FINAL REPORT

A GLOBAL VALUE CHAIN APPROACH TO FOOD SAFETY AND QUALITY STANDARDS*

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INTRODUCTION

Today the public is increasingly anxious about the reliability of the entire agri-food system from inputs, production, and distribution to consumption. As international agri-food trade becomes global, so do food safety scandals. A recent milk contamination with melamine in China that caused kidney stones and illness for nearly 300,000 children and six infant deaths thus far has stirred a huge public outcry about the country's food safety system domestically and internationally. Even well-known local and global brands are affected. Indeed, it is China's biggest producer of infant milk powder formula and the major milk suppliers which are at the center of the milk scandal. In Canada, recent confirmed cases of listeriorsis leading to a series of recalls and a plant closing are linked to some of the deli meats made by Maple Leaf, the country's biggest meat processor and one of the top 50 global food manufacturers in the world (see Appendix for recent food safety cases).

In response to these public concerns, governments and industry actors have tightened food safety regulations through an evolution from a simple collection of risk-reducing standards to a proliferation of complex public and private standards. The new standards not only deal with food safety concerns, such as pesticide residue and food additives, but also encompass product quality and social and environmental issues (Henson and Reardon 2005; Reardon, Codron, Busch, Bingen, and Harris 2001). This transformation raises new questions for researchers, regulators and consumer activists concerning what drives this change and what consequences it bears for producers and consumers in both developed and developing countries. Are these new public and private standards leading to products that are safer, healthier, and more socially and environmentally sound? Or do "commercial barriers to trade" block off the access of the poor and smallholders in developing countries to advanced markets through regulatory overprotection

(García Martinez and Poole 2004:230)? How agri-food production is regulated through public and private standards can have significant implications for who the winners and losers are in the global agri-food economy (Henson and Reardon 2005; World Bank 2005).

This regulatory question, however, cannot be fully addressed without understanding the changing organizational structure of the global agri-food value chain. A relatively small number of agri-food multinationals orchestrates food supply though a complicated network of global supply chains that tie daily grocery shoppers in the United States and Canada to small growers in Brazil, Mexico, China, and other exporting countries. While agri-food products today undergo processing through multiple industrialized steps and travel longer distances than ever to reach end consumers, these value chains are tightly managed by private standards that are individually and collectively promulgated and enforced by powerful corporate actors. Surprisingly, we know relatively little about how the organization and governance of value chains affects the mix of public and private food standards and the optimal level of food safety in developed and developing countries.

To address this question, this paper builds an analytical model to explain the relationship between value chain structures, food standards and food safety levels, and we explore the plausibility of this model based on new and previous food safety case studies. By comparing the value chains of several types of products – meats, fruits and vegetables, and dairy products – we can disentangle how value chain structures interact with different food regulatory systems. Moreover, this paper shows how both developed and developing countries are affected by and respond to the transformation of the global agri-food industry as well as the system of changing food safety standards.

Building upon the well-established literature on value chain linkages between European

markets and the African agri-food industry (Dolan and Humphrey 2000, 2004; Humphrey 2008), this paper attempts to fill the gap in the literature concerning the North American linkage with Central and South Americas as well as China. At this initial stage of model building, however, these empirical cases are deployed less for model testing than model specification.

The rest of the paper is organized as follows. Our analytical model and main typologies are introduced in the next section. Case studies then are presented in detail, followed by the discussion of our key findings and the next steps of the research.

ANALYTICAL FRAMEWORK: VALUE CHAIN GOVERNANCE, FOOD SAFETY AND FOOD STANDARDS

In this section, we discuss three key topics: value chain governance, food safety, and food standards. For each, we outline the major trends and introduce the key typologies that help us map out variation in each factor in order to build a model to address the relationships among them.

Governing global agri-food value chains

Agriculture and agri-food production over the last two decades has become increasingly industrialized and globalized (Humphrey 2006; Reardon, Barrett, Berdegué, and Swinnen Forthcoming). Industrialized production is pursued by corporate giants to achieve economies of scale with higher productivity and profits. Mass-scale cultivation and processing now characterize contemporary agri-food production, which is infused with technological and biological advances drawn from intensive research and development (R&D) activities. Additionally, the proliferation of prepackaged and prepared foods has contributed to the rise of

food processors as lead firms in agri-food value chains through intensive technological and market research efforts. The entire supply chain from inputs to retail is tightly scheduled for "just-in-time" production that keeps capital-intensive facilities fully utilized (Boyd and Watts 1997). Most segments of the value chain are concentrated and vertically coordinated by a handful of powerful lead firms with recognizable brands and large processing and buying power (Humphrey 2006; Young and Hobbs 2002).

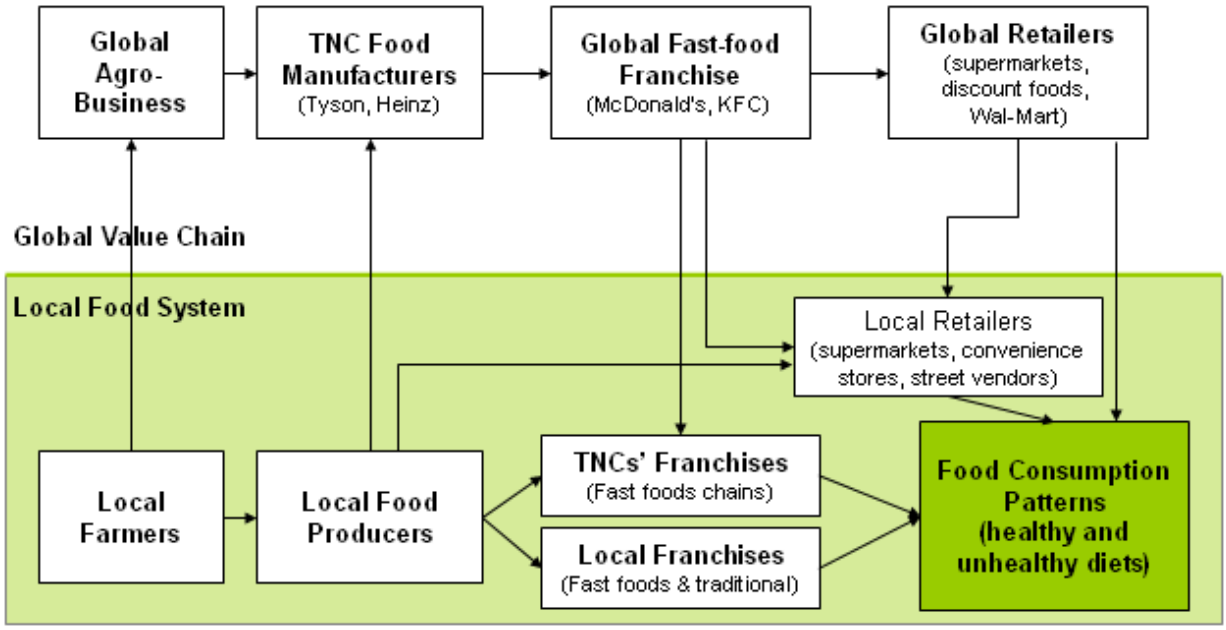
Chicken production is one example of industrialized agri-food production. Fast-food giants like McDonald's and KFC are supplied by a handful of chicken integrators. Two leading integrators, Pilgrim's Pride and Tyson Foods, accounted for 46 percent of the U.S. market in 2006, up from 30 percent in 1996. The productivity of a modernized processing plant has tripled in 15 years, from 80 birds per man hour in 1990 to 225 in 2005. Furthermore, to meet the increasingly diversified demand for processed chicken, Tyson alone produces over 4,600 different chicken products for private label brands as well as for its own labels (Shane 2006; Shelton 2005). They vertically integrate and coordinate the value chain from breeding, growing and processing. While relying on thousands of spatially clustered contract growers, mostly small farm owners, these integrators tightly control growers' activity by providing baby chicks, feed, medication, and technical assistance (Gereffi, Lee, and Christian 2008).

Another significant development is the globalization of agriculture and agri-food production. Along with a liberalized trade regime, globalized production has brought forth cross-national and cross-continental supply chains of agricultural products (Fold and Pritchard 2005). These multinational producers link daily grocery shoppers in developed countries to small farmers in developing countries. North American and European shoppers find fresh fruits and vegetables on a year-round basis, while exporters and farmers in Asia, African and Latin America

find new market opportunities from globalized production. Retailers and supermarkets vigorously pursue a global sourcing strategy, using their buying power to impose safety and quality standards on their suppliers. This, in turn, facilitates consolidation in developing countries, as a tiny number of local agri-food exporters emerge, often marginalizing most small farmers that are unable to meet the standards (Dolan and Humphrey 2004; Maertens and Swinnen 2009).

The contemporary global agri-food value chain operates through the interaction of global and local value chains (see Figure 1). This configuration is mainly driven by multinational lead firms: agro-business giants, diversified food manufacturers, fast-food franchises, and global retailers. They influence how agri-foods are produced, distributed and marketed in both developed and developing countries through ever tighter vertical coordination across the value chain. That does not mean that local suppliers and retailers have no agency vis-à-vis their global counterparts. To the contrary, they are a vital part of the latter's strategy and often benefit from the opportunities provided by global value chains (Jaffee and Masakure 2005). However, their agency and leverage in relation to global players largely depend on their own capabilities, the level of competition they face, and the institutional and regulatory environment in which they are embedded. Therefore, the extent to which each side of the value chain – supplier and buyers – is concentrated, and the way the interface between the two is governed, provide valuable information regarding the opportunities and constraints that exist for local growers and processors with respect to changing food standards in international agri-food trade.

Figure 1: Interaction of Global and Local Food Value Chains



Source: Gereffi, Lee, and Christian (2008)

Food safety and quality standards in transition

As agri-food production became industrialized and globalized, the nature of food safety changed. Industrialized agri-food production has resulted in higher productivity and novel products, but it also involves new and perhaps greater risks relating to the mass production and distribution of food. In elongated but fragmented supply chains, agri-food products are exposed to possible contamination at multiple processing stages managed by different actors (Humphrey 2006:578). Increased contract farming and food processing spread responsibilities of food safety among a wider set of actors. At the same time, it increases the burden of the processors and retailers that have prominent consumer brands and large market share to ensure the safety of the products they manufacture or sell. Safety risks associated with the diffusion of production among a wider set of actors are magnified within the population as concentration in food production and retailing grows.

These problems are intensified by global production and global sourcing. It quickly spreads risk worldwide, while making transparency and traceability in the supply chains more complicated. It puts together diverse food production systems having different levels of safety awareness, regulation and enforcement capacities (Humphrey 2006:578). Thus, food scandals are often turned into complex questions of accountability. Creating equivalence or harmonization across different regulatory regimes and standards has yet to be accomplished, despite a decade of efforts to establish international rules on food trade under the World Trade Organization (WTO) (Orden and Roberts 2007).

The recent Chinese milk scandal illustrates the cross-national character of food safety issues. At least 12 countries thus far have banned Chinese dairy products due to worries about contamination in foods like yogurt, cookies and candies. In Europe, where importation of processed foods containing dairy from China is prevalent, the European Commission ordered testing of imports containing more than 15 percent milk powder. The United States recalled instant coffee and tea drinks containing a made-in-China nondairy creamer. Brazil went so far as to ban all Chinese food imports. However, importing countries cannot fully address the safety risks attached to these products without proper measures by and coordination with the Chinese government authorities and suppliers.

Food standards have evolved in response to this new landscape in the globalized and liberalized food production regime. Traditionally, food products were subject to minimum public quality standards for grain, and quality and safety standards for meat and dairy products. Facing growing health risks from food contamination, however, existing public regulations have tightened up and new public standards have proliferated in recent years. Furthermore, private food standards for safety and quality have emerged since the 1990s (García Martinez and Poole

2004). Private standards are promulgated and enforced primarily by corporate actors in an individual or a collective manner.

Table 1 provides a basic typology and examples of contemporary food safety and quality standards. There are public and private standards, defined by who promulgates and enforces them. Public institutions set food regulations and mandatory standards, making compliance compulsory. While the basic tenet of public regulations is to protect consumers, historically they also act to shape industrial structure by forcing actors who cannot comply out of competition (Fligstein 2001). Private standards can be set by individual firms, often big retail chains, but market participants can also set guidelines collectively in a formal process. Standards can be either mandatory or voluntary, depending on the extent to which they are legally binding. Some private standards are mandatory in a *de-facto* (if not *de jure*) sense, when they gain overwhelming market share and influence and abiding by them becomes critical to gain access to the supply chain.

Finally, as supply chains become more global, so do private standards. The EUREPGAP[1] standards for fresh fruits and vegetables, for example, were initiated by 13 European retailers in the late 1990s, responding to the demands of the U.K.'s Food Safety Act. The name of the program was changed in September 2007 to GLOBALGAP to reflect its expanding international role as one of the major international private standards that link farmers and other suppliers to a growing number of international retailers.

[1] EUREPGAP started in 1997 as an initiative by retailers belonging to the Euro-Retailer Produce Working Group (EUREP). GAP is an acronym for Good Agricultural Practices.

Table 1: Examples of Public and Private Food Safety and Quality Standards

	Public Mandatory	Public Voluntary	Private	
			Collective	Individual firms
National	• National Legislation (e.g., pesticide uses, sanitary inspections)	• Food Safety Enhancement Program • HACCP Advantage • SQF (until 2003) • USDA's National Organic Program	• Dutch HACCP • BRC Global Standard • Assure Food Standards • Qualitat und Sicherhei • Intergrale Keten Beheersing • US's Pork Quality Assurance Program	• Nature's Choice (Tesco Stores, UK) • Field-to-Fork (Marks & Spencer, UK) • Filiere Agriculture Raisonnee (Auchan, France) • Filiere Qualite (Carrefour, France) • Terre et Saveur (Casino)
International	• European Union Regulations • WTO regulations	• ISO 9000 • ISO 22000	• International Food Standard • SQF 1000/ 2000/ 3000 • GLOBALGAP (formerly EUREPGAP)	The same as above (for multinational companies)

* HACCP: Hazard Analysis and Critical Control Point; SQF: Safe Quality Food;
BRC: British Retail Consortium; ISO: International Organization for Standardization
Source: Henson (2006)

Food processors and retailers use their own or collective private standards for a variety of reasons. First, private standards can supplement missing or inadequate public standards. In fact, public standards often cannot keep up with quickly changing trends in agri-food markets, particularly in developing countries. Second, firms can increase profits through product differentiation using their own private standards. Consumers link products to high quality or labor and environmental standards through certification, labeling and branding, which leads to competitive and reputational advantage. Finally, food companies can reduce costs and risks in their supply chains by standardizing products across suppliers. When applied to countries, private standards facilitate the geographical expansion of sourcing networks with minimum risk (Henson and Reardon 2005:245-247).

The distinction between public and private standards, however, is not always clear-cut and they often interact. Private standards in Europe, for example, are considered as "a direct response to the increased stringency of public standards and the obligations they place on food companies" (Humphrey 2006:579). Britain's Food Safety Act of 1990 and the European Union's ensuing General Food Law have facilitated private standards by holding consumer-brand companies accountable for any wrongdoing in the supply chain. By limiting public standards to minimum safety requirement, governments often leave private actors to fill the gap beyond the minimum (Henson and Reardon 2005:252). This holds true for international standards as well. National governments tend to underinvest in international public standards because of their reluctance to cede too much authority to international decision making bodies. However, this often makes public standards outmoded, and leaves private actors with an incentive to create their own standards (Orden and Roberts 2007:111-2).

Alongside a swing to private standards, the introduction of process standards and increasing food quality and social and environmental standards are other significant developments in recent years. Food safety standards regulate pesticide residue, the use of food additives, and hygiene requirements. Contrary to the traditional end-product approach, process standards aim to control all the processes that create the products. Establishing traceability is a key component of process controls, which are extended through the entire value chain from farm (including inputs, such as feed), often in foreign countries, to fork. Hazard Analysis and Critical Control Point (HACCP) is an example of a process standard.

While the new approach has become accepted as a more cost-effective means of reducing food safety hazards, it increases the burden of monitoring and regulating the processes of global manufacturers and retailers, who often have no direct control over offshore farming

operation. There are added responsibilities for suppliers as well. Farmers, processors and exporters in developing countries confront not only heightened regulations in developed country markets, but also many different types of private standards promulgated and enforced individually and collectively by leading buyers. This is why establishing harmonization and equivalence is a critical task to alleviate unnecessary regulatory burdens (Josling, Roberts, and Orden 2004).

Food standards can be comprehensive not only in process but also in scope. Table 2 lists food quality and social and environmental elements alongside those used in food safety. Competition in the agri-food sector is shifting from price-based to quality-based and from undifferentiated commodities to value-added differentiated goods (Henson and Reardon 2005:243). Thus, lead firms use their own standards as a strategic tool for product differentiation and market penetration, extension and segmentation. Some of the food characteristics required by standards are often not intrinsic to the product itself. Consumers cannot be sure by looking if the product is grown organically or whether certain labor, trade, environmental or animal welfare standards have been followed. Such credence claims are difficult to verify through inspection of the product (Reardon et al. 2001). This is another reason process standards are vital, along with accompanying third-party certification (Hatanaka, Bain, and Busch 2005).

Table 2: Food Safety, Product Quality, and Social/Environmental Standards

Food Safety	**Product Quality**	**Social/ Environmental Standards**
Pesticide use and residue limits	Grading	Recycling requirements
Food additives	Freshness	Organic production requirements
Hygiene requirements	Product composition	Labor standards
HACCP	Product cleanliness	Fair trade standards
Traceability requirements	Labeling requirements	Corporate social responsibility
	Nutritional claims	Animal welfare

Source: World Bank (2005)

While there are legitimate concerns that these new private safety and quality standards can place a disproportionate burden on smallholders in developing countries, some developing country suppliers actually succeed in quality-based competition. They use it as a chance to distinguish their products through process and product upgrading as well as a way to differentiate themselves from informal sector producers (Jaffee and Masakure 2005). Their "branding from below" strategy is opposed to retailers "branding from above" (Humphrey 2006:579).[2] Appreciating such variation on each side of the global agri-food value chain is critical to building an analytical model regarding value chain governance and food standards, to which we now turn.

Analytical Framework: Value Chain Governance and Food Standards

Based on the discussion above, we propose a model to address the question of how and to what extent variation in value chain governance explains the types of food standards that prevail in a particular value chain and the overall degree of food safety therein. Figure 2 presents four different situations depending on the degree of concentration in the markets for supply (food processor or supplier) and demand (retailer or buyer).[3] Each box has different characteristics of value chain governance (i.e., who drives and governs the value chain), as well as in the type of food standards most likely to be associated with each kind of market structure. The logic behind

[2] Another mitigating factor on the negative effect of tighter standards on smallholders in developing countries is that while high standards bring forth consolidation into large-scale estate-based production, the welfare effect of high standards for rural households is still positive. Restructuring changes the mechanism through which local households gain incomes: from contract-farming (production markets) to being employed in integrated farming production (labor markets) (see Maertens and Swinnen 2009).

[3] A typical agri-food value chain has two sets of supplier-buyer linkages: one is between farmers and processors, and the other between processors and retailers. Although global value chains analysis generally focuses on the linkage between the retailer sector and its first-tier suppliers, utilizing that particular linkage's key role in defining the governance of the entire chain (Sturgeon 2009), our proposed framework can be applied to both sets of linkage. When it comes to food safety, attention to multiple linkages of the chain has merit because it can show what particular node of the chain is more susceptible to food safety failure than others.

this typology is that the more a particular value chain is concentrated and governed through tight explicit coordination by a few consolidated actors, the more the value chain is likely to contain comprehensive private standards to regulate food safety and quality. Conversely, fragmented value chains at both the supply and demand ends are likely to encounter more limited public standards.

Figure 2: Analytical Model – Value Chain Governance and Food Standards

		Food Demand (retailer/buyer)	
		Concentrated	Fragmented
Food Supply (processor/ supplier)	Concentrated	**(A) Bilateral oligopolies** → Private / Most comprehensive standards	**(C) Producer-driven chains** → Public + private / Safety & quality-focused process standards
	Fragmented	**(B) Buyer-driven chains** → Public + private / Safety & quality-focused product standards	**(D) Traditional markets** → Limited public standards / Least comprehensive standards

Source: Authors' diagram

In Box A, where buyers and suppliers are concentrated, both sets of value chain actors have significant market and brand power, resources, and leverage to govern the value chain. In a value chain that is highly concentrated in both supply and retail, private standards driven by food processors and retailers are likely to be the leading mechanism for regulating agri-food production with the most comprehensive safety and quality requirements. In the U.S. chicken value chain, as shown above, both processors (e.g., Pilgrims' Pride and Tyson) and retailers (e.g., McDonald's, KFC and Wal-Mart) are consolidated and have consumer brands and resources to

implement their own private standards. Furthermore, competition is increasingly based on diversified processed products. In the chicken sector, one of the fastest growing organic food sectors in the United States, there are multiple types of government-regulated or non-regulated labels for organic chicken, such as “Free Range,” “Natural,” “Antibiotics” and “No Hormones” for the former, and “Cage-Free” and “Pastured Poultry” for the latter (Oberholtzer, Greene, and Lopez 2006).

Box B, where buyers are concentrated while suppliers are not, represents a buyer-driven value chain where “large retailers, brand-name merchandisers and trading companies play the pivotal role in setting up decentralized production networks in a variety of exporting countries” (Gereffi 1994:97). This type of chain is frequently observed in many tradable agri-foods from developing to developed countries. Here the leading buyers (retailers in developed countries) have strong power, resources and leverage that allow them to impose their private standards on fragmented suppliers (farmers in developing countries).

The U.K.’s supermarkets, for example, imposed strict safety and quality specifications on African suppliers in the fresh vegetable value chain in the 1990s as greater product variety, product innovation, and increased packaging and process requirements became competitive advantages in the U.K. market. Tightened specifications were also a reaction to an increasingly demanding regulatory environment, as exemplified by the 1990 Food Safety Act and European Union Directives (Dolan and Humphrey 2000; 2004). Therefore, while the concern about fragmented, small-sized suppliers can bring forth certain basic public safety regulations, quality-minded retailers are likely to develop sophisticated private standards both individually (e.g., Tesco’s Nature’s Choice, Carrefour’s Filiere Qualite) as well as in a collective manner. Both the GLOBALGAP and the British Retail Consortium (BRC) Technical Standards are driven by

European and British retailers, but they also incorporate the principles of HACCP, a public standard.

In general, the agri-food value chain is characterized by the presence of strong retailers as lead firms, given the heightened consolidation in the retail segment (Kaufman 2007). Even producer-driven chains (Box C), once dominated by large brand-name processors like Heinz and Nestle, have tilted toward a bi-polar value chain (Box A), as powerful retailers began to challenge their power (Vieira 2006). As long as most of its production activities are done in-house, the producer may have less incentive than the retailer to develop its own standards for suppliers, whose private label products are mostly made by independent suppliers. As more inputs and tasks are outsourced, however, the producer's buying activities become as important as its own production. These producers may focus more on process standards to ensure the suppliers follow the defined procedures. The best examples of this type of chain are products that are sold in grocery stores as well as other retail outlets, such as gas stations.

Finally, despite overall increased concentration in agri-food production and retail, the level of concentration varies by product, and by importing and exporting countries. When both the supply and demand for food are fragmented (Box D), there is likely to be no or limited public standards that only cover basic safety concerns. Private quality and social and environmental standards are least developed here compared to the other three boxes. This can be the case for traditional agricultural commodities that are traded in local farmers' markets oriented toward domestic consumption, rather than exported to foreign markets. Actors in this type of chain have no brand recognition and transactions among them are largely price-based. The vacuum in standards can make this type of value chain more prone to food contamination and other food scandals.

Our typology in Figure 2 has policy implications as well as predictive power in terms of the types of standards likely to emerge. Different policy concerns can arise depending on the relationship between producers and retailers. When powerful retailers and processors play a leading role in setting and enforcing comprehensive standards for their product differentiation strategies (e.g., Box A), more policy attention may have to be paid to the potential anti-competition and overregulation effects of those standards. Conversely, in a situation where public safety and private quality standards are both in short supply (e.g., Box D), the primary focus of public policy intervention should be to ensure a basic level of food safety in underregulated sectors.

This analytical model is still very simple. First, not only does value chain governance affect the food standard system and the level of food safety, but the latter can also influence the former. Many studies have documented consolidation, procurement centralization, and tightening vertical coordination following the introduction of stricter food standards (Henson and Reardon 2005; Jank, Leme, Nassar, and Filho 1999). It is the same for food safety. The prevalence of food contamination in a previous period may subsequently lead to higher food standards and tighter value chain governance later. Or stringent food standards may lead to divergence among value chain actors. When importing countries tighten their standards for imported goods, large growers who are capable of meeting the standards remain in exports, while small farmers who are unable to do so may be forced out of business or into a domestic market that has lower safety requirements (Cervantes-Godoy, Sparling, Avendaño, and Calvin 2007). Likewise, when public regulation requires substantial investment in food safety measures, small producers may move to the informal sector, where such regulation is unenforced (Farina, Gutman, Lavarello, Nunes, and Reardon 2005). Therefore, a complete model should include the feedback linkages and be

dynamic over time.

Second, other factors can affect the relationships in question. First, while the model can be applied to domestic value chains with little modification, it is an empirical question how they might differ in terms of chain governance and food regulation. The market orientation of the chain – (a) the relative importance of exports, and (b) the destination of these exports – can matter. In other words, we would expect that the more export-oriented a food or agricultural product is, and the more these exports are destined for developed country markets, the greater the likelihood of private standards to supplement public standards is (unless the public standards used are those of the importing country).

Industry-level ownership structures – state versus private, foreign versus domestic, joint ventures, and so on – can affect the relationship as well. For example, sectors populated by state-owned enterprises are more likely to be subject to public oversight than private counterparts are. Similarly, sectors where foreign-owned firms have power in developing countries may have higher safety and quality standards than sectors dominated by domestic firms.

Finally, the *capacity* to set and impose the standards – both by the buyers and the suppliers – is as critical as the *incentives* to do so (Henson and Reardon 2005:247-8; Reardon et al. 2001:428). The ability to organize a concerted effort may relate to sectoral structure, that is, the degree to which the sector is concentrated or fragmented. Notwithstanding these additional factors, we believe the proposed model provides a useful starting point to generate plausible hypotheses concerning the relationship between value chain governance and food safety and quality standards.

CASE STUDIES

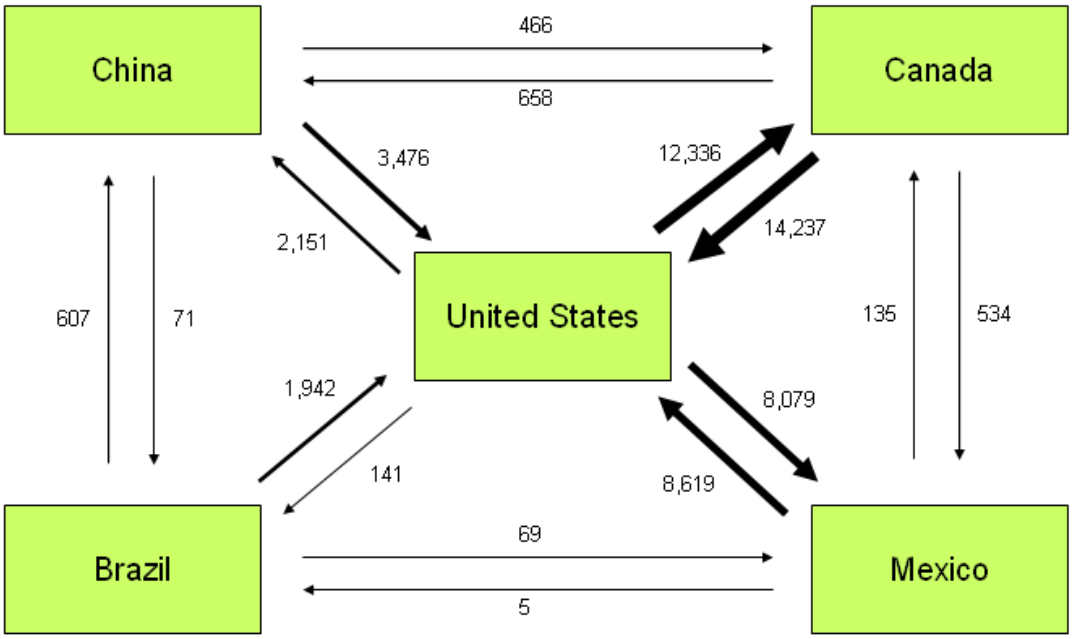
Based on the proposed framework, we focus in this section on a series of domestic and transnational food value chains in the Americas and China, with an emphasis on exports to the U.S. market: (1) dairy value chains in China and Canada; (2) beef value chains of Brazil and Mexico; and (3) cantaloupe value chains of Mexico. We also draw from the findings of relevant case studies in the existing literature to complement these primary cases. Table 3 summarizes the characteristics of each case in terms of the key variables outlined above.

Table 3: Summary of Case Studies

Country-Product Case	Degree of concentration				Export Orientation	Standards		Types
	Farmer	Processor (Exporter)	Domestic retailer	Foreign retailer		Public	Private	
China: Liquid Milk (-1990s)	Low	Low	Low	-	Low	Weak	Weak	Type D
China: Liquid Milk (2000s-)	Low	High	Medium	-	Low	Weak	Weak	Type C
Canada: Liquid Milk	Medium	High	High	-	Low	Strong	Strong	Type A
Brazil: Beef	Medium	High	High (mostly foreign-owned)	High	High (Europe)	Strong	Strong (high-end) Weak (low-end)	Type B (high-end) Type D (low-end)
Mexico: Beef	Low	Medium	Medium	-	Low	Weak	Weak	Type D
Mexico: Cantaloupe	Low	Medium	High	High	High (US)	Weak	Strong (export) Weak (domestic)	Type B (export) Type D (domestic)

Figure 3 presents agricultural trade flows among the five countries we focus on in this study. In terms of trade values, the United States is most tightly connected to Canada and Mexico, the two NAFTA countries. It also shows that the United States is the most important export market for the rest of the countries as well. Agricultural trade among non-U.S. countries is relatively small in value, compared to their trade with the United States.

Figure 3: International Agri-Food Trade Flows of Selected Countries, 2006 (US$ Million)



* Note: Used SITC (Rev. 3) 01 (food and live animals) category and based on the exporting country's reports; China includes Hong Kong and Macao, SAR. Trade between Canada and Brazil, and China and Mexico is not presented for brevity's sake (each amounts to smaller than US$400 Million).
Source: UN Comtrade

The Dairy Value Chains: China and Canada

The dairy sector in China, as noted above, has recently suffered a series of highly publicized food contaminations that led one of the major producers, Sanlu Group, to finally go bankrupt in December 2008 (Wong 2008). In Canada, a cheese manufacturer, Ivanhoe Cheese Inc., recalled its three brands of cheese due to the possibilities of listeria contamination, although there was no reported illness (Loriggio 2008). While food safety concerns arise in both settings, contrasting industry structures pose different levels of risk to consumers in each country, which allow us to apply our analytical framework to the cases.

China and Canada show a stark contrast in many aspects of the dairy value chain and food standard system. While Canada's milk value chain is highly concentrated in both production

and retailing and contains tightly managed public standards alongside private standards for quality differentiation (Type A in our typology), milk processors in China have only recently experienced concentration in the face of drastically increased consumption and production, but raw milk suppliers remain fragmented. As a result, China's dairy sector has transformed from traditional fragmented markets (Type D) to producer-driven chains (Type C). However, severe competition among processors for milk supply in China, in contrast to a stable competitive environment in Canada, has left them with a lack of private standards alongside ineffective and corrupt public oversight.

China

China's recent infant formula contamination involving melamine, an industrial chemical used in plastics, caused kidney stones and illness for nearly 300,000 children and six infant deaths as of December 3, 2008. Melamine was added to watered-down milk to fool quality inspectors with artificially high protein levels because it is a nitrogen-rich compound (Fairclough 2008). Unlike the initial announcement by the state media that the contaminated formula was only retailed domestically, later reports indicated that some formulas were exported. A nationwide inspection of 175 Chinese companies producing milk powder showed 22 used melamine. At least 12 countries banned Chinese dairy products due to worries about contamination in foods like yogurt, cookies, and candies. China's milk exports have dropped by 92 percent since September, when the scandal was first made public (Jacobs 2008).[4]

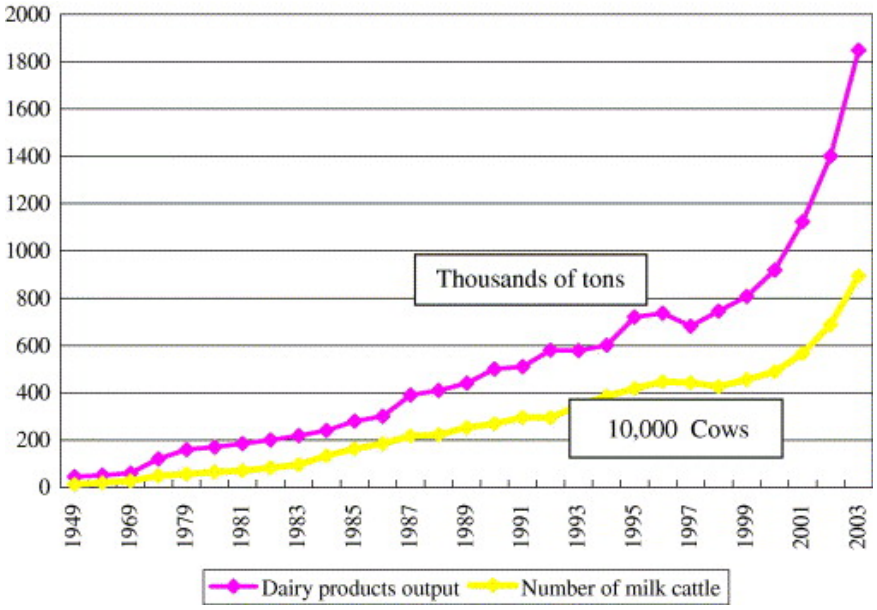
Facing blame for the illicit additive, farmers point to the price controls on food by the government and ensuing milk processors' cost-cutting effort as providing financial incentives for

[4] More recent tests following melamine-tainted infant formula found that eggs imported from China to Hong Kong were also tainted by melamine. It is suspected that in China melamine had been used for years in animal feed, which suggest the use of melamine could be more widespread than initially thought (Barboza 2008).

milk dilution. In fact, following government price controls implemented to combat inflation, Sanlu and other dairy companies lowered prices earlier in 2008, but the burden of cutting costs was placed on many farmers in the upstream segments of the dairy value chain, who have weak bargaining power *vis-à-vis* the big processors. While the blame game still continues, a broader picture of the Chinese dairy value chain, as shown below, highlights that the food standards system in the sector failed to align with drastically shifting industry structures, thus generating vulnerable points within the chain.

Over the last decade, the demand for liquid milk has dramatically risen in China, and so has production. Since the late 1990s, liquid milk consumption in urban areas has grown annually at double-digit rates. The average urban resident in 1996 only consumed a milk equivalent of 4.8 kg. per capita of fresh dairy products, while in 2003 consumption quadrupled to 18.6 kg. per capita. Rising household incomes, a changed perception of milk products as regular food items, increased advertising and marketing, and the adoption of school milk programs are cited as contributing factors. In production, as shown in Figure 4, there is a sharp upturn in the mid-1990s. The annual growth of dairy products output was nearly 20 percent between 1997 and 2003, which made China world's 7th dairy producers by the mid-2000s (Fuller, Huang, Ma, and Rozelle 2006).

Figure 4: The Growth of China's Milk Sector, 1949-2003



Source: Fuller et al. (2006:207)

The quick expansion of milk production and consumption has transformed the structure of the value chain. A traditional system in which small local producers deliver the milk to the consumer's home has given way to concentrated national brand producers and increased sales through supermarkets (see Figure 5). The leading producers increased their share in the expanding market. The top four firms, most of which were established in the 1990s, accounted for more than 50% of China's drinking milk sales in 2006, compared to 33% in 2002 (Table 4).

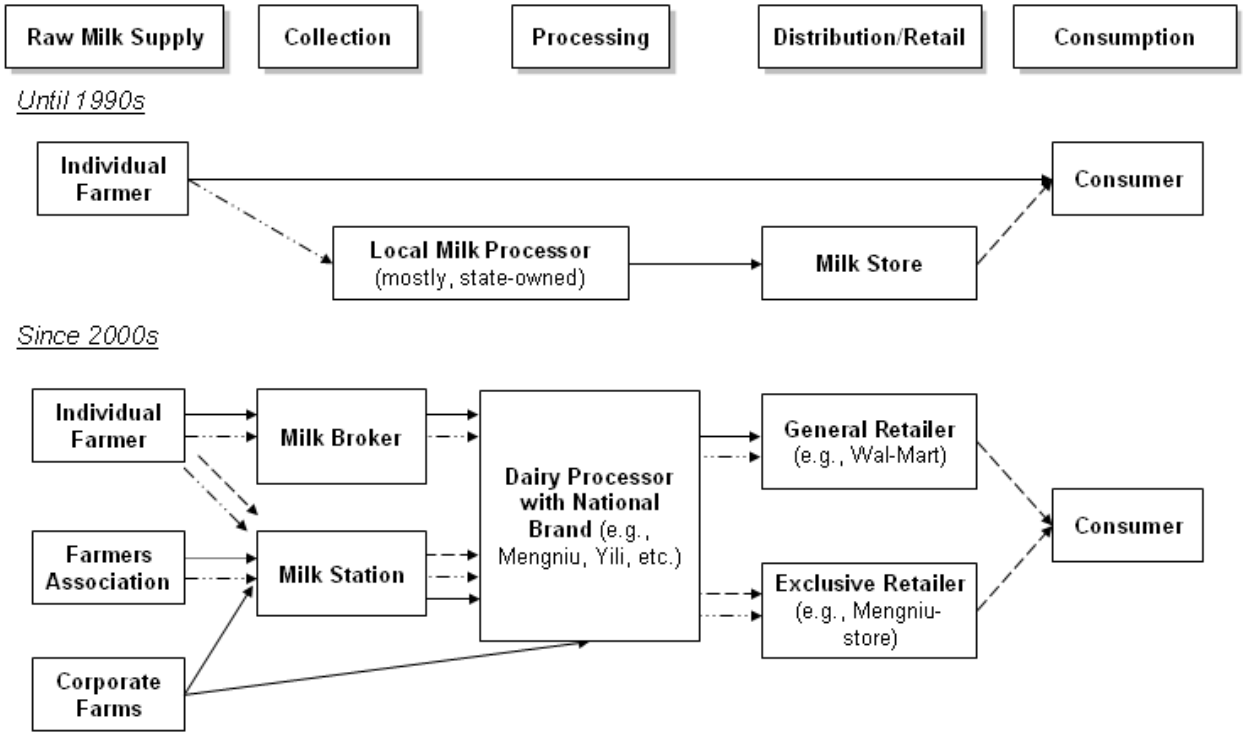
Table 4: Company Shares of Drinking Milk Products in China, 2002-2006 (%)

	2002	2003	2004	2005	2006
Mengniu Group	4.4	8.5	12.1	14.8	18.9
Yili Industrial Group	9.8	12.5	14.8	16.3	17.6
Sanlu Group	7.9	8.5	8.7	8.8	8.5
Bright Dairy & Food	10.5	7.9	7.1	6.3	5.6
Wahaha Group	4.5	4.5	3.6	3.6	3.6
CR4	32.7	37.4	42.7	46.2	50.6
Total Value (RMB million)	40,800.6	52,969.0	65,503.8	80,595.3	94,750.4
(US$ million)*	4,929.4	6,399.5	7,914.0	9,835.2	11,883.4

* Converted with US Department of Agriculture's Agricultural Exchange Rate Data Set (http://www.ers.usda.gov/Data/ExchangeRates/)
Source: Euromonitor International (2007)

The concentration in milk processing and retailing, however, has not been accompanied by concentrated raw milk production, as shown in Figure 5. China's top dairy processors still rely on highly fragmented suppliers of raw milk. Much of the supply comes through independent, often small, and unregulated brokers who collect the raw milk from farmers, each of whom on average has three or four cows (Fuller et al. 2006). This complicated supply chain structure is confounded by the fact that the supply of raw milk falls short of increased demand. Thus, severe competition occurs among new entrants and existing processors for the supply of raw milk when the former add large facilities (Fuller et al. 2006). This further undermines the ability of the processors to enforce standards over farmers.

Figure 5: China's Dairy and Milk Value Chain in Transition



Note: Solid lines represent ownership relationship; dash-and-dot lines are contract relationship; dash lines denote the market relationship
Source: Authors' diagram

For example, Mengniu, the largest dairy producer, gets raw milk through its own milk station. However, as they have expanded their capacity quickly by acquiring local processors over the last decade, much of the milk supply still comes from independent brokers. Contract relationships between farmers and processors are on the rise, but they are limited and fragile because farmers often show no contractual commitment amid “dairy wars” over raw milk supply among processors (Fuller et al. 2006).

While the milk processors and retailers have become highly concentrated in a very short period, regulating milk safety and quality still relies on thin public standards. Enforcement of the standards is further hampered by corruption in the form of bribery of local regulators. Currently no licensing requirements or quality standards are required to become a dairy supplier in China; private safety and quality standards have yet to be put in place. In this regard, China’s dairy case does not perfectly fit the proposed model. However, it highlights the fact that food safety risk could be heightened dramatically when a standards system fails to keep pace with drastic industrial change. At the same time, the proposed model allows us to anticipate what type of standard system China’s dairy sector is mostly likely to have in the future.

In fact, following the outbreak, the Chinese government announced its bolstered efforts to guarantee the safety of the dairy supply. The proposed measures include 24-hour nationwide supervision of dairy supply by 5,000 inspectors sent out by the national government, compulsory test of all raw milk for melamine and other additives, and tightened inspection of exports to match standards of import nations (Chao 2008). However, the effectiveness of this proposal remains to be seen. Whether private standards will prevail in coming years hinges on leading dairy processors’ strategies in relation to the structural circumstances at which they are situated.

In sum, this account shows a drastic shift of China's dairy sector from a very fragmented value chain with little public and no private standards (Type D) to one closer to a producer-driven chain (Type C). However, a more appropriate form of chain governance and food standards that could ensure the safety of dairy products has yet to be put in place.

Canada

Canada's dairy industry contrasts significantly from the one in China in terms of both value chain structure and its regulatory system. It is tightly regulated based on a supply management system with planned domestic production, and pricing and import controls to prevent price fluctuations from impacting dairy farmers (Canadian Dairy Information Center 2008). Processors are not allowed to demand more milk than the quotas assigned to them based on sales. They can only increase their quotas by showing evidence of increased sales. As a result, margins for processors and retailers, as well as market shares of firms, have changed little since 1996, as shown in Table 5.[5]

Table 5: Company Shares of Drinking Milk Products in Canada, 2002-2006 (%)

	2002	2003	2004	2005	2006
Agropur Cooperative	23.6	24.0	24.3	24.7	24.9
Parmalat Canada	25.6	25.1	23.8	23.9	24.6
Saputo	18.5	17.2	17.7	18.2	18.9
Neilson Dairy	9.8	12.6	13.6	14.3	14.6
Nestlé Canada	2.1	2.1	2.1	2.1	2.0
CR4	78.9	79.3	81.1	83.0	83.2
Total Value (C$ million)	2,848.9	2,941.4	3,024.5	3,115.5	3,214.1
(US$ million)*	1,815.4	2,099.4	2,324.7	2,571.0	2,833.4

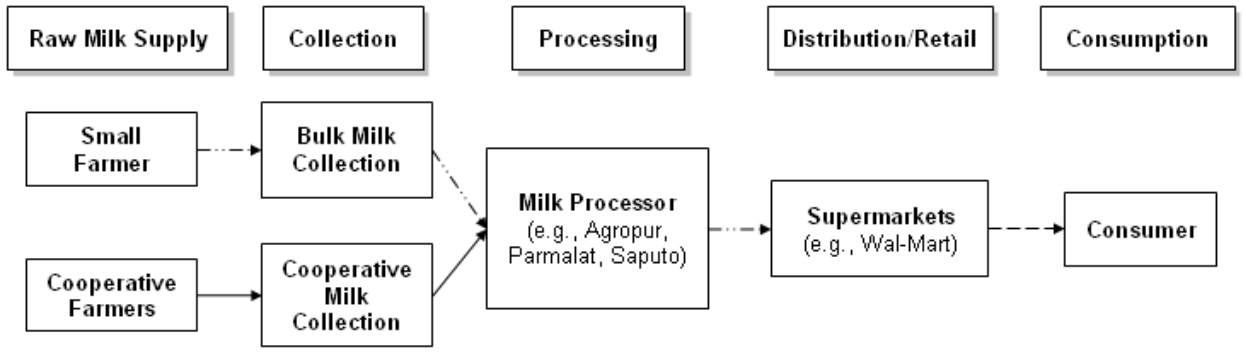
* Converted with US Department of Agriculture's Agricultural Exchange Rate Data Set (http://www.ers.usda.gov/Data/ExchangeRates/)
Source: Euromonitor International (2008)

[5] In 1996-2004, 60% of margins went to farmers and 40% to processing and retailing (Hemme and Wesseling 2006).

Production is heavily concentrated in the three largest processors (Agropur, Parmalat, and Saputo), which process 80 percent of Canada's milk. Agropur is a private cooperative of 3,700 Quebec dairy farmers who own both dairy farms and manufacturing and processing plants for the Natrel and Quebon brands under Agropur. Parmalat is a multinational corporation based in Italy that owns the popular Lactantia brand. Its Canadian subsidiary was formed from its acquisition of Beatrice Foods Canada in 1997. Montreal-based Saputo is the world's 19th-largest dairy producer and owns the leading Dairyland brand. In October 2008, it acquired George Weston's Neilson Dairy – the fourth largest milk processor in Canada – to become Canada's largest milk producer.

The value chain structure of Canada's drinking milk sector is much more streamlined than China's. The entire value chain is either tightly coordinated or vertically integrated by the processor (Figure 6). The supply chain for Agropur's Natrel brand, for example, starts at the cooperative member's dairy farm in Quebec. The raw milk is then pooled in one of the cooperative's premises in Quebec. The milk is then taken to the manufacturer's factory and processed at that point. The entire value chain up to the end product is owned by the cooperative of Quebec dairy farmers.

Figure 6: Canada's milk value chain



Note: Solid lines represent ownership relationship; dash-and-dot lines are contract relationship; dash lines denote the market relationship
Source: Authors' diagram

Slim margins for processing activities lead processors to focus on value-added attributes for higher pricing. For instance, Agropur Cooperative launched the "Natrel Nature Pure" brand, claiming it to be "more pure" than standard milk due to a new filtering process that consists of a unique centrifugal system. The filtering process removes over 99% of spoilage bacteria, resulting in milk that allegedly tastes and stays fresher than regular milk. The new product has led to increased sales, higher prices, and higher profit margins. Saputo has made a similar move for its Dairyland brand. However, that milk is still regarded as a standard commodity in Canada, which has constrained the processor's strategy for product differentiation.

Along with private safety and quality standards, the Canadian diary sector is subject to a variety of public – national and provincial – regulations. Key national regulations include: Canada Agricultural Products Act Dairy Products Regulations; Food and Drug Regulations; National Dairy Regulation and Code; Organic Production Systems: General Principals and Management Standards / Permitted Substances List. The Canadian On-Farm Food Safety Program (1997) helps implement a HACCP-based program on dairy farms. Most provinces also have their own Dairy Industry Acts and supplemental regulations. Thus, all milk in Canada must be free of antibiotics, recombinant bovine somatotropin (rBST) hormones and preservatives. The two main regulations governing dairy products are the Food and Drug Regulations and the Dairy Products Regulations. Division 8 of the Food and Drug Regulations outlines standards for dairy products. The Dairy Products Regulations set standards for the industry to follow for eligibility to export inter-provincially or internationally. Export privileges require registration with the

Canadian Food Inspection Agency (CFIA). Regulations also outline health and safety standards as well as packaging and sterilization information.

The presence of strong public and private standards does not ensure food to be contaminant-free. In August and September 2008, cheese manufacturer Ivanhoe Cheese Inc. recalled three brands of cheese due to the possibility of contamination with listeria monocytogenes. There were no reported illnesses due to the recalled products. Metro, Richelieu, Ami, and Extra grocery stores pulled the products from shelves (Loriggio 2008). That holds true for other sectors. For example, a recent listeria contamination with Maple Leaf deli meat caused at least 20 deaths and thousands of related illnesses in August 2008. The case highlights the failure of regulation to prevent safety issues, even for the leading manufacturer in a tightly coordinated sector. The accumulation of bacteria inside meat slicing machines, which caused the contamination, is a common issue with industrial meat processing. Although the company maintained its own safety standards and recalled contaminated products and closed the plant after the bacteria was detected, it could not completely contain the widespread damage. This case also cast light on the effectiveness of private regulation. Some critics blame the food safety system for increasing private self-regulation alongside limited public oversight, particularly on-site (Professional Institute of the Public Service of Canada 2008). It was revealed that in the Maple Leaf case the regulator dropped its rule requiring meat-processing companies to alert the government about listeria contamination earlier that year (Cribb 2008).

In short, China and Canada show a contrast in both the organization of their dairy value chains and their food standards systems. A rapid shift from traditional markets (Type D) to producer-driven chains (Type C) in China's milk value chain has come without the establishment of adequate public and private standards, which generated vulnerable points in the system. In

Canada, value chain structure is stable with highly concentrated processing (Type A) with public and private safety and quality standards in place. However, it does not guarantee contamination-free and increasing reliance on private self-regulation is criticized for its ineffectiveness.[6]

The Beef Value Chains: Brazil and Mexico

Unlike the dairy sector cases of China and Canada, both of which are mostly oriented toward domestic consumption, beef value chains in Brazil and Mexico show a great deal of contrast in terms of market orientation and structure of the food standards system. While Brazilian beef production caters to both domestic and foreign buyers with producers and exporters considerably concentrated, Mexico's beef production is geared to a domestic market that is largely fragmented in production and distribution and undifferentiated in consumption. These contrasting characteristics of the beef value chains relate to different food safety and quality standards systems. Brazilian beef export value chains are characterized as bilateral oligopolistic (Type A) or buyer-driven (Type B), where private safety and quality standards play a great role alongside public standards. Meanwhile, Mexican beef value chains are traditional markets (Type D) and suffer from the lack of adequate standards and oversight, as do low-end domestic value chains in Brazil.

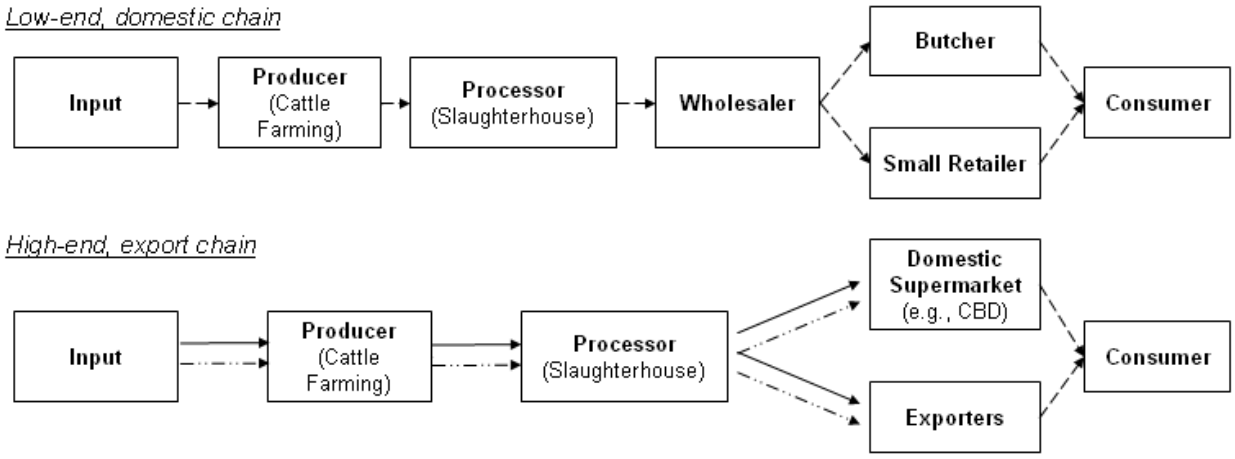
[6] One can argue that this difference between China and Canada due to the different level of development of each dairy sector. Our analysis does not preclude this possibility. Indeed, we believe post-outbreak efforts by the Chinese government and the industry to strengthen food safety regulations will eventually contribute to closing the regulatory gap between the countries. However, this does not mean China will have the same types of food standards in place as Canada has anytime soon. Different market and sectoral structures can lead to the divergence of standards systems even between countries with similarly developed dairy sectors, as shown in the cases of Argentina and Brazil (Farina et al. 2005).

Brazil

Brazil is the second biggest beef producer in the world and the third largest exporter. The main destinations for Brazilian exports are European Union countries and Russia, especially for processed meat. Outbreaks of food-and-mouth disease (FMD) are more sporadic compared to other neighboring competitors, such as Argentina and Uruguay, and Brazil is regarded as extremely successful in combating FMD and making notable improvements in its sanitary and traceability programs (Rich 2005).

A deeper look at the internal structure of the Brazilian beef sector, however, reveals a more complicated picture of the beef value chain and its consequences for food safety and standards. On the production and retail side, large supermarket chains have replaced traditional small butcher shops as the major marketing channel for beef products, particularly in large urban areas. This has brought forth a high-quality value chain channel that is directed to export markets and urban domestic markets alongside a traditional low-quality market-governed value chain (see Figure 7). In the former, the retailer builds a long-term contractual relationship or vertically integrates with the slaughterhouse and some stages of cattle farming, skipping the broker or wholesaler. Meanwhile, low-end chains are characterized by price-based market governance with little explicit coordination among chain actors. This bifurcation is also facilitated by the rise of quality-conscious domestic consumers as well as increasing awareness of quality management for the external market (Vieira 2006; Zylberztajn and Filho 2003).

Figure 7: Brazil's Beef Value Chain



Note: Solid lines represent ownership relationship; dash-and-dot lines are contract relationship; dash lines denote the market relationship

Source: Adapted from Zylberztajn and Filho (2003)

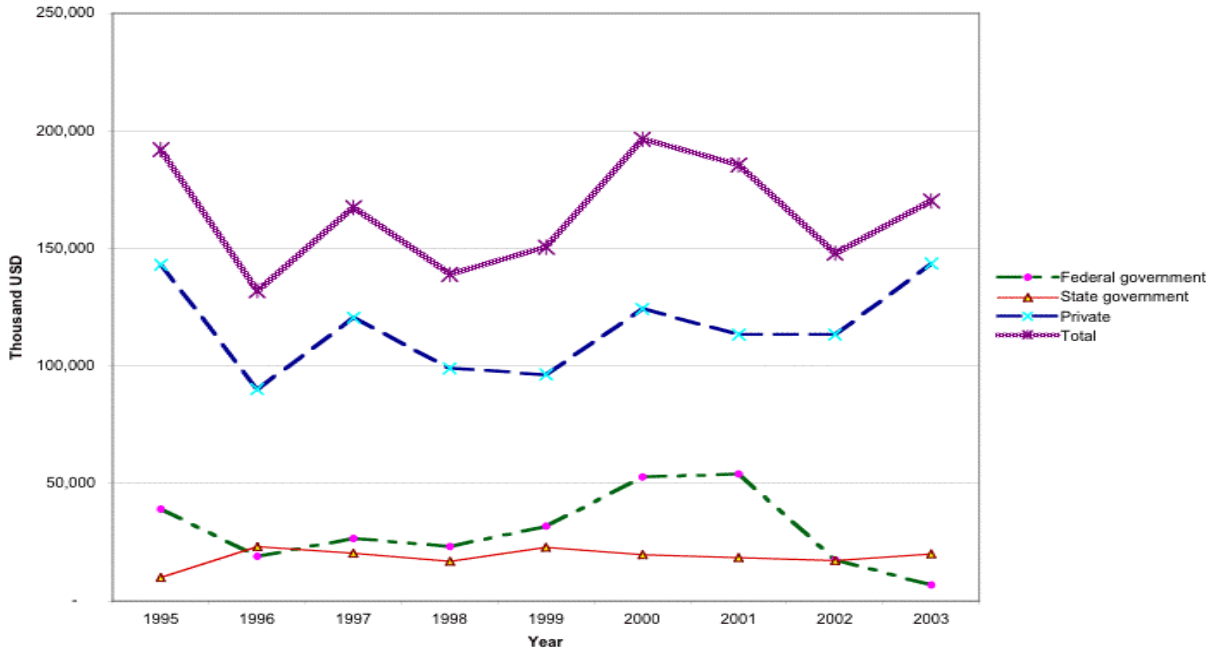
Value chain governance in the high-quality segment has been tightened via marketing alliances between cattle farmers, slaughterhouses and supermarkets. They focus on long-term commitments for the supply of high-quality meats for niche markets. This alliance is partly facilitated by higher concentration in beef processing in Brazil than in other countries. The five largest packers in Brazil account for 60 percent of beef exports, much higher than in Argentina, where the four largest packers control less than 15 percent (Rich 2005:21). While traditional outlets for beef, such as butchers and small retail stores, remain fragmented, emerging supermarkets that play a bigger role in the high-end chains are considerably concentrated. Of the top six retail chains, three are foreign-owned (Carrefour, Wal-Mart, and Sonae), and only one is operated by national capital (Sendas). These buyers play a leading role in lowering the margins of processors, promoting modernization and increasing the scale of operations of meat processing and distribution. In this regard, while Brazilian low-end beef chains are characterized

as traditional markets (Type D) with both suppliers and buyers fragmented, the high-end chains are categorized as bilateral oligopolies (Type A) or, more likely, buyer-driven chains (Type B).[7]

Consistent with our framework, the private sector plays an active role in controlling disease and promoting beef exports in the post-FMD period. As shown in Figure 8, it was ahead of federal and state governments in expenditure on disease control in 1995-2003. The expenditure includes establishing and monitoring through the Brazilian System of Identification and Certification of Origin of Cattle (SISBOV), which allows the maintenance of information on farm origin, animal identification, date of birth, gender, breeding system, vaccination, and health information, and sales records. Also, private quality assurance schemes (QAS), while relatively new in Brazil, are actively promoted by the retail sector, which is heavily foreign-owned. For example, Vieira (2006:24-25) finds beef quality standards imposed by a European retailer are the same as those used in this supermarket's home country. The standards encompass the whole production and process systems and include a clause regulating ecologically friendly production and animal welfare. The retailer also requires its suppliers to follow a livestock traceability system, SISBOV. In return, the suppliers' beef products are certified to be sold in all international shops of the supermarket chain. At the same time, public regulations in Brazil are constantly updated according to changes in European Union directives and other international public standards (Vieira 2006).

[7] While a significant level of concentration in export-oriented beef processing may make the chain appear as a bilateral oligopoly, a buyer-driven chain may be a more adequate characterization in Brazil considering the power wielded by the buyers, mostly supermarkets in developed countries, over suppliers.

Figure 8: Expenditure on Disease Control in Brazil's Beef Sector, 1995-2003



Source: Rich (2005:16)

However, the traceability program is only required for producers and processors exporting premium beef. In the low-end traditional subsector, cattle is regarded as a cash maker rather than a production factor, and farmers have no commitment to improving quality and adopting advanced management tools. Since transactions are price-driven in the low-end value chain, specific investments in safety and quality, such as high-quality herds and cooling equipment, is less likely to lead to immediate returns than in the quality-minded value chain (Zylberztajn and Filho 2003). In this regard, the traditional beef value chain in Brazil is characterized by limited public standards and lack of private safety and quality standards.

Mexico

Unlike Brazil, the beef sector in Mexico is oriented toward domestic consumption with little export.[8] In 2006, Mexico's beef exports were US $132 million, 67 percent of which was destined for the United States, 19% to Japan, and 12% to South Korea. Exported beef is a relatively small portion of Mexico's beef production, accounting for 1.8 percent of domestic production in 2007 (USDA Foreign Agricultural Service 2007). In 2006, Mexico imported $973 million of beef, 85 percent of which came from the United States (Table 6).

Table 6: Mexico's Top Export and Import Markets for Beef, 2006 (USD Million)

Export			Import		
Region	**Trade Value**	**Share (%)**	**Region**	**Trade Value**	**Share (%)**
USA	88.4	67.0	USA	822.9	84.55%
Japan	25.1	19.0	Canada	120.1	12.34%
Rep. of Korea	16.4	12.4	New Zealand	9.9	1.01%
Costa Rica	2.0	1.5	Chile	9.4	0.97%
Dominican Rep.	0.2	0.2	Australia	5.9	0.61%
Total	132.1		Total	973.3	

Note: SITC (rev. 3), 011 (Bovine Meat)

Source: UN Comtrade

The beef value chain in Mexico is very fragmented. The primary beef production sector is made up of a large number of small cattle operations. The lack of productivity is a common feature of these operations. Processing activities consist of federally inspected slaughter plants (TIF, Tipo Inspeccion Federal), a modernized segment, and municipal abattoirs, a traditional sector that is exclusively dedicated to local market supply. The latter is still popular because they

[8] Discussion on the structure of Mexico's beef value chain in this section mostly is drawn from Anderson et al. (2002).

usually carry lower costs than the TIF plants, which are limited in number (Anderson et al. 2002).[9]

Consumption of beef in Mexico is largely undifferentiated. Consumers strongly favor fresh meat, and there is only a marginal difference in price among different carcass parts. Therefore, producing quality beef cuts provide little premium for producers. As in Brazil, beef retailing in supermarkets is on the rise, but public markets and small butcher shops in the most populated areas are still the main retail outlet for beef, alongside the traditional "taquerias," which are small restaurants specialized in typical food, where beef and other meats are basic ingredients.

This fragmented nature of the value chain alongside the focus on domestic consumption has left Mexico's beef sector generally underdeveloped in food safety and quality standards. While the cow-calf operations in Northern Mexico must meet heightened sanitary regulations included in the NAFTA agreement due to its orientation to the U.S. market, neither the U.S. nor the Mexican governments impose any safety requirements on farms and processing plants. While some Mexican farms and processing plants have high standards of sanitation, which are needed to supply U.S. supermarket chains, there is no public list of the sanitary practices required by these retailers. It is largely the responsibility of the supermarkets and restaurants to police the products themselves (Walsh and Rodriguez 2008). Thus, even those export-oriented plants have become a source of safety concern by importing countries. In September 2008, Mexican government voluntarily suspended meat exports to the United States after U.S. inspectors revoked exporting licenses from seven pork and beef Mexican processing plants due to

[9] There were 288 TIF slaughter plants as of 2007. Only about 40 percent of their existing capacity had been operated by the early 2000s. Mexican government aids the domestic beef cattle industry by subsidize roughly a half of the cost of slaughtering cattle at TIF plants (USDA Foreign Agricultural Service 2007).

systematic safety problems (Rosenberg and Doering 2008). This suggests public and private standards are in short supply both for Mexico's domestic consumption as well as its beef exports.

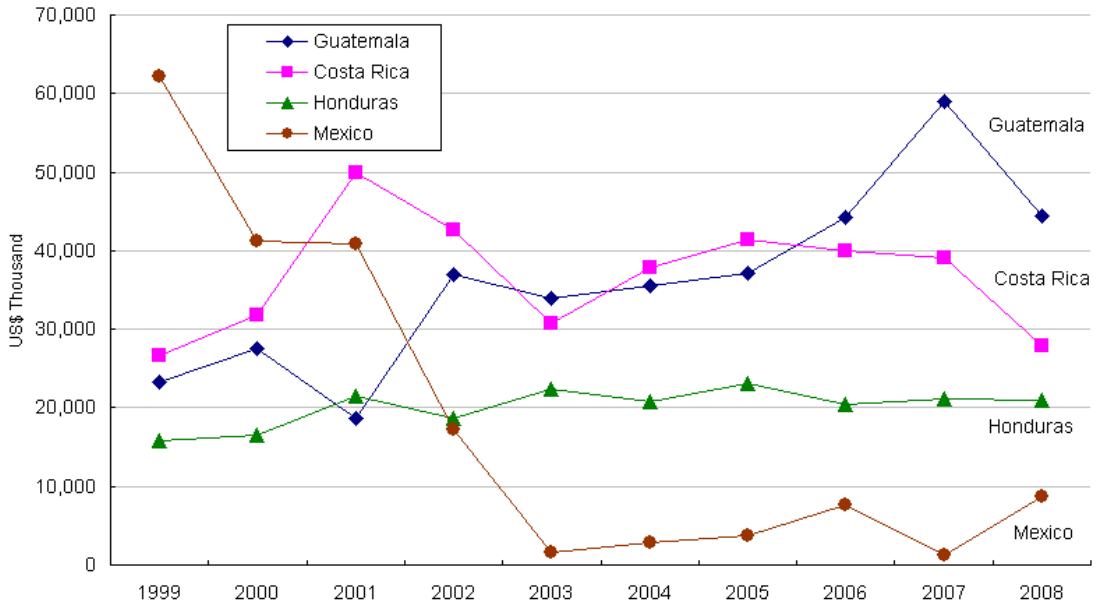
In sum, Brazil's beef export sector is characterized by high concentration and tight value chain governance, accompanied by tough food safety and quality standards imposed by foreign retailers in domestic and import markets and actively pursued by Brazil's export-oriented domestic processors. In contrast, Mexico's beef sector is fragmented across the value chain with weak standards for safety and quality. Higher consumer demands for undifferentiated fresh beef over processed products reduce the incentive for the processors and retailers to invest in private quality standards.

The Cantaloupe Value Chain: Mexico

Cantaloupes, one of the major melon varieties, have become a fruit available on a year-round basis, as production became flexible and imports increased. Mexico was the largest exporter to the United States, the world's biggest import market for the product, until its exports was hard hit by salmonella outbreaks for three consecutive years beginning in 2000 (Boriss, Brunke, and Kreith 2006).[10] The outbreaks resulted in a U.S. import ban on Mexican cantaloupes and a sharp decline in Mexico's exports, which have been replaced by ones from Central American countries, notably Guatemala, Costa Rica, and Honduras. As shown in Figure 9, the share of Mexico's cantaloupes in the U.S. market plummeted to 1.6 percent in 2003 from 47 percent in 1999 and has never recovered to a pre-outbreak level. Meanwhile, these three Central American countries combined to account for 89 percent of U.S.-imported cantaloupes in 2008.

[10] Mexico remains the leading exporters of other types of melons – watermelons and honeydews – to the U.S. market (Boriss et al. 2006).

Figure 9: U.S. Cantaloupe Imports by Origin, 1999-2008



Note: HS code 080719 (cantaloupe)
Source: USDA FASOnline (http://www.fas.usda.gov/ustrade/)

This case highlights, first, the differential effect of food safety outbreak and ensuing tightened regulation on farmers of different size. While large growers weathered the export ban with their substantial investment in required safety measures, small farmers was diverted to domestic markets that are relatively lax about safety requirements. Second, U.S. importers' strategy to change their sourcing to neighboring countries rather than improving Mexican food safety standards contributed to a sharp decline in Mexico's exports along with increased exports from Guatemala and Costa Rica. Finally, geographical and organizational fragmentation in Mexican cantaloupe exporters limited their ability to systematically respond to a series of outbreaks and ensuing export bans by the U.S. and Canada.

Since 1990, more than 800 food-borne illness cases involving fresh cantaloupes have been reported (Canadian Food Inspection Agency 2007). Although the rough webbing on the rind

makes them more vulnerable to microbial contamination than other smooth-skinned varieties, salmonella outbreaks in 2000-2002 changed the dynamics of cantaloupe trade in North and Central America. Particularly, the 2001 Salmonella Poona outbreak tied to cantaloupes from southern Mexico claimed two deaths in the United States and 50 illnesses in both the United States and Canada. For three consecutive seasons, the U.S. FDA issued an import alert and the importing firm issued a voluntary recall. This ban seriously affected Mexican exporters and growers (Calvin 2003).

Cantaloupe production in Mexico is highly fragmented and geographically dispersed. Most of producers are small growers that are scattered in 13 different states. This characteristic keeps the industry from being well organized (Cervantes-Godoy et al. 2007). Thus, when exports to their northern neighbors were blocked, many small growers were diverted to the domestic market. For example, about 80 percent of smallholders' production in the pre-outbreak period was exported from Colima, a state in western Mexico. Although production from the state was not involved with U.S. outbreaks, 87 percent of their production was sold to the domestic market in 2007. In the domestic cantaloupe value chain, spot market transactions are common, while contracts are not. Small cantaloupe growers are poorly informed of food safety issues and lacking in knowledge of Good Agricultural Practices (GAPs), which they are required to certify to comply with for U.S. exports under a new export program.

Responses from Mexican government and industrial organizations have fallen short in supporting smallholders to survive tightened food safety requirements. In reaction to the countrywide export ban in 2002, the government developed a new mandatory program for cantaloupe exports through the Servicio Nacional de Sanidad, Inocuidad y Calidad Agroalimentaria (SENASICA). It required all exports to obtain certification of compliance with

GAPs and Good Manufacturing Practices (GMPs) (Calvin 2003). While 13 Mexican companies had been certified by SENASICA to export cantaloupe to the U.S. market as of March 2007, most of them are large growers and packers that had already used the standards voluntarily before they became mandatory by the government because many U.S. retail buyers required them. Many small growers found increased cost for exports – about 20 percent – too costly for their small production volumes (Cervantes-Godoy et al. 2007). COEMEL (the State Council of Melon Producers) was founded in 2004 as an industry association but mostly represent larger producers with many small farmers underrepresented and little assisted.

As a result, the Mexican cantaloupe chain has been bifurcated between large/medium growers that were marginally impacted by salmonella outbreaks and the ensuing export ban (Type B) and small growers that turned their production into the domestic market (Type D), where they received lower prices than in the export market in exchange for less demanding safety requirements. The bifurcation in part was facilitated by a strategic move by major fruit multinationals. Rather than invest in upgrading their Mexican suppliers, they decided to replace them with suppliers from Central American neighbors. In 1999-2008, Mexico's cantaloupe exports to the U.S. dropped by 86 percent, while Guatemala increased its exports by 90 percent and Honduras by 33 percent. Mexico not only suffered from the sharp decline in exports but also in production in general. Its cantaloupe production declined by 24 percent between 1999 and 2005 (Cervantes-Godoy et al. 2007).

Moving production to Central America, however, has not ensured a safer supply. In 2007, Dole, one of the major cantaloupe importers, recalled cantaloupes from Costa Rica in the Eastern United States and Quebec due to potential salmonella contamination. Most recently, cantaloupes from Agropecuaria Montelibano, a Honduran grower and packer, were voluntarily recalled in

March 2008 after U.S. FDA's import alert was issued. In fact, the recent case turned into a diplomatic issue when the Honduran president and the large grower both protested that the FDA's decision to ban all shipment to the United States by the company was unsubstantiated (Wyss 2008). The grower claimed that the ban was detrimental because it exports three-quarters of its production to the United States, but safety requirements and technical changes demanded by the FDA to lift the ban are too costly.

Finally, the Mexican cantaloupe case provides a stark contrast with another food-borne illness outbreak implicated with Mexican green onions (Calvin, Avendano, and Schwentesius 2004). In the latter, the Mexican export-oriented growers were mostly larger and geographically concentrated in Baja California and Sonora. The relationship between shippers and suppliers were close, and many growers in Mexico had already used certification for GAPs and GMPs before the outbreak of hepatitis A in 2003. When an import alert was issued by U.S. FDA, larger growers took immediate action to resolve the problem, working with SENASICA to develop an export protocol for green onions. These efforts helped minimize the adverse effect of the outbreak and maintain their market access. In contrast, the organizational and geographical fragmentation of Mexico's cantaloupe sector, as shown above, hindered any concerted effort to mitigate the adverse impact of food safety scandal.

CONCLUSIONS

Food safety and quality standards have transformed significantly in recent decades as agri-food production became more industrialized and globalized. The prevalence of private standards and process controls raises new questions of what consequences this transformation bears for producers and consumers in terms of building safe, healthy, and sustainable food

systems at home and abroad. This paper has taken up this challenging issue from the global value chain perspective. It has, specifically, examined the relationship between value chain structure, food standards systems, and food safety. It has proposed an analytical model to address the relationship and applied it to three different product cases – dairy products, meats, and fruits – in the North American agri-food linkages with Central and South Americas and China.

Each case study has confirmed a close association between value chain structure, defined by degree of concentration in supplier and buyer segments, and the characteristics of food standards system – a varying mix of public/private and product/process standards. Overall, private standards in their most comprehensive form are found in value chains that are concentrated in both supply and demand. Conversely, traditional fragmented markets suffer the lack of adequate standards to ensure basic food safety, let alone quality and social and environmental concerns.

Our case illustrations, however, show more complicated, and thus theoretically intriguing, pictures. First, the gap between value chain structure and food standards may be a key source of vulnerability for food safety, as shown in the China milk case. Unless efforts are made to have standards keep pace with rapid industrial change, transition to a new value chain structure may pose a greater safety risk, highlighting the importance of maintaining a constant alignment between industry structure and its associated standards system.

Second, market orientation – exports versus domestic market – is significant. As shown in contrasting beef value chain cases in Brazil and Mexico, whether the sector is export-oriented and how demanding the foreign buyer is play a crucial role in the development of the food standards system and the actual level of food safety. However, exporting does not automatically ensure a higher level of food standards, as highlighted in Mexico's cantaloupe case. It depends

on the extent to which each chain actor (foreign buyer and local supplier) and institutional actors (governments and industry associations) are able and willing to make commitment to enhancing food safety system.

Finally, a bifurcation between export markets and domestic markets is evident in terms of value chain structure and standards system. The distinction between the two, however, is not static but interactive in that shifting governance structure and safety requirements in global value chains affect the dynamics of the domestic market as well as the value chain strategies of local suppliers. The presence of alternative markets with less demanding safety requirements may give a breathing space to smallholders who are forced out of more demanding export markets. At the same time, the parallel existence of the dual systems may be the source of problem when contamination is easily transmittable from one system to the other.

Our study, however, has several limitations in fully examining the relationship between value chain structure and food safety and quality standards. First, our case studies are mostly based on existing secondary data, which constrains our ability to examine a complicated process that involves industrial evolution, standard-making and enforcement. Our case studies, while exploratory in purpose, are limited in number, so they cannot cover all the relevant factors affecting the relationship in question. Finally, our case selection and evaluation are affected by existing – often more publicized – outbreak events. It remains challenging to determine the actual level of food safety in a particular value chain and make it comparable.

Further research will benefit from more in-depth case study. Examining what standards are put in place in a particular value chain requires survey and field interviews with value chain actors as much as analysis of value chain structures in operation. More research on the strategies and actions of buyers will help us construct a more complete view of global value chains and the

dynamics of food standards system therein. Finally, a systemic attention to the multiplicity of global value chains – by market orientation and by different types of buyers and suppliers – will provide a more dynamic view of how global value chains interact with food standards system.

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APPENDIX A: Recent Food Safety Cases

Table 1: Recent Food Safety Cases

Year	Product Type	Countries	Actors	Action
Sept. 2008	**Infant formula** contaminated with **melamine**, an industrial chemical used in plastics, caused kidney stones in 200+ babies and one infant death.[11]	**China** domestic	Government: MOH, Provincial governments (Hebei, where Sanlu is based) Manufacturers: Sanlu Group, China's biggest producer of milk powder formula NGOs: WHO is providing technical assistance Retailers: Wal-Mart, Carrefour pulled the milk after the recall was issued	Sanlu Group recalled some products in March but did not notify the government or public. Sanlu recalled 700 tons of formula in early September. The government ordered termination of production and selling of powdered formula by the company. The government called for thorough investigation and is offering aid to infants with kidney problems. Melamine is though to have been intentionally added to the formula as a cheap way to artificially increase protein counts. Melamine was also found in pet foods from China last year that sickened hundreds of cats and dogs in the US last year. US FDA stated that no Chinese infant formula has been approved for import.
August-Sept. 2008	**Cheese** and **cooked ham** were recalled due to **listeria** concerns	**Canada** domestic	Government: Canadian Food Inspection Agency Manufacturers: Ivanhoe Cheese Inc.; MetroRichelieu Grocers: Metro, Richelieu, Ami and Extra stores	Ivanhoe Cheese Inc. recalled 3 brands of cheese due to possibility of contamination with listeria monocytogenes. No reported illnesses due to the recalled products as of yet.

August-Sept. 2008	Some Maple Leaf **deli meats** were contaminated with **listeria** bacteria. 29 confirmed cases of listeriorsis as of August 29th	**Canada** domestic	Maple Leaf: Canada's biggest meat processor Number 46 in Top 100 Global Food Manufacturers based on 2006 food revenues. Government: federal officials Unions: Public Service Alliance of Canada launched National Safety Campaign. Agricultural Union. Retailers: Canadian Federation of Independent Grocers (members)—food safety manual developed by members sold last fall, training sessions annually	Maple Leaf Foods voluntarily recalled packaged deli meats and temporarily closed its Toronto plant. Maple Leaf recalled 220 processed meat sold across Canada in one of Canada's biggest food recalls ever. The CEO of Maple Leaf stated the company was fully accountable for the nationwide outbreak linked to 15 deaths. Maple Leaf closed the Toronto plant to clean equipment and review food safety procedures. The string of outbreaks sparked a National Safety Campaign addressing the cut in government funding for food safety programs by almost 30% from $359 million in FY06-07 to $254 million in FY10-11. The government had plans to shift to more industry self-policing ("private standards"), and the recent outbreaks have questioned the effectiveness of self-verification.
August 2008	**Whole Foods** recalled fresh ground beef sold between June 2 and Aug. 6 in 2 states after **E. coli** contamination	**U.S.** domestic	Retailer: Whole Foods, which usually approves packing plants, failed to notice change in slaughterhouse by Coleman. Other regional grocery chains recalled beef packages: Kroger Company (Fred Meyer, King Soopers, City Market), and Dorothy Lane Supplier: Coleman Natural Beef Processor: Nebraska Beef, their beef has been linked to almost 50 cases of E. coli infection in the summer of 2008.	Coleman was supposed to get Whole Foods' approval for the change in beef processors but failed to do so. Whole Foods audits suppliers annually and is supposed to have more inspection that most retailers. Whole Foods immediately instituted review of procedures for approving suppliers and product quality. Whole Foods will require E. coli testing beyond government standards for beef

April-August 2008	Preliminary results showed **jalapeno peppers** were a major contamination source as well as **Serrano peppers** and possibly **tomatoes**.	Export: **Mexico** Import: **U.S.**	SOURCES: Farm in Mexico, packing plant in Mexico, warehouse in McAllen, TX. Supplier: Agricola Zaragoza, Inc. (McAllen, TX) recalled jalapeno peppers in July 2008[12] Government: FDA Retailers/ restaurants: pulled tomatoes, peppers from food service and added warnings in grocery stores	The largest outbreak of food-borne illness in the U.S. in the past ten years, the Saintpaul strain of salmonella sickened 1,442 people, hospitalized 296, and resulted in 2 deaths. US FDA warned against eating raw jalapeno and Serrano peppers from Mexico. FDA increased surveillance and sampling of produce from Mexico. Import controls occurred on a shipper-specific basis. The warning was lifted on August 28, 2008.
2006	The initial outbreak in September 2006 involved **fresh spinach**, and the second phase of the outbreak in November-December 2006 was caused by **prepackaged iceberg lettuce**.	**U.S.** domestic	Suppliers: DOLE Baby Spinach, Natural Selection Foods LLC, River Ranch Fresh Foods Government: FDA, California Dept. of Health Services	The FDA and California's Department of Health Services concluded that the cause of an E.Coli O157:H7 outbreak stemmed from contaminated Dole brand **Baby Spinach**. 205 people fell ill and 3 people died. The lettuce-linked outbreak was connected to Taco Bell restaurants and resulted in 71 people falling ill. Two California companies, Natural Selection Foods LLC and River Ranch Fresh Foods, voluntarily recalled fresh spinach and spinach products. The contaminated products had been processed by Natural Selection Foods, LLC in California.
2003	**Green onions** lead to the largest **hepatitis A** outbreak in US history (600+ people around Pittsburgh sickened; 4 died)	Export: **Mexico** Import: **U.S.**	Governments; restaurants	US FDA inspection of farm in Ojos, Negros, Mexico revealed it was the source of contamination in 2003
2002	**Excessive antibiotic residues** from **frozen spinach**	Export: **China** Import: **Japan**	Private tests by the Japanese National Federation of Farmers' Movements revealed that Chinese frozen spinach had chlorpyrifos (pesticide) residues.	Japan rejected China's products in 2002-2003. Japan adopted maximum residue limit for fresh spinach, new policy on agricultural chemicals, exporting to Japan became more expensive.
1999	**Raspberries** lead to an outbreak of food-borne illness	Export: **Guatemala** Import: **U.S.**	Industry, Government organizations, Growers	US suspended imports of raspberries from Guatemala; Export market was re-established in 1999.