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Effects of institutional pressures on the governance of food safety in emerging food supply chains: a case of Lebanese food processors

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Abstract

Food safety has become a major development challenge and a key influence on the strategic behavior of food companies. The study seeks to analyze the effect of perceived institutional pressures on the governance of food safety and the effect this may have on food safety performance in emerging food supply chains. The research develops a conceptual framework that links perceived institutional pressures, degree of food manufacturer-supplier relationships, food safety practices, and food safety output. The hypothesized relationships were tested in the Middle Eastern context, where food safety concerns are rising. Accordingly, a survey was carried out to collect data from food quality/safety managers representing 94 food processors across Lebanon. The study finds that perceived institutional pressures have a direct and strong effect on the degree of integration in the agro-food supply chain (i.e., in terms of long-term relationships, strategic information sharing, information technology connection, and logistic integration), and such an integration, in turn, increases the intensity of food safety practices and food safety performance. However, in the absence of strong manufacturer-supplier relationships, perceived institutional pressures do not lead to improved food safety performance. The study suggests that long-term food manufacturer-supplier relationship is necessary if agro-food chain actors are to respond to established regulatory demands, industry practices, and social norms.

Keywords Institutional pressures · Food safety governance · Food safety performance · Supply chain integration

Abbreviations

GVC	Global value chain
TCE	Transaction costs economics
IT	Information technology
FSMS	Food Safety Management Systems
HACCP	Hazard analysis critical control point
BRC	British Retail Consortium
ISO	International Organization for Standardization
SQF	Safe quality food
IFS	International Food Standard
FSSC	Food Safety System Certification
IRB	Institutional Review Board
AUB	American University of Beirut
PLS-SEM	Partial least squares structural equation modeling
CR	Composite reliability
VIF	Variance inflation factor
HTMT	Heterotrait–Monotrait ratio
AVE	Average variance extracted
R^2	Coefficient of determination
Q^2	Cross-validated redundancy
IPMA	Importance-performance map analysis

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Introduction

In the highly globalized agro-food supply chains, food safety has become a societal concern and critical factor in influencing the strategic behavior of food companies (Diekmann and Theuvsen 2019; Ait Hou et al. 2015). Agro-food supply chains are increasingly exposed to various food safety hazards (Esteki et al. 2019; Nayak and Waterson 2019). Past and recent high profile food scares such as the *E. coli* contamination from a sprout farm in Germany (2011), the *salmonella* outbreak from peanut butter paste in the US and Canada (2008–2009), the Irish pork products contamination with dioxin (2008), and the adulteration of Chinese milk products with melamine (2008) have exerted unprecedented scrutiny on food companies to guarantee food safety. Failure to address food safety concerns can have far-reaching consequences, including economic losses, reputational damages, and business closures (Esteki et al. 2019) and a loss of livelihoods for farming communities and workers (Davidson et al. 2016). Firms may respond to real and perceived food safety hazards by strengthening food safety cultures within the organization and adopting appropriate food safety governance regimes in their relationships with other supply chain actors (Tan et al. 2017; van Ruth et al. 2017; Baur et al. 2017; Nyarugwe et al. 2020). In today's market environment, the effect of institutional pressures on the governance of agro-food supply chains is evident as new food safety-oriented agro-food supply chains (e.g., organic farming, short food supply chains, etc.) have become embedded in the food safety regimes dominated by the large-scale agro-food companies (Laforge et al. 2017; Dubois 2019; Gale and Hu 2011).

The present study focuses on food manufacturer-supplier relationships in the context of emerging food supply chains and analyzes the effect of perceived institutional pressures on the food safety culture and performance of food manufacturers. Following Schuster and Maertens (2013, p. 292), emerging food supply chains can be defined as, in this study, "supply chains with increasing food safety requirements to take advantage of the potential opportunities the modern chains offer." The "global value chain (GVC)" concept (Gereffi 2005), distinguishes global supply chains as "buyer-driven" and "producer-driven" to explain the transformations in the production and distribution of goods at the global level. Increasingly, the organization of global food chains is being reshaped by powerful buyers and thus has become buyer-driven (Gereffi and Lee 2012; Hattersley et al. 2013). Accordingly, powerful buyers ("lead-firms") are influencing the organization of agro-food supply chains and governance of food safety. Access to high-value markets by economic actors in the developing countries relies on their ability to improve competitiveness in the global supply chains coordinated by the lead firms (Gereffi and Lee 2012) and establish strategic responses to changes in the institutional environment (Mercado et al. 2018). Consequently, firms in emerging agro-food supply chains are under increasing pressures to participate in high-value modern chains and to implement food safety governance regimes to improve their position in the global market. The theory of institutions predicts that firms tend to respond to institutional pressures by choosing a governance regime that can conform to established regulatory demands, industry practices, and social norms.

The present research assesses the effect of perceived institutional pressures on the governance of food safety and the impact this may have on food safety performance. The study introduces a model that links the principal elements of supply chain integration and food safety output (performance) to test the effect of perceived institutional pressures on the governance of food safety. More specifically, the study analyzes the effect of institutional pressures on the degree of food manufacturer-supplier relationships and intensity of food safety practices and food safety output. The perishability of food products (Akkerman et al. 2010), the extended supply relationship and interconnectedness of transactions (Trienekens and Zuurbier 2008), and the recurrent food fraud (Esteki et al. 2019) have increased the vulnerability of food supply chains to various food safety risks. The current study intends to expand our understanding as to how firms, in the context of emerging food supply chains, are responding to food safety concerns while enhancing their operational efficiency and market competitiveness the modern food supply chain offers.

The empirical study was carried out among food processors in Lebanon. Lebanon is a compelling case as food safety issues are attracting increasing public attention (e.g., Bou-Mitri et al. 2018; Abebe et al. 2017; Abebe et al. 2020), following the uncovering of several food safety scandals. In 2014, for example, the Lebanese Ministry of Health launched a series of inspection campaigns targeting around 1,005 companies that included big slaughterhouses, factories, restaurants, bakeries, and supermarkets across the country. The public pressure had led the Lebanese parliament to approve its first and long-awaited food safety law in 2016 (Law No. 35).

The conceptual framework: key concepts and hypotheses

The conceptual framework presented in Fig. 1 builds on Prajogo and Olhager (2012) and links the principal elements of manufacturer-supplier relationships (hereafter called supply chain integration), food safety practices, and food safety output (performance). The current research aims to extend the work of Prajogo and Olhager (2012) by incorporating perceived institutional pressures as drivers of potential transformations in the governance of food safety in emerging supply chains. In the conceptual model developed by Prajogo and Olhager (2012), long-term relationship is viewed as a response to market competitiveness and operational efficiency; this may be useful in the context of non-food industries. However, in food supply chains, organizations must conform to established regulatory demands, industry practices, and social norms to prevent food safety hazards (Hoffman 2001). In fact, food safety is found to have played an important role in the transformations of food supply chains in developed countries (Trienekens and Wognum 2013; Trienekens et al. 2012).

The present study is informed by the theory of institutions (North 1994) and supply chain integration. According

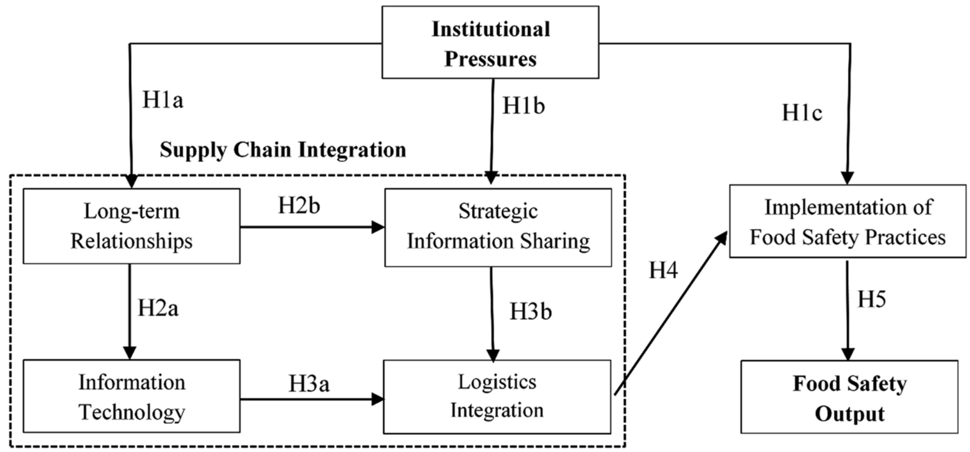


Fig. 1 Relationships of institutional pressures, supply chain integration, and food safety output

to North (1994, p.360), institutions are "humanly devised constraints that structure human interaction; they [include] formal constraints (rules, laws, constitutions), informal constraints (norms of behavior, conventions, and self-imposed codes of conduct), and their enforcement characteristics." In supply chains, relationships, interests, and values among different actors converge in institutions (Hoffman 2001). Generally, two (alternative) forms of food safety governance regimes can be identified in agro-food supply chains (1) chain-based—i.e., supply chain integration (i.e., long-term relationships, information, and logistics integration) and (2) firm-specific—i.e., food safety practices/ food safety cultures (Trienekens and Wognum 2013). The conceptual model presented in Fig. 1 tests the effect of (perceived) institutional pressures on the governance of food safety and the effect this may have on food safety output (i.e., in terms of microbiological food safety complaints, hygiene-related complaints, sampling techniques used to confirm the microbiological performance of raw materials and final products, and hygiene and pathogen conformities). The model incorporates the principal elements of integrated supply chains, namely long-term relationships, information, and logistics integration and food safety activities (i.e., food safety culture) and microbiological safety output (Luning et al. 2011).

Institutional pressures

The literature distinguishes institutional pressures at three levels (DiMaggio and Powell 1983): coercive, normative, and mimetic pressures. Coercive pressure arises from the presence of strict government rules and regulations and the organization's attempt to comply with established regulatory demands (Wu et al. 2013). Powerful trading partners (e.g., retailers) can also exert coercive pressure on other supply chain actors (e.g., manufacturers) to enforce compliance with specific (e.g., food safety) requirements (Hattersley et al. 2013). Normative pressure is exerted by professional networks or (trade) associations as organizations try to establish legitimacy within their professional associations (Bhakoo and Choi 2013); also, it may arise from social obligations as organizations attempt to do the right thing for societies (March and Olsen 1983). Mimetic pressure relates to uncertainties in the market as organizations try to emulate other organizations that they believe are successful (John et al. 2001). In practice, coercive, normative, and mimetic pressures are interdependent; thus, a single practice can prompt the three pressures at a time (DiMaggio and Powell 1983).

Consumers' demand for food safety may affect not only direct suppliers but also other upstream actors in the food supply chain (Wever et al. 2012; Stranieri et al. 2017). Food supply chains face multiple transaction risks (Trienekens and Wognum 2013). In the context of the study, food manufacturers are exposed to both supply- and demand-side risks. For example, supply-side risks associated with the sourcing of raw materials can expose the manufacturer to demand-side risks, such as product recalls, negative media image, and reduced market competitiveness. Firms may seek a governance regime that can both optimize transaction risks and enhance competitiveness in the supply chain (Trienekens and Wognum 2013; Wever et al. 2012). Manufacturers may respond to supply- and demand-side food safety risks by transforming their supply management from arm's length (transactional) to long-term relationships (Tan et al. 2017). Also, firms can be exposed to food safety risks related to their production processes. They may respond to such risks by implementing robust food safety standards and procedures (Wever et al. 2012; Stranieri et al. 2017; Trienekens et al. 2012).

Recent studies have documented a positive relationship between institutional pressures and sustainable supply chain practices such as green initiatives (Zhu and Sarkis 2007), halal standards (Tan et al. 2017; Kurth and Glasbergen 2017), and corporate social responsibility (Awaysheh and

Klassen 2010). The food industry is one of the highly regulated sectors; firms must respond to such legislative demands by implementing various food safety practices. Thus, institutional pressure is expected to influence the integration of food supply chains, as hypothesized below:

H1a Institutional pressure is positively correlated with the degree of long-term relationships between manufacturers and suppliers.

H1b Institutional pressure is positively correlated with the degree of strategic information sharing between manufacturers and suppliers.

H1c Institutional pressure is positively correlated with the degree of food safety practices implementation by food manufacturers.

Supply chain integration

The present study builds on Prajogo and Olhager (2012), who conceptualize supply chain integration as a function of long-term relationships, strategic information sharing, information technology connection, and logistics integration.

Long-term relationship

The Transaction Costs Economics (TCE) framework (Williamson 1991) provides three generic forms to govern supply chain relationships; they include market, hybrid, and hierarchal, which may vary in terms of incentives, uncertainty reduction, and transaction costs. In a market type of governance, price is the sole mechanism to coordinate transactions, often, between anonymous parties, and such relationships are short-term. On the other extreme is a hierarchical form of governance where all the production, distribution, and marketing activities are under the control of one entity. The hybrid form of governance lies between the classical market and hierarchy forms of governance (Williamson 1991). According to TCE, the behavior of the trading partners (e.g., opportunism) and the nature of transactions (e.g., uncertainty and specificity of investments to safeguard food safety) may provide useful information to determine the type of governance regime that is needed to instill order in the relationships. The hybrid form of governance has different forms, including long-term relationships, strategic alliances, and joint ventures (Zhang and Aramyan 2009). According to Menard and Valceschini (2005, p. 424), the hybrid form is more common and attractive than the other two regimes to govern complex relationships of food supply chains. They argue that the hybrid form allows supply chain actors to keep property and decision rights distinct while providing each actor the flexibility to select reliable partners for joint planning and investments (in key supply chain resources such as information technology and logistics) and employ strategic information exchanges with other actors in the chain.

Prior studies (e.g., Chen and Paulraj 2004; Prajogo and Olhager 2012) found a positive correlation between long-term relationships and information and logistics integration. In this era of complex and rapidly evolving food supply chains, long-term partnerships can be paramount to deal with food safety hazards (Trienekens and Zuurbier 2008; Trienekens et al. 2012). The present study extends the work of Prajogo and Olhager (2012) by testing this relationship in the context of the food industry, which is under increasing pressure and scrutiny to ensure food safety. Also, in the present study, long-term relationship is conceptualized as an organizational response to food safety risks (see H1a) and the basis for information and logistics integration. Accordingly, the second hypothesis follows:

H2a Long-term relationship is positively correlated with the intensity of information technology connection between food manufacturers and key suppliers.

H2b Long-term relationship is positively correlated with the degree of strategic information sharing between food manufacturers and key suppliers.

Information integration

Several studies have applied the notion of information integration to refer to either the use of information technologies or information sharing practices between trading partners (Jacobs et al. 2016). Prajogo and Olhager (2012) argue that both the technological and social aspects of information integration are necessary for supply chain integration. On the technological side, the internet, electronic data interchange, and advanced information technology (IT) systems can provide interactive ways to coordinate activities and manage relationships in food supply chains (Kittipanya-Ngam and Tan 2020). IT systems such as warehouse management systems (for the control of quality and safety in storage and distribution processes), laboratory information management systems (for the control of products or animals), and enterprise resource planning systems (for collaborative planning and forecasting programs) are crucial for food supply chain transparency and integration (Trienekens et al. 2012, p.62). IT connections allow supply chain actors to manage complex information exchanges in real-time (see Prajogo and Olhager 2012; Kittipanya-Ngam and Tan 2020). Studies such as Vanpoucke et al. (2017), using global manufacturing data, and Zhang et al. (2016), based on evidence of Chinese manufacturing firms, have shown a direct (positive) effect of IT connection on supply integration. Thus, a third hypothesis is presented:

H3a Information technology connection is positively correlated with logistics integration between food manufacturers and key suppliers.

Although IT connection is necessary for information integration, its intensive use may depend on the quantity and quality of information and the willingness of other supply chain actors to share strategic information (i.e., the social aspect, Prajogo and Olhager 2012). In food supply chains, information related to process and product characteristics is critical to implement traceability systems and for logistics integration (Trienekens and Wognum 2013). Following Prajogo and Olhager (2012) but applied in a different context (food supply chains), this study intends to test the effect of information integration on logistics integration from both the technological and social aspects by formulating the following hypothesis:

H3b Strategic information sharing is positively correlated with logistics integration between food manufacturers and key suppliers.

Logistics integration

Logistics integration aims to provide a seamless connection for the flow of materials from suppliers to processors (Prajogo and Olhager 2012). There is, however, a lack of consensus regarding the relationship between logistic integration and supply chain performance. According to Prajogo et al. (2016), logistics integration and performance are indirectly related via other operations such as lean production processes (e.g., total quality control principles). In the food supply chain, logistics integration involves the management of microbial growth and food waste as raw materials (or primary) products move from suppliers to manufacturers. This is necessary but not sufficient to ensure the quality and safety of the final product. In the present study, food safety is the performance indicator, which may also depend on intermediate processes such as the implementation of prerequisite programs, critical controlling and monitoring points, and compliance procedures (Luning et al. 2011). Logistics integration can influence the intensity of food safety practices and thereby food safety output. This relationship is hypothesized as follows:

H4 Logistics integration is positively correlated with the implementation of food safety practices by food manufacturers.

Implementation of food safety practices

For decades, supply chain performance has been associated with cost, quality, price, and delivery conditions and applied in the context of non-food industries (Prajogo and Olhager 2012). However, the nature of products/production and distribution are significantly different in food supply chains. In the present study, the intensity of food safety practices (i.e., activities necessary to control microbiological safety hazards and assure product safety) is measured (1) by assessing the organizational structures supporting food safety (Luning et al. 2011)—i.e., administrative conditions and information systems—and implementation of food safety management systems. In the latter, a plethora of Food Safety Management Systems (FSMS) are present to govern food safety in supply chains, including Hazard Analysis Critical Control Point (HACCP), British Retail Consortium (BRC), International Organization for Standardization (ISO) 22,000, Safe Quality Food (SQF), International Food Standard (IFS), and Food Safety System Certification (FSSC) 22,000 (Akkerman et al. 2010). Strong organizational structures supporting food safety (Luning et al. 2011) and the implementation of one or more FSMSs can enhance food safety output (Trienekens et al. 2012). Thus, the final hypothesis is stated as follows:

H5 Implementation of food safety practices by food manufacturers is positively correlated with food safety output.

Method

Data collection and study sample

A survey questionnaire, approved by the Institutional Review Board (IRB) at the American University of Beirut (AUB), was used to collect data from food manufacturers in Lebanon. The survey was executed through face-to-face interviews and online with the quality/food safety managers of each company. For the online survey, AUB-supported Limesurvey was applied. First, 342 food companies were invited for the study, which 124 of them participated. However, responses from 30 food companies were incomplete and excluded from further consideration. The study finally included the responses of 94 food processors, which constituted a response rate of 27.5%. In fact, this can be considered a success given the sensitivity of food safety issues in Lebanon. A response rate of above 20% is generally considered desirable in studies involving business organizations (Malhotra and Grover 1998). The companies included in this study were engaged in the production of baked goods, meat, dairy, fruits and vegetables, confectionery, cereals, and oils, and represented all the governorates of Lebanon.

A description of food companies participated in the study showed that 68% (64) were family-owned. Only 29% (27) manufacturers had less than 20 years of operation, while the majority of the food manufacturers (71%) were in the business for 20 years or more. Approximately 30% (28) of the manufactures in the study were predominantly export-oriented. The majority of manufactures (63%) were in the business of baked goods, confectionery, cereals, and oils processing, while the remaining 37% were primarily engaged in the meat, dairy, fruits, and vegetable processing businesses. Around 51% (48) of the manufactures were small size (i.e., 50 or less full-time equivalent employees), while 49% of them were medium (51 to 250 employees) and large-scale (more than 250 employees) enterprises.

Measurement and structural model assessment

A structured questionnaire was used to gather information needed to test the hypothesized relationships in Fig. 1. The survey questionnaire included five reflectively and two formatively measured multi-item constructs. Distinguishing measurement modes into reflective and formative is necessary to establish the content validity and structural relations of unobserved (latent) constructs (Coltman et al. 2008); in reflectively measured constructs, causality flows from the latent construct to the indicator and the opposite is true informatively measured constructs. The reflectively measured constructs are: perceived institutional pressures, degree of supply chain integration, food safety practices, and food safety output. A 7-point-Likert scale, ranging from 1 ("very unimportant") to 7 ("very important"), was applied to measure (perceived) institutional pressures and the four supply chain integration constructs. Twenty-nine items were included in the questionnaire, and all the multi-item scales were based on (or adapted from) an extensive review of prior studies (e.g., Qijun and Batt 2016; Prajogo and Olhager 2012) to ensure their content validity.

For the analysis of food safety practices and food safety output, the study has adapted the formative indicators from Luning et al. (2015). The extent of food safety practices implementation is measured as follows. First, food safety managers were asked to indicate the status of ISO 22,000 implementation in their respective organization: "Already implemented and certified by a third party" (=1), "Already implemented but not certified by a third party" (=2), "In-progress" (=3), "Intended to implement in the next two years" (=4), and "Do not intend to implement in the near future" (=5). The study focused on ISO 22,000 mainly because it is an international, science-based, risk management approach to food safety (Codex Alimentarius Commission 2003) and has gained increasing attention due to its ability to address food safety concerns across the whole food supply chain. Second, food safety managers were asked to characterize the food safety cultures of their organization as supportive (=1), constrained (restricted=2), or poor (=3). Following Luning et al. (2015), seven items were included in the initial analysis: technological staff, the variability of workforce composition, operator competences, management commitment, employee involvement, formalization of food safety decisions, and information systems supporting food safety decisions. For the construct measuring food safety output (performance), a total of seven items were included in the initial analysis: advancedness of product sampling to confirm microbiological performance, the character of food safety evaluation, nature of microbiological food safety complaints, type of hygiene and pathogen non-conformities, the seriousness of FSMS evaluation remarks, type of hygiene-related complaints, and the extensiveness of judgment criteria. Food safety managers were asked to evaluate each item based on four situational descriptions: a low (=1), basic (=2), average (=3), and advanced (=4) performance level (Luning et al. 2015 provide a detailed description of each level).

Finally,the direct and indirect influence of perceived institutional pressures on food safety output (performance), via the mediating constructs of supply chain integration and food safety practices, was measured using Partial Least Squares Structural Equation Modeling (PLS-SEM). PLS-SEM allows the inclusion of the (unobservable) constructs discussed above (i.e., perceived institutional pressures, long-term relationships, information technology, strategic information sharing, logistics integration, implementation of food safety practices, and food safety output); several indicators (observed variables) measured each construct (see Tables 1 and 2). PLS-SEM has received increased attention in business and social science research (Sarstedt et al. 2014) as it combines optimal prediction efficiency and robustness with different scale types and small sample size.[1] Furthermore, PLS-SEM does not have distributional restrictions on measured variables and thus allows the incorporation of nominal-, ordinal- and interval-scaled indicators (Henseler et al. 2016). As discussed above, all the indicators measuring the seven constructs are ordinal-scaled. The study applied the latest algorithm (SmartPLS 3 software, Ringle et al. 2015) to investigate the strength and direction of relationships between the multi-item constructs of perceived institutional pressures, supply chain integration, food safety practices, and food safety output.

[1] The rule of thumb to determine the sample size is 10 times the number of maximum arrowheads pointing on a single latent variable.

Table 1 Reflective construct indicators

Indicators (sources)	Loadings	AVE	CR
Institutional pressures (Qijun and Batt 2016; Prajogo and Olhager 2012)		0.671	0.934
There are internal and external pressures to implement food safety practices to			
Enhance our export competitiveness	0.817		
Increase our competitive advantage	0.884		
Improve our company image	0.823		
Avoid negative media attention	0.705		
Improve our relationship with suppliers	0.758		
Meet customer requirements	0.871		
Improve our relationship with customers	0.861		
Long term relationship (Prajogo and Olhager 2012)		0.731	0.915
We expect our relationship with key suppliers to last a long time	0.886		
We collaborate with key suppliers to improve their quality in the long run	0.876		
The suppliers see our relationship as a long-term alliance	0.893		
We view our suppliers as an extension of our company	0.757		
Information technology connection (Prajogo and Olhager 2012)		0.639	0.898
Inter-organizational coordination with our key suppliers is achieved using electronic links	0.719		
We use information technology-enabled transaction processing	0.855		
We have electronic mailing capabilities with our key suppliers	0.763		
We use electronic transfer of purchase orders, invoices, and/or funds with our key suppliers	0.857		
We use advanced information systems to track and/or expedite shipments/deliveries with our key suppliers	0.795		
Strategic information exchange (Prajogo and Olhager 2012)		0.703	0.904
Suppliers are provided with any information that might help them	0.726		
Exchange of information with our key suppliers takes place frequently, informally, and timely	0.846		
We keep each other informed about changes that may affect the other party	0.908		
We have frequent face-to-face planning/communication with our suppliers	0.864		
Logistic integration (Prajogo and Olhager 2012)		0.710	0.907
Our inter-organizational logistics activities are closely coordinated	0.850		
Our logistics activities are well integrated with suppliers' logistics activities	0.867		
We have a seamless integration of logistics activities with our key suppliers	0.862		
Our logistics integration is characterized by excellent distribution, transportation, and warehousing facilities	0.790		

Table 2 Formative construct indicators

Formative construct indicators (source)	Outer weights	Outer loadings	VIF
Food safety practices[a] (Luning et al. 2015)			
Extent of ISO 22,000 implementation	0.558***	0.812***	1.1196
Sufficiency of information system toward food safety	0.212	0.703***	1.885
Extent of management commitment to food safety	0.472**	0.842***	2.048
Food safety performance (output)[b] (Luning et al. 2015)			
Advancedness of product sampling to confirm microbiological performance	0.551***	0.668***	1.502
Character of food safety evaluation	0.650***	0.736***	1.052
Nature of microbiological food safety complaints	– 0.088	0.516***	1.711
Type of hygiene and pathogen non-conformities	0.359**	0.554***	1.200

***$p < 0.01$, **$p < 0.05$, *$p < 0.1$

[a]Excluded indicators due to low factor loadings: The degree of employee involvement, presence of technological staff, the variability of workforce composition, and sufficiency of operator competences. [b] Excluded indicators due to low factor loadings: The seriousness of FSMS evaluation remarks, type of hygiene-related complaints, and the extensiveness of judgment criteria

Table 3 Assessment of discriminant validity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Fornell–Larcker criterion							
Food safety output (1)	Formative						
Info exchange (2)	0.150	**0.839**					
Info technology (3)	0.362	0.434	**0.800**				
Logistic integration (4)	0.137	0.711	0.564	**0.843**			
Long term relationship (5)	0.200	0.653	0.593	0.708	**0.855**		
Institutional pressure (6)	0.165	0.447	0.331	0.460	0.494	**0.819**	
Food safety practices (7)	0.576	0.179	0.304	0.191	0.216	0.016	Formative
Heterotrait–Monotrait ratio	(1)	(2)	(3)	(4)	(5)		
Info exchange (1)	–						
Info technology (2)	0.492						
Logistic integration (3)	0.812	0.649					
Long term relationship (4)	0.739	0.672	0.806				
Institutional pressure (5)	0.505	0.380	0.503	0.543	–		

Results

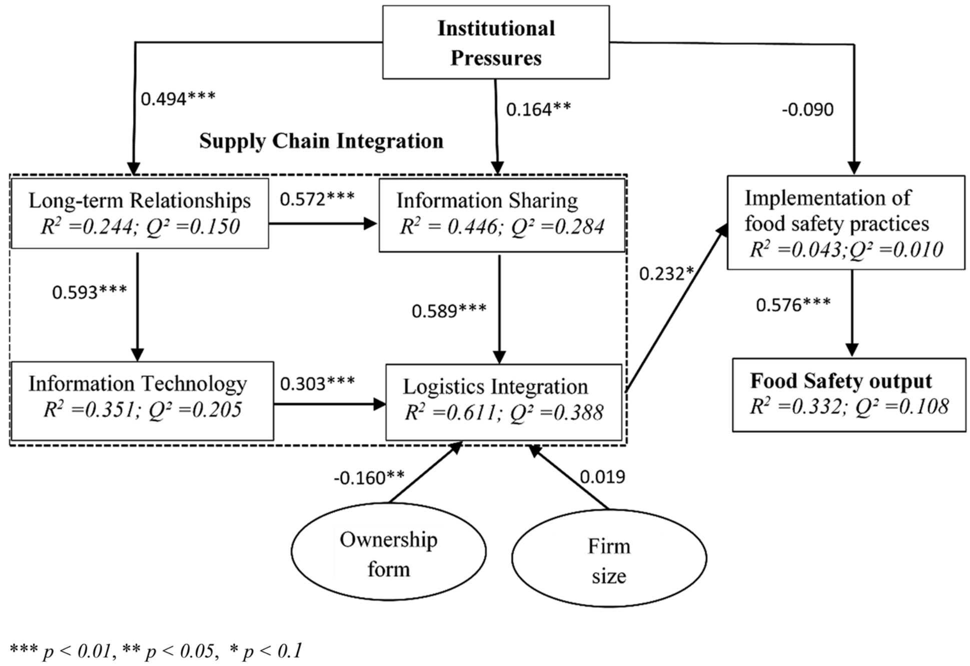
Reliability and validity checks

The five reflective constructs (i.e., perceived institutional pressures, long-term relationships, information technology, strategic information sharing, and logistics integration) reported in Table 1 were measured using a 7-point Likert scale, and thus an internal consistency reliability test is required to assess the interrelatedness and unidimensionality of the set of items measuring each construct. Cronbach's alpha' is traditionally used for estimating internal consistency reliability in social science research (Wong 2013). However, it tends to underestimate the true reliability value (Sijtsma 2009). "Composite Reliability (CR)" has become a preferred approach for PLS-SEM analysis (Sarstedt et al. 2014), where a higher CR value corresponds to a higher level of reliability. According to Sarstedt et al. (2014, p.108), CR values between 0.60 and 0.70 are "acceptable" while CR values between 0.70 and 0.95 are "satisfactory to good". CR values above 0.95 may indicate items that are redundant and may lead to undesirable response patterns. In the study, five indicators were removed from the final analysis as they exhibited loadings below 0.70. All five reflectively measured constructs have a value greater than 0.890 (Table 1), which is greater than the 0.7 threshold for composite reliability. Next, the convergent validity of all items associated with the five reflectively measured constructs was performed using the Average Variance Extracted (AVE). The five constructs have a value higher than the minimum acceptable value of 0.5 (i.e., 0.639 to 0.731); meaning, on average, each construct explains over 50% of the variance of its items.

The inclusion of the formative construct indicators in the model follows the guideline provided by Wong (2013, p.28), Hair et al. (2016), and Sarstedt et al. (2014). Internal consistency reliability is not appropriate for the formatively measured constructs; they are assessed based on the statistical significance and relevance of the indicator weights and loadings and collinearity. In the study, only indicators with insignificant outer weights and low outer loadings (i.e., below 0.50) are dropped. As shown in Table 2, seven indicators are retained for the two formative constructs because either their outer weights (relative importance) are significant or outer loadings (absolute importance) are greater than 0.5. Multicollinearity may be a problem among the formative constructs, and thus each item's variance inflation factor (VIF) was calculated (Sarstedt et al. 2014). All the VIF values are below 2.1, and hence multicollinearity is not a concern (Table 2).

As shown in Tables 1 and 2, the reliability and convergent validity of the constructs are well established; this leads to the next step—the assessment of discriminant validity. Table 3 assess discriminant validity using Fornell–Larcker Criterion and Heterotrait–Monotrait Ratio (HTMT). The AVE values for all the latent variables are greater than the minimum value of 0.5, confirming convergent validity. The square root of each latent variable's AVE is suggested to check for discriminant validity, and a value larger than other correlation values of the latent variables indicates that discriminant validity is satisfied (Fornell and Larcker 1981). Also, the recently proposed HTMT method was applied (Henseler et al. 2015) to assess the discriminant validity of reflectively measured constructs; a value of less than one is considered acceptable to establish discriminant validity (Henseler et al. 2016). Based on a comprehensive literature review and Monte Carlo simulation, Voorhees et al. (2016), published in the *Journal of the Academy of Marketing Science*, conclude HTMT as a "method [that] offers the best balance between high detection and low arbitrary violation" (p.119). They propose a

Fig. 2 Path model and PLS-SEM results



cutoff point of 0.85 as "the best assessment" to establish discriminant validity and as a standard for publication. The results in Table 3 confirm that the values are below this cutoff point, and hence discriminant validity is well established.

Assessing the PLS-SEM output

A bootstrapping procedure (based on 94 cases, 5000 samples, no sign change option) was performed using the latest version of SmartPLS 3 (version 3.2.8) to calculate bootstrap standard errors and check the statistical significance of various PLS-SEM results such as path coefficients (Ringle et al. 2015). PLS-SEM does not provide a standard goodness-of-fit statistic, and thus its output quality is assessed using the coefficient of determination (R^2), cross-validated redundancy (Q^2) and the path coefficients (Sarstedt et al. 2014). Figure 2 presents the R^2 and Q^2. A high R^2 value suggests greater predictive accuracy. Hair et al. (2011) noted that the interpretation of R^2 depends on the discipline, and in some business studies, a value of 0.20 is still considered high. In the study, five of the six constructs have an R^2 value greater than 0.20. Also, the "blindfolding" procedure available in SmartPLS was applied to calculate Q^2 and assess the predictive relevance of the endogenous constructs, with an omission distance of seven. The values of all the endogenous constructs are substantially greater than zero (Fig. 2), indicating the acceptability of the PLS path model (Sarstedt et al. 2014).

Path model and PLS-SEM results

As shown in Fig. 2, the empirical evidence from the Lebanese food manufacturers supported eight of the nine hypotheses (H1a, H1b, H2a, H2b, H3a, H3b, H4, and H5). Only the relationship between institutional pressures and the implementation of food safety practices (H1c) was not supported.

Discussion

The empirical study of the Lebanese food manufacturers supports the appropriateness of the developed conceptual model. Perceived institutional pressures were expected to influence food safety performance by strengthening the manufacturer-supplier relationships and improving the food safety cultures in the organizations. The study confirms the influence of institutional forces on the degree of supply chain integration, i.e., in terms of enhancing long-term relationships (H1a) and strategic information sharing (H1b) between food manufacturers and key suppliers, in keeping with earlier studies (Aung and Chang 2014; van Ruth et al. 2017; Gale and Hu 2011). However, contrary to expectation, perceived institutional pressures did not directly influence the implementation of food safety practices in the organizations but rather indirectly through the strengthening of food manufacturer-supplier relationships. The findings suggest that firms can improve food safety performance directly by increasing the intensity of food safety practices (food safety cultures) in the organization or indirectly by strengthening

Table 4 Total effects of the structural model relationships

	Total indirect effects	Total direct effects	Total effects (direct + indirect)
Institutional pressures → Long term relationship	–	0.494***	0.494***
Institutional pressures → Information sharing	0.282***	0.164**	0.447***
Institutional pressures → Information technology	0.293***	–	0.293***
Institutional pressures → Logistic integration	0.352***	–	0.352***
Institutional pressures → Food safety practices	0.082	− 0.090	− 0.009
Institutional pressures → Food safety output	− 0.005	–	− 0.005
Long term relationship → Information sharing	–	0.572***	0.572***
Long term relationship → Information technology	–	0.593***	0.593***
Long term relationship → Logistic integration	0.516***	–	0.516***
Long term relationship → Food safety practices	0.120*	–	0.120*
Long term relationship → Food safety output	0.069*	–	0.069*
Strategic information sharing → Logistics integration	–	0.589***	0.589***
Strategic information sharing → Food safety practices	0.137*	–	0.137*
Strategic information sharing → Food safety output	0.079*	–	0.079*
Information technology → Logistic integration	–	0.303***	0.303***
Information technology → Food safety practices	0.070	–	0.070
Information technology → Food safety output	0.041	–	0.041
Logistic integration → Food safety practices	–	0.232*	0.232*
Logistic integration → Food safety output	0.134*	–	0.134*
Food safety practices → Food safety output	–	0.576***	0.576***

****p* < 0.01, ***p* < 0.05, **p* < 0.1*

the relationships with key suppliers. In keeping with the TCE theory, food companies have opted for a supply chain approach to respond to food safety risks and economize on transaction costs. Due to the globalization in food trade and the increasing distance, where food is produced and consumed, a supply chain approach has increasingly become a strategic response by food manufacturers in emerging supply chains (Aung and Chang 2014; Ait Hou et al. 2015).

Zooming in the effects of institutional pressures on the food manufacturer-supplier relationships, long-term relationships have strong effects on information technology connection (H2a) and strategic information sharing (H2b) between food manufacturers and their suppliers. Information technology connection (H3a) and strategic information sharing (H3b), in turn, have a strong influence on logistics integration, which is positively associated with the implementation of food safety practices (food safety culture) within the organizations (H4). These relationships are in keeping with prior studies (e.g., Chen and Paulraj 2004; Prajogo and Olhager 2012). The added value of the present study is that such relationships are tested in the context of food supply chains and food safety.

The implementation of food safety practices is strongly and positively correlated with food safety output (H5), as expected. Past studies have indicated the importance of organizational structures supporting food safety such as technological staff, workforce composition, operator competences, technological expertise and laboratory facilities (e.g., Luning et al. 2011; Luning et al. 2015) and food safety culture such as the implementation of food safety standards—ISO 22,000 and HACCP and pre-requisite programs (Psomas and Kafetzopoulos 2015)—to enhance food safety performance in the food industry (Nyarugwe et al. 2020).

PLS-SEM method also allows analyzing the total effects (i.e., the direct and indirect effects in the structural model) and offers a richer picture of the relationships in the PLS-SEM path model (Sarstedt et al. 2014). Accordingly, the PLS-SEM algorithm has been applied to assess the indirect influence of institutional pressures on the target constructs (i.e., logistics integration and food safety output). The analysis revealed interesting perspectives (Table 4). Perceived institutional pressures have stronger indirect effects on strategic information sharing (i.e., 0.282, which is higher than its direct effects, 0.164) and information technology (0.293) and logistic integration (0.347). Strategic information sharing, in turn, has indirect effects on the intensity of food safety practices (0.137) and food safety output (0.079). These results suggest that supply chain integration mediates the relationship between perceived institutional pressures and food safety performance.

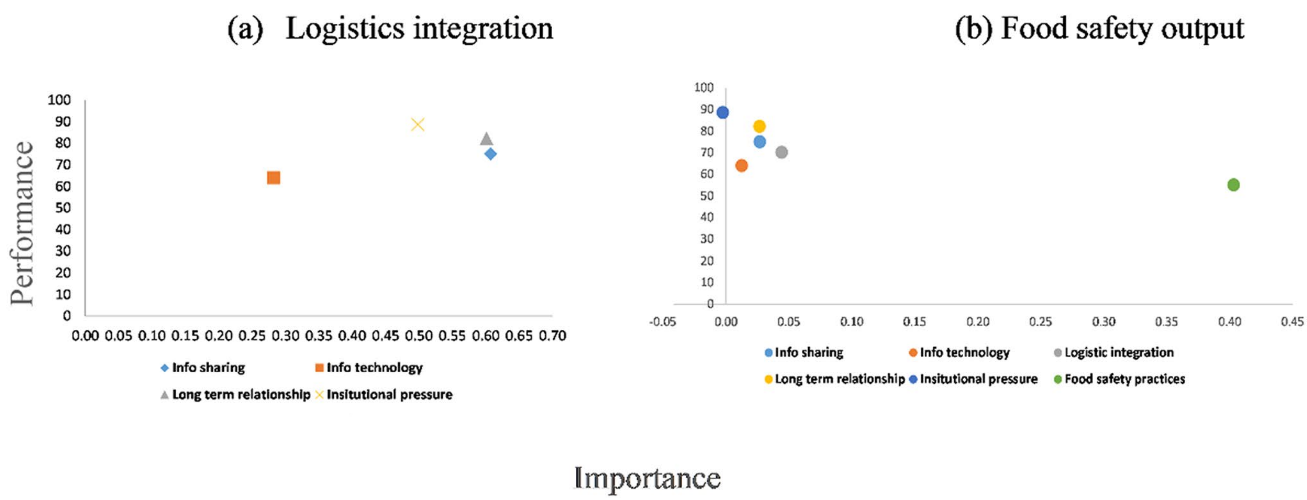


Fig. 3 Importance-performance map of target constructs: **a** logistics integration and **b** food safety output

Finally, PLS-SEM offers the importance-performance map analysis (IPMA), which may be a useful tool to provide practical recommendations for managers on how to enhance their supply relationships and food safety performance. By extending the results of the standard path coefficient estimates in Smart PLS, IPMA helps to identify factors that have a relatively strong influence and potential for improvement on the target constructs (Ringle and Sarstedt 2016). The goal is to identify predecessors with relatively strong total effects (high importance) for the target construct but low average latent variable scores (low performance).

Figure 3 displays the (unstandardized) total effects (importance) on the x-axis and the latent variable scores (performance) on the y-axis. Long-term relationships and strategic information sharing have relatively high importance on the target construct 'logistics integration' (Fig. 3a); food manufacturers may still strengthen the performance of logistics integration by improving their long-term relationships and strategic information sharing with suppliers. More importantly, in Fig. 3b, the latent variable implementation of 'food safety practices' has high importance (0.40) but low performance (55%) for the final target construct 'food safety output'. Meaning, food manufacturers have substantial room to enhance food safety performance by improving food safety practices (food safety culture) within the organizations. All other things remain equal, a unit increase in the intensity of food safety practices would enhance food safety performance by 40%.

Conclusion

Food safety is a public health concern and a major development challenge. Empirical evidence is scarce to guide public policy in the governance of food supply chains. The study has explored the effect of perceived institutional pressures on the degree of food manufacturer-supplier relationships and food safety practices and food safety performance in the context of emerging food supply chains, by applying the latest version of PLS-SEM to handle a complex model structure with a relatively small sample size (see Voorhees et al. 2016; Henseler et al. 2016). The study finds that perceived institutional pressures have strong effects on supply chain integration—i.e., long-term relationships (0.494), strategic information sharing (0.447), information technology connection (0.293), and logistic integration (0.349). However, in the absence of strong manufacturer-supplier relationships, perceived institutional pressures may not lead to improved food safety performance.

The study provides several implications for food manufacturers and policy guiding food safety governance in the context of emerging agro-food supply chains. First, the findings indicate long-term relationships as immediate responses to perceived institutional pressures (on food safety) and the basis for building integrated agro-food supply chains. Thus, food manufacturers should maintain and strengthen their relationships with key suppliers by investing in information technology and strategic information sharing. Second, the findings suggest that food manufacturers cannot improve the performance of food safety without strong food safety cultures within the organization. Although 50% of the food manufactures reported to have implemented ISO 22,000, those companies with own technical staff (i.e., food microbiologists, food quality management expert, etc.) and research laboratories for microbial analyses are only 30% and those that have detailed food safety strategy and food quality (safety) team are only 38%. Thus, food companies have substantial room to enhance the food safety culture and food safety performance of their organization by strengthening their food safety staff (in terms of quantity and competences) and facility and increasing the involvement of employees in the design and modifications of food safety control systems. Third, the findings encourage food manufacturers to establish long-term supply relationships, invest in information technology, strengthen strategic information sharing and logistics integration with supply chain partners to respond to established regulatory demands (coercive pressures), industry competition (mimetic pressures) and social norms (normative pressures). As agro-food companies strengthen their supply chain relationships, they tend to increase the intensity of food safety practices (food safety cultures), which, in turn, are necessary to enhance food safety performance. Fourth, the study establishes perceived institutional pressures transforming the governance of food safety in emerging agro-food supply chains. Public policy may support such transformations by taking (chain-wide rather than firm-specific) measures to enhance the integrity and transparency of agro-food supply chains. Finally, the findings are based on food manufacturers within Lebanon. Future studies may expand the scope of analysis to other agro-food supply chain actors and across geographies.

The study addresses important gaps in the agro-food supply chain literature by exploring the effect of perceived institutional pressures on the governance and food safety performance of agro-food supply chains. First, the study was able to develop and test a conceptual framework that links the principal elements of supply chain integration (i.e., long-term relationships, strategic information sharing, information technology connection, and logistics integration) and food safety management systems to advance our understanding of firm strategic responses to food safety concerns. Second, due to varying levels of regulatory demands, customer requirements, and cultural factors, context-specific studies are paramount to understand the strategic behavior and food safety culture of firms operating in a different set of institutions (Mercado et al. 2018). This study provides empirical evidence on the restructuring of agro-food supply chains in the Middle Eastern context (Lebanon) where food safety concerns are rising (e.g., Bou-Mitri et al. 2018; Abebe et al. 2017; Abebe et al. 2020). Finally, the study establishes a direct link between institutional pressures and the governance of food safety in emerging food supply chains.

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