afraz *et al.,* 2021; Huang *et al.,* 2014; Adetoyinbo *et al.,* 2023), we theorise the following:

H3: Closer SC organisations positively influence FQ

The effects of business contingencies on the nexus between individual SC relationships and business performance can be direct (Adetoyinbo *et al.,* 2023; Fu *et al.,* 2017; Otter *et al*., 2014) and indirect (Leuschner *et al*., 2013; Gnizy *et al*., 2017; Leonidou *et al*., 2017; Song and Yang, 2019; Chatterjee *et al*., 2023; Adetoyinbo and Mithöfer, 2023). However, no studies have simultaneously considered these interplays, especially for FQ. Hence, we expect the following:

H4: High business contingencies moderate the interplay between SC organisations and FQ

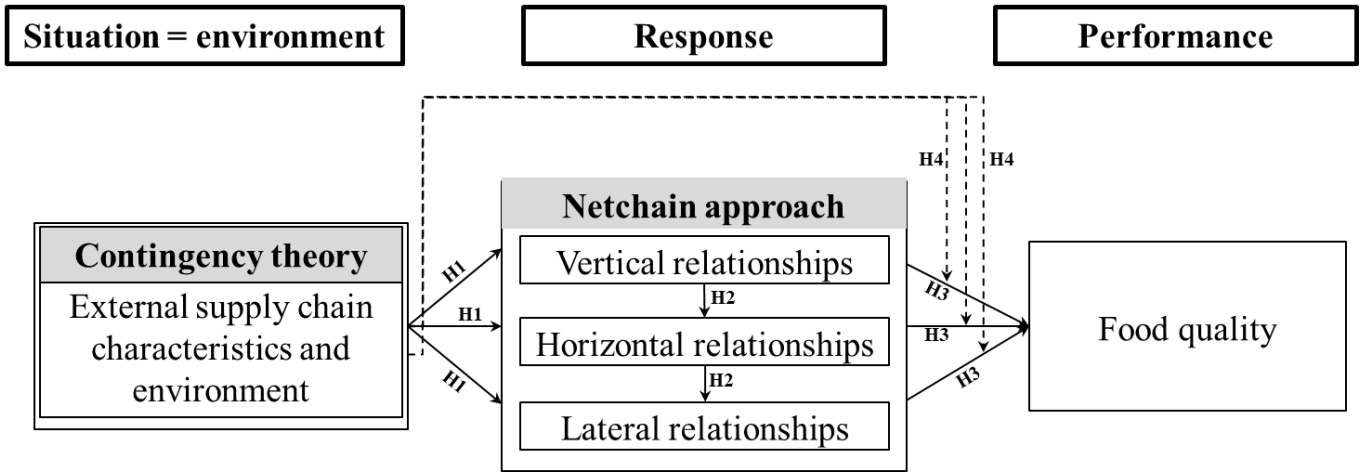

Figure 1. Conceptual framework based on contingency theory and netchain analysis
Source: Authors' illustration based on Otter *et al.* (2014) and Adetoyinbo *et al.* (2023)

2.2. Data Collection

2.2.1. The study area

This study uses multi-tier data from artisan shrimpers and processors in the shrimp subsector of Nigeria. The study was conducted in three coastal states: Akwa-Ibom, Lagos, and Ondo. These

states are found along the Atlantic continental shelf of southern Nigeria, together with six others: Ogun, Edo, Delta, Bayelsa, Rivers, and Cross River (Adetoyinbo and Otter, 2020). While Lagos and Akwa-Ibom have vast shrimping communities, and retailing and wholesaling markets, Ondo state's coastline – spanning 180 km – is the most extensive. From these states, we considered four main shrimping local government areas (LGAs) for the study: Ibeno in Akwa-Ibom; Badagry and Eti-osa in Lagos; and Ilaje in Ondo.

2.2.2 Sampling approach

We used a multi-stage sampling method in selecting samples of artisan shrimpers and processors. In the first and second stages, we purposely selected three states and four LGAs, respectively, based on their levels of shrimp production. In the third stage, twenty shrimping communities were randomly selected from the LGAs; four from Ibeno in Akwa-Ibom, seven from Ilaje in Ondo, and nine from Lagos state (four in Badagry and five in Eti-osa). Finally, a minimum of 20 shrimpers and 10 processors were randomly selected from each community, resulting in a total sample of 405 shrimpers and 238 processors (mostly women) for the study.

2.2.3. Analytical framework

A flow chart of the study's methodological design is presented in Figure 2. We applied Partial Least Squares (PLS), a variance-based Structural Equation Modelling (SEM) approach that uses blocks of variables to estimate model parameters by maximising the explained variance of the dependent variables (Hair *et al*., 2012). This approach is robust in investigating the interactions between underlying conceptual models and theory (Hair *et al*., 2018). Four main steps were followed in modelling this (see Figure 2). First, two structural models were specified for producers and processors based on the proposed conceptual framework. Second, separate standardized path coefficients were estimated for the producers and processors using 1000 bias-corrected bootstraps. Third, the models were evaluated using recommended quality criteria such as item loadings, convergent and discriminant validities, and internal consistency including inner and outer VIF values and heterotrait-monotrait ratio (Hair et al., 2012, 2018). Fourth, the two-stage modelling approach was used to estimate the moderation effects (Sanchez, 2013).

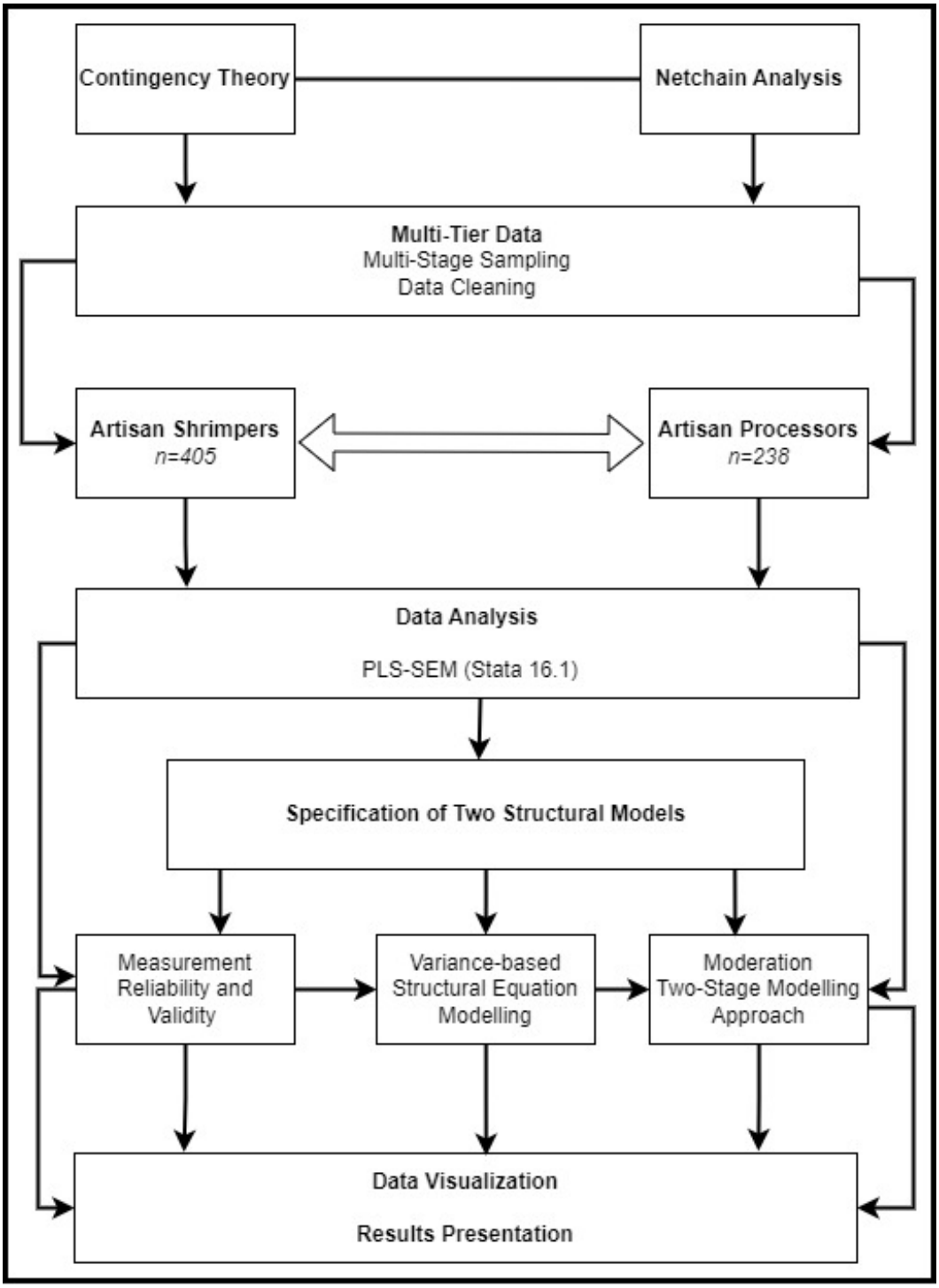

Figure 2. A flow chart of the study's methodology

Source: Authors' construct

The extracted variables and the metrics (see Table AI and BI) and the item statements (see Tables AXV and BVIII) have been provided in the appendix. We measured MT with four items (Arora *et al*., 2016; De Clercq *et al*., 2016). PA for producers and processors was operationalised using six and five items, respectively. Among processors, DT was measured using three items. VER in the producer and processor models was captured with seven and four items, respectively. We measured HOR among producers and processors using three and five items, respectively, while LAR in the producer and processor models was measured with three

items. Items for PA, DT, VER, HOR, and LAR were all adapted from Otter *et al*. (2014) and Adetoyinbo *et al.* (2023). Lastly, FQ in the producer and processor models was measured using three and four items, respectively (Aramyan *et al.* 2007; Ding *et al*., 2014).[2]

SEM is often associated with common-method bias due to data from a single respondent (Kock, 2015). Using Harman's single variable test (Lindell and Whitney, 2001; Podsakoff *et al*., 2003), we found that 23.7% and 19.5% of the variances in the producer and processor models were each explained by one factor, respectively, suggesting that common-method bias is absent from our models.

3. Results

3.1. Descriptive results

Table I summarises the descriptive statistics of the sampled respondents. The statistics show that both producers and processors are, on average, 39–40 years old, implying that they are middle aged. The actors have fairly similar shrimping and processing years of experience, with the producers and processors having 16 and 15 years of experience, respectively. Additional information reveals that the majority of shrimp producers (97%) are males, while all processors are females. Organisationally, 24% of the sampled producers are members of producer groups while 21% of the processors belonged to the women's union. On average, both groups of actors have a membership period of 10–11 years. The data further reveal that only 5% of the producers and 2% of the processors had access to extension services.

Table I. Descriptive statistics of shrimp producers and processors

Variable	Producers		Processors	
	Mean	Standard Deviation	Mean	Standard Deviation
Age in years	39.00	11.25	39.96	10.81
Years of shrimping and processing	16.41	10.84	15.12	9.74
Gender: 1=female; 0=otherwise	0.03	0.18	1.00	0.00
Membership in producer/processing group: 1=yes; 0=otherwise	0.24	0.43	0.21	0.41
Years in producer/processing group	10.20	7.23	11.00	8.61
Extension service: 1=access; 0=otherwise	0.05	0.21	0.02	0.14
Number of observations	405		238	

Source: Authors' computation

3.2. Empirical results

3.2.1. Producers' structural model

The estimated structural models were subjected to measurement reliability and validity tests (Hair *et al*., 2012, 2018). All the quality metrics are in the acceptable range (see Tables AI and BI in the supplementary file), suggesting that the estimated structural models are valid and reliable.[3]

The empirical results indicate that 23.4% of the total variance in FQ is explained by the producer model (see Table II). The result shows support for H1 as both MT and PA influence different SC network relationships. Specifically, MT positively influences VER but loosens HOR. Also, PA positively influences VER and LAR but loosens HOR. Further results reveal partial support for H2. HOR positively influences LAR, indicating that both HOR and LAR are interdependent amongst artisan producers. We find empirical support for H3, suggesting that closer SC organisations positively influence FQ. Furthermore, the results reveal that FQ has significant positive relationships with VER and LAR.

Table II. Structural model showing standardised path coefficients for producers

Variable	Vertical relationships (VER)	Horizontal relationships (HOR)	Lateral relationships (LAR)	Food quality (FQ)	FQ Moderation
Market turbulence (MT)	0.362***	-0.127**	-0.022		0.220***
Power asymmetry (PA)	0.350***	-0.115**	0.239***		0.245***
Vertical relationships (VER)		0.077		0.453***	0.234***
Horizontal relationships (HOR)			0.196***	-0.059	-0.020
Lateral relationships (LAR)				0.132***	0.064
VERxMT					-0.006
VERxPA					0.005
HORxMT					-0.032
HORxPA					-0.078*
LARxMT					0.125**
LARxPA					-0.049
R^2	0.323	0.019	0.076	0.234	0.339
Number of obs.	405				

Note: ***p <0.01; ** p<0.05; * p<0.1
Source: Authors' computation

The moderation analysis (see Table II and Figure 3) also indicates that the positive effects of VER and LAR on FQ depend on prevailing business contingencies, thus providing empirical evidence for H5. Also, we find that PA negatively moderates the interplay between HOR and FQ. Conversely, MT positively moderates the effect of LAR on FQ. Overall, the variance in FQ explained by the producer model increased to 33.9% in the moderation model, suggesting an improvement in the original model.

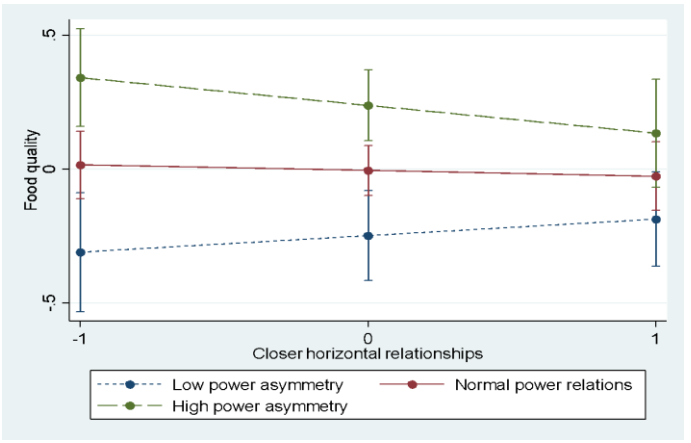

Fig. 3A: Closer HOR

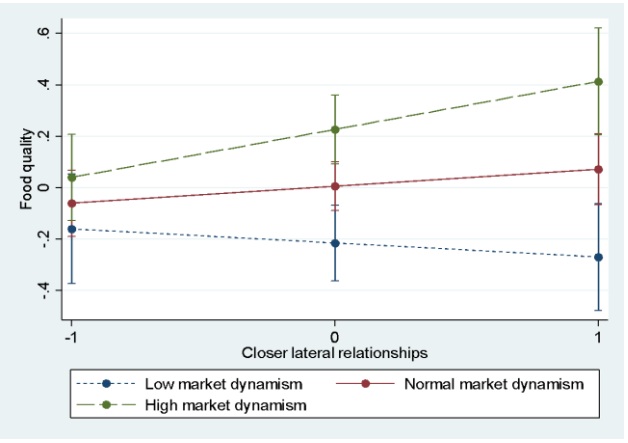

Fig. 3B: Closer LAR

Figure 3. Moderation effects of business contingencies on FQ (producer model)
Source: Authors' computation

3.2.2 Processors' structural model

The empirical findings also indicate that 14.2% of the total variance in FQ is explained by the processor model (see Table III). Similarly, we find empirical support for H1, with MT, DT, and PA influencing processors' inter-organisational structures. Notably, MT positively influences VER. PA positively influences all the inter-organisational relationships: VER, HOR, and LAR. Conversely, whilst DT positively influences VER, it negatively affects HOR. Also, our analysis shows empirical support for H2, suggesting that SC network relationships are interdependent. The results show that VER positively influences HOR, which in turn positively influences LAR. This provides partial empirical support for H3, as only VER positively influences FQ.

Table III. Structural model showing standardised path coefficients for processors

Variable	Vertical relationships (VER)	Horizontal relationships (HOR)	Lateral relationships (LAR)	Food quality (FQ)	FQ Moderation
Market turbulence (MT)	0.263***	0.051	-0.147*		-0.121*
Power asymmetry (PA)	0.235***	0.124*	0.357***		-0.037
Distrust (DT)	0.155***	-0.148**	0.070		0.500***
Vertical relationships (VER)		0.149**		0.368***	0.258***
Horizontal relationships (HOR)			0.231***	0.087	0.064
Lateral relationships (LAR)				-0.006	-0.292***
VERxMT					-0.030
VERxPA					-0.148**
VERxDT					0.126**

HORxMT					-0.091
HORxPA					-0.093
HORxDT					-0.042
LARxMT					0.073
LARxPA					0.315***
LARxDT					-0.103
R^2	0.246	0.046	0.164	0.142	0.310
Number of observations	238				

Note: ***p <0.01; ** p<0.05; * p<0.1
Source: Authors' computation

Further results from the moderation analysis provide empirical support for H4 (see Table III and Figure 4). DT positively moderates the positive effect of VER on FQ. However, while PA negatively moderates the effect of VER on FQ, it positively moderates the effect of LAR on FQ. In general, the variance in FQ explained by the processor model increased to 31.0%, indicating an improvement in the original model.

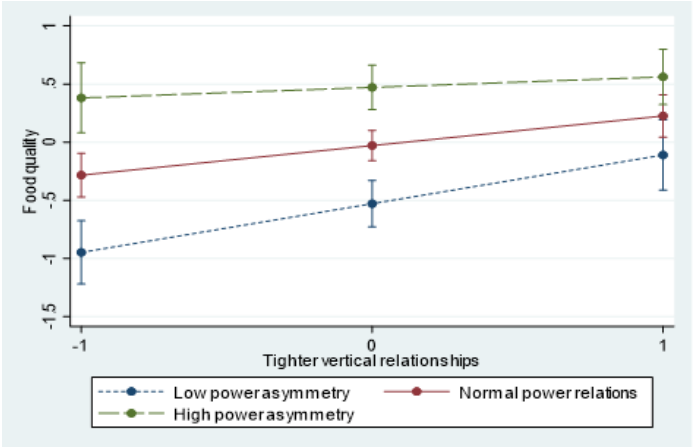

Fig. 4A: Tighter VER

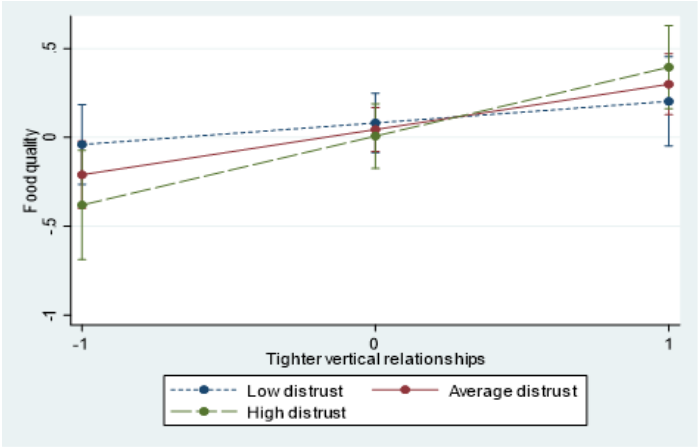

Fig. 4B: Tighter VER

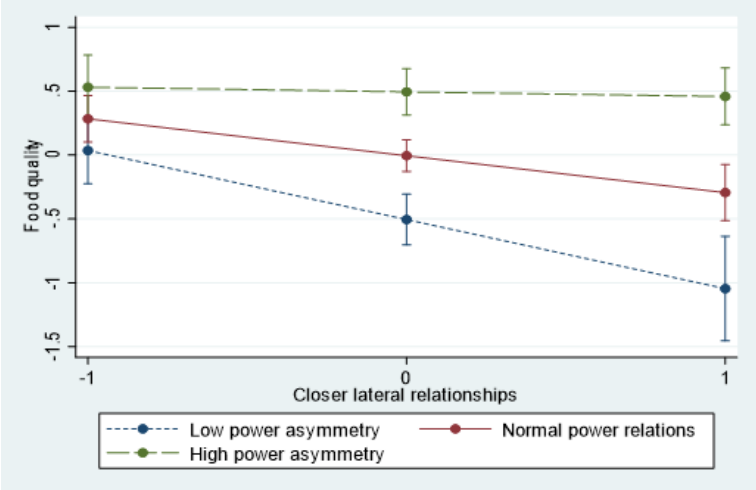

Fig. 4C: Closer LAR

Figure 4. Moderation effects of business contingencies on FQ (processor model). Source: Authors' computation

3.2.3. Robustness results

Finally, we performed robustness checks on potential reverse causality in our models by estimating an alternative model, in which FQ and business contingencies were made exogenous and endogenous, respectively (Gölgeci *et al*., 2019). We find that the average variance in the alternative producer (13.8%) and processor (11.6%) models was below that of the original producer (16.9%) and processor (16.2%) models, suggesting that the original models were better and did not suffer from reverse causality. Endogeneity was tested by estimating the Gaussian copula of the models (Hult *et al*., 2018), and we found that the copulas of VER were significant in both models, indicating potential endogeneity. This problem was addressed by controlling for state location (i.e., Akwa-Ibom and Ondo). We also estimated two-stage least squares regression models in which start-up capital, cash reserves, and average coefficient of VER at the village level without the individual were used as instrumental variables for VER in the producer and processor models. The findings show that VER in both models consistently contributes to better FQ (see Table AII).

4. Discussion

This study analyses the effects of SC organisational networks on FQ under various business contingencies. Generally, our findings show that prevailing business contingencies do not only influence SC networks but simultaneously moderate the effect of each SC relationship on FQ. These represent new theoretical and empirical contributions to the existing literature (Wang *et al*., 2015; Fu *et al.,* 2017; Maertens and Vande Velde, 2017; Soares *et al*., 2017; Jonkman *et al.,* 2019; Hong *et al*., 2020; Lejarza and Baldea, 2022; Besik *et al.,* 2023), which until now had a less comprehensive view of how individual network relationships affect food quality in changing business environments.

Our analysis of how business contingencies influence complex organisational structures has shown that contingencies substantially shape SC networks. Notably, both producers and processors develop tighter VER in response to perceived high business contingencies such as MT, PA, and DT. This finding is consistent with observations in the African agri-food sector (Michler and Wu, 2020; de Brauw and Bulte, 2021), particularly the fishery sector (Adetoyinbo and Otter, 2020; Adetoyinbo *et al.,* 2023), where actors confronted with unpredictable business

situations forge relational governance to ensure flexible coordination of business activities and adequate exchange of information. With the exception of the PA-HOR link in the processor model, our findings suggest that business contingencies tend to drive both producers and processors away from forging closer HOR. We ascribed this to inefficient coordination mechanisms of existing fisher groups and the prevailing property rights of fishery resources in the study locale (Adetoyinbo and Otter, 2020). Given the open-access and communal property management regimes, artisanal fishery resources are highly susceptible to collective-action problems (e.g., free-riding, high information asymmetry, distrust, and opportunism) (Kleiber *et al*., 2015), which deter actors from forming stronger horizontal interactions, since cooperating partners could become more opportunistic and competitive when MT, PA, and DT increase. This finding is akin to Otter *et al*. (2014), who found that perceived PA and DT loosen HOR among avocado farmers in Chile. Also, unstable business situations drive actors to forge closer interplay with other relevant stakeholders such as extension agents and NGOs. This is because closer ties with relevant external stakeholders serve as an alternative and less stringent source of information for actors in unstable business environments (Weaver, 2010; Nyaga *et al*., 2013).

Findings from this study also confirm the netchain hypothesis that inter-organisational relationships are strongly interdependent (Lazzarini *et al*., 2001). These results corroborate the contingency theory that firms adjust their organisational structures in dealing with the challenges posed by changing business situations (Donaldson, 2001; Lawrence and Lorsch, 1967). The strong interdependence of various organisational relationships points to the organic structure as the most fitting organisational framework for highly unstable business environments. Adetoyinbo *et al.* (2023) argued that the participatory nature of organic structures facilitates the flow of effective knowledge and information needed for structural adaptation in changing business environments. By ensuring the combination of collaborative, complementary, and coordinated organisational models, organic structures facilitate co-innovations, co-learning, and co-specialisation, which are key elements for the effective delivery of quality shrimp products along the SC.

Our results regarding the effect of organisational structures on FQ suggest that tighter interplay between shrimpers and processors is essential for enhancing FQ. Given that shrimps are highly perishable, maintaining freshness is an important measure of shrimpers' performance. Hence, shrimpers may attempt to take advantage of their relational governance with processors by coordinating shrimp procurement before voyage and by routinely exchanging information about the quantity caught and the expected delivery time while at sea. This is consistent with previous studies (Sodano *et al*., 2008; Fu *et al.,* 2017; Soares *et al.,* 2017; Adetoyinbo and Otter, 2020; Siddh *et al.,* 2018, 2022), which have argued that closer VER permits actors to sell their products directly to trading partners to prevent deterioration.

Closer LAR was also found to improve FQ, a result which corroborates earlier findings (Fu *et al.,* 2017; Hong *et al*., 2020; Maertens and Vande Velde, 2017; Soares *et al*., 2017), but contradicts the assertion by Adetoyinbo *et al.* (2023) that only VER influences shrimpers' performance. The positive influence of LAR on FQ stems from the occasional training and extensive support of the Ministry of Agriculture to artisans in partnership with private shrimping companies. During these training sessions, information is shared on improved shrimping techniques and quality standards. Thus, the support from external stakeholders might have contributed to better shrimp quality among producers.

Conversely, only VER influences FQ significantly in the processor model, implying that closer interaction between processors and traders is essential for preserving shrimp quality. As argued by Ding *et al*. (2014) and Fu *et al*. (2017), tighter SC integrations and the quality of information are germane for enhancing FQ. Women processors preserve shrimp by frying,

which temporarily extends the product's shelf life. Consequently, in their quest to maintain shrimp quality, these processors may tend to take advantage of their relational contracts with traders by regularly exchanging market information and routinely transacting processed shrimps before deterioration.

Regarding how organisational relationships influence FQ in varying business settings, our findings indicate that unstable business contingencies moderate the interplay between SC organisations and FQ. In the producer model, PA negatively moderates the HOR-FQ nexus, implying that high PA reduces the influence of HOR on FQ. We explain this by the fact that high PA among cooperating shrimpers may lead to elite capture, since individuals with higher reputations are likely to benefit more from closer HOR than less powerful actors. This situation may cause hold-up problems for less influential shrimpers, which may inadvertently lower shrimp quality when fresh products are kept for long. Along the value chain, high PA between trading partners could result in business unease and hesitation, which might lengthen transaction duration and consequently reduce shrimp quality. This finding is consistent with previous studies (Brown *et al*., 1995; Wang, 2011), in which PA was found to moderate the interplay between SC network and business performance. In contrast, MT positively moderates the influence of LAR on FQ, indicating that the resources and capabilities gained from this relationship could contribute to higher FQ when market dynamism is high. This finding concurs with previous studies (Delbufalo, 2012; Leuschner *et al*., 2013; Leonidou *et al*., 2017; Song and Yang, 2019), which showed that the interaction of actors with external stakeholders fits business settings characterised by high market turbulence.

The results further reveal the moderating effect of unstable business contingencies on the nexus between SC organisations and FQ among producers. The positive moderating effect of DT on the interplay between VER and FQ suggests that relational contracts between processors and traders may contribute to higher shrimp quality under conditions of high DT. This is likely the case in that relational contracts have fundamental components such as informal contract attributes and recurrent transactions (Michler and Wu, 2020), which are effective and valuable when relational trust levels are initially low. By facilitating the development of trust among trading partners, relational contracts shorten transaction time and allow parties to make effective contracting decisions that guarantee better shrimp quality.

Conversely, the negative moderation effect of PA on the nexus between tighter VER on FQ among processors could be attributed to two reasons. First, processors transact with powerful lead actors such as traders and aggregators, who intentionally exert influence in shaping market conditions such as prices. Such situations may elongate the period of business negotiation, which adversely affects the quality of shrimp (Adetoyinbo and Otter, 2020). Second, small-scale processors may experience a hold-up problem that negatively impacts shrimp quality if large-scale processors with better strategic resources, business knowledge, experience, and social networks decide to sell and saturate existing markets with shrimp. Although processors deal with such power imbalances by intensifying relational contracts, collective action, and interacting with external stakeholders (see Table I), such interactions appear not to fit business situations characterised by mediated and non-mediated power relations from customers and competitors, respectively. This result is in line with Nyaga *et al.* (2013), who found non-mediated power to negatively influence operational performance. Finally, PA positively moderates the effect of LAR on FQ, highlighting that the resources and information obtained from external stakeholders may result in increased FQ among processors when power relations are unbalanced.

5. Conclusions and implications

In this study, we applied a comprehensive analytical framework to analyse the effect of supply chain networks on food quality in unstable business environments. The results show strong evidence to suggest that external business contingencies do not only influence supply chain networks but also moderate how individual supply chain relationships contribute to better food quality. Business contingencies such as market turbulence, power asymmetry, and distrust drive actors to form tighter informal, vertical and lateral relationships but largely loosen horizontal relationships. Our moderation analysis further reveals that the influence of closer lateral relationships on food quality is greater among producers when market conditions are volatile. However, high power asymmetry lessens the positive influence of horizontal and lateral relationships on food quality. Among processors, the positive influence of vertical relationships on food quality increases when trust is low, while the effect of closer horizontal relationships on food quality reduces under conditions of high market turbulence and power imbalance. The study concludes that the formation of closer vertical relationships (e.g., relational contracts) is required by both actors in their quest to supply quality food products along the food chain.

5.1 Theoretical implications

Several theoretical implications can be drawn from this study. Our framework extends the contingency paradigm (Donaldson, 2001; Lawrence and Lorsch, 1967) and netchain approach (Lazzarini *et al*., 2001) by revealing that business contingencies influence various supply chain organisational relationships and simultaneously moderate their effects on food quality across multiple segments. By considering the direct and indirect effects of business contingencies on the nexus between interdependent organisational relationships and food quality, this framework allows for a flexible and multi-dimensional assessment of how food quality can be improved under different business situations.

From a statistical perspective, our findings confirm the importance of various inter-organisational relationships (e.g., vertical, horizontal, and lateral) in ensuring improved product quality along food chains. With this, we add to the recent conversation on potential organisational pathways for maintaining the quality of perishable foods along value chains (Siddh *et al*., 2015, 2017, 2018, 2022; Adekambi *et al*., 2016; Arinloye and van Boeke, 2016).

To comprehensively understand how to improve product quality throughout supply chains of highly perishable foods, our moderation analyses across the two tiers offer strong empirical support for the consideration of business contingencies. The study answers the call by Siddh *et al.,* (2015) and Barbancho-Maya and López-Toro (2022) and extends the framework proposed by Besik *et al.* (2023) by demonstrating that each organisational relationship contributes to improved food quality throughout multi-tiered food networks, depending on the prevailing market and agency conditions. We show that tighter vertical relationships are necessary for improved food quality in the context of supply chains with highly perishable foods, even though alternative relationships (e.g., horizontal and lateral) may be complementary when market and agency conditions are unfavourable.

Finally, our study focuses on the highly perishable food sector in a developing country, where small-scale actors such as artisanal shrimpers and processors encounter significant challenges in preserving food quality and where the pathways to guarantee better food quality are understudied. By highlighting the antecedents of each organisational relationship among these actors, this framework offers an important extension to prior multi-tiered food quality models (Jonkman *et al.,* 2019; Lejarza and Baldea, 2022; Besik *et al.,* 2023) and may serve as

a benchmark for other highly perishable food sectors (e.g., vegetables and poultry) characterised by rapidly changing business environments (Siddh *et al.,* 2015).

5.2 Practical and policy implications

Practically, our results suggest that informal relational governance between producers and processors, and between processors and traders, drives food quality. This is particularly true for processors faced with high levels of mistrust. Therefore, to facilitate a better exchange of market information and alleviate hold-up problems to the supply of quality shrimp along the value chain, both actors must forge closer relationships with their customers. Moreover, producers should endeavour to interact closely and regularly with external stakeholders, notably extension agents that provide crucial technical assistance and information for maintaining shrimp quality. Since market turbulence positively moderates the interplay between lateral relationships and food quality, producers can leverage the relational support offered by external stakeholders to ensure better shrimp quality under turbulent market conditions.

In terms of policy, the beneficial effect of closer lateral relationships under significant power imbalance points to the need to build the capacity of public institutions to continually support artisanal shrimping activities. External stakeholders including policymakers and development partners can contribute to improved shrimp quality and balanced power dynamics through regular training of actors, especially less-influential shrimpers. A more reliable mechanism via which the grievances of less influential artisans can get to the relevant stakeholders should be established through artisanal fisher groups and women's unions. Policy efforts should also be targeted at strengthening the capacity of actors and the governance structures of fisher groups to assist them in adapting to business contingencies for better shrimp quality.

5.3 Research limitations and direction for future studies

While our study has contributed to a better understanding of how complex organisational networks enhance food quality in unstable business environments, our analysis was limited to the fishery sector of Nigeria using cross-sectional data. Consequently, the generalisation of our findings to other industries or regions with distinct business settings may not be applicable. Instead, future studies which focus on multi-tier and multi-country analysis can determine the nexus between organisational structures and food quality in changing business environments using time-series or panel datasets. Whereas our study focuses only on two reliant segments of the supply chain, future studies can extend this framework to three or more segments or the sectoral level to determine how food quality can be ensured along the value chain. Future studies can use models such as mathematical programming, event simulations, and game theory in testing our conceptual framework and to further understand which SC organisational relationships are crucial for maintaining food quality along the whole food chain. While our study focuses on supplier-oriented (upstream) food quality by relying on actors' perceptions of food quality performance (Siddh *et al.,* 2018, 2022), other studies can capture customer-based (downstream) food quality, internal quality (process and logistics quality), and other product quality measures such as sensory properties, shelf-life, and safety along the food value chains using laboratory tests.

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Notes

[1] See Adetoyinbo and Otter (2020) for an extensive overview of the shrimp value chain in Nigeria.

[2] All the items were measured using a 5-point Likert scale, except for HOR in the producer model.

[3] An exception is the AVE of VER (0.482) in the producer model, which is below 0.5. We retained the construct in the model because it is important for our interpretation and it fulfils other quality measurement criteria, particularly other construct validity indicators such as HTMT and the Fornell-Larcker criterion (Fornell and Larcker, 1981).