

Evolution in Inter-firm Governance along the Transport Biofuel Value Chain in Maritime Silk Road Countries

Abstract

We investigate how value chain governance can evolve in the transport biofuel sector beyond logistics and operations optimization, drawing on cases of eighteen manufacturers in four Belt and Road countries. We find that key motivations for vertical integration include control of strategic factors such as security of supply and gaining access to the retail market, subject to inter-institutional and intra-organizational barriers. We contribute to a theory of governance mode selection by suggesting plural governance mode offers a key strategic choice under institutional constraints. In BRI countries, plural mode could be less disruptive when integrating value chains.

Keywords:

Transaction Cost Theory, Fuel-ethanol, Global Value Chain, China, South East Asia, biofuels, Belt and Road Initiative

1. Introduction

The use of biofuel as a transport fuel has a long history, but large-scale production of transport fuels is a rather recent development in the last four decades, beginning with the Brazilian National Alcohol Programme in 1975. By the late 1990s, it has become a global trend with more than 50 countries implementing some sort of biofuel production or consumption policies (IEA, 2011). The growth increased significantly after 2000, led by the U.S., which has become the largest producer, exporter and consumer of biofuel. By 2017, total global production of biofuel was 84 million tonnes of oil equivalent, about 3% of the global transport energy consumption (BP, 2018; EIA, 2017).

This industry was built on a complicated political economy landscape, where the ecosystems of the oil and the agricultural industries interact with each other. There is a substantial literature investigating various aspects of the industry in terms of policy (Sorda *et al.*, 2010), environmental impacts (Searchinger *et al.*, 2008), land competition, food and poverty interactions (Murphy *et al.*, 2011), supply chain optimization (Xie & Huang, 2018), and technology advances (Escobar *et al.*, 2009; Huang & Chen, 2014)). Nevertheless, there has been little work to understand the nature and factors behind the formation of inter-firm governance structures, as well as the dynamics of changing governance structure over time and space (AEA, 2009:613). The challenges faced by biofuel industries can be seen as exemplars of sustainable supply chain management in general, defined as “integration of economic, environmental and social dimensions into the management of intra- and inter-organizational flows, through innovative and collaborative approaches, with the objective of creating sustainable value” (Bentahar & Benzidia, 2018).

Selecting the inter-firm governance mode, also referred to as the coordination among firms, is among the most important strategic decisions for managers of a firm. The concept of "governance" describes "inter-firm relationships and institutional mechanisms through which non-market co-ordination of activities in the chain takes place" (Humphrey & Schmitz, 2008).

We provide contributions in terms of applying theories of inter-firm governance to new sectors relevant to transportation and logistics, in the context of a major regional integration scheme (the Belt and Road Initiative or BRI). We also add two new governance modes to the inter-firm governance mode hierarchy (regulatory captive and plural mode), in addition to the traditional relational governance mode prevalent in this maritime belt across South East Asia, where there is a strong influence of Chinese diaspora businesses (Dieleman & Sachs, 2006).

In the context of the BRI, we argue that it is essential, for firms and policy makers alike, to understand the implications of different governance modes along the chain. Otherwise, it is neither easy to design a good policy that would facilitate the development and integration of an industry, nor conducive for firms to integrate and operate efficiently in an increasingly globalized value chain structure (Meixell & Gargeya, 2005).

Within BRI, there has been a policy push, led by the Chinese government, to increase integration of various value chains across Belt and Road countries. For instance, China's President Xi Jinping stated at the Boao Forum for Asia that “China's investment opportunities are expanding ... in infrastructure connectivity ... in new technologies, new products, new business patterns, and new business models are constantly springing up.” (Xi, 2015) Moreover, there is increasing trade in intermediate and finished goods within BRI

countries (Boffa, 2018). Integration can promote trade and efficiency, but there are inherent risks and difficulties.

While there have been extensive discussions of integrating BRI value chains with regard to major infrastructure projects (Huang, 2016), there has been limited examination of other sectors which could have equally complicated value chains and sensitive institutional landscapes, such as in energy and agriculture. In laying out its BRI Action Plan, the Chinese government describes the need “to create an integrated industrial chain of energy and resource cooperation” (State Council, 2015). In particular, we focus here on the transport biofuel sector, which operates at the crossroads of energy and agriculture and hence offers insights into both of these important sectors.

We analyze the forces behind the evolution of the fuel-ethanol (the leading form of biofuels) industry by examining the dynamics of governance along its value chain:

- i) To explore the differences in the structure of the fuel-ethanol industry and its evolution in emerging economies. We seek to characterize and analyze, in detail and with the support of empirical evidence, the structure of the industry - in terms of entrants and their capabilities, and vertical integration movement along the value chain in the selected countries along the Maritime Silk Road.
- ii) To map inter-firm governance modes along the value chain and examine their determinants through the lens of major theories in the organization of economic institutions.

Section 2 offers a critical review of three major theoretical perspectives influencing inter-firm relationship and governance. **Section 3** lays out the analytical framework we adopt, which is based on the Global Value Chain governance structure. **Section 4** explains the choice of multiple in-depth case study method and the selection of the four main ethanol producing countries along the Maritime Silk Road, i.e. China, Thailand, Vietnam and the Philippines. The transport fuel-ethanol value chain can be divided into three distinct groups or stages - upstream (agro-commodity), midstream (ethanol manufacturing), and downstream (transport fuel distribution and retail). In **Section 5**, we draw on interviews with eighteen major manufacturers in these four BRI countries and use them to map out the governance structure along the value chain. **Section 6** offers discussion of new insights gained as to the motives and the reasons for selecting certain governance structures and makes theoretical contributions to the understanding of strategic determinants of a manager's choice of governance mode. Context-specific critical success factors of an industry are the paramount considerations in these decisions and other explanatory factors are found to play smaller roles. As discussed in **Section 7**, the nature of the permeability of value chain boundaries, the firm's resources and country's specific institutional factors are among the key constraints in governance mode choice. Firms also deploy plural modes to mitigate uncertainty and opportunism.

2. Three theoretical perspectives in inter-firm governance

Over the last three decades, scholars have tried to decode the structure, provide classifications, explain the rationales and determinants, and evaluate the performance of various choices and types of inter-firm governance modes (Gulati & Singh, 1998). Most empirical case studies (Monteverde & Teece, 1982; Masten, 1984; Klein, 1988; Joskow,

1985) focused on make-versus-buy decisions in various sectors. Our approach is similar to that of Reeves et al (2010), which employs the resource-based view and the lens of transaction costs in the context of the outsourcing decisions in the automotive supply industry.

The review article by Klein (2004) provides an extensive overview on cases of vertical integration citing other determinants based on transaction cost theory, characteristics of a firm and sector, as well as other exogenous factors. Below, we critically review three main perspectives in interpreting the logics of this make-or-buy decision:

2.1 Efficiency as a decision criterion for choice of inter-firm coordination

This tradition could be traced back to Adam Smith's view of division of labor. Firms are initially vertically integrated as suppliers of intermediate goods and would not find the economies of scale to justify involvement. However, as production increases during the evolution of the industry, various stages of the production process spin off into specialized firms that can produce more efficiently with a much higher volume (Young, 1928; Stigler, 1951). This technological economic point of view also explains re-integration due to the advancement of technology. Technology enables the combination of production processes resulting at a lower cost.

Nevertheless, the technological perspective only considers production cost and neglects transaction cost (Coase, 1937). Williamson (1985) argued that the pattern of inter-firm relationship in an industry reflects the minimization of the sum of production costs and transaction costs, where this transaction cost theory (TCT) perspective has gained prominence over the past decades (Peltzman, 1991; Whinston, 2003). Hierarchy and market are viewed as two extreme ends of a spectrum of governance modes, where intermediate governance mechanisms are such as short or long-term contracts, networks, alliances and relational arrangements. The decision to select any of the alternative governance structures is based on the relative costs of the transaction, such as the costs of acquiring and handling information about the quality of inputs, the prices, and the suppliers, as well as costs of negotiating, writing, monitoring, and enforcing contracts.

Some principal-agent theorists argue that the choice of governance structure - particularly vertical integration mode - needs to consider any internal managerial cost for the principal, the acquiring firm. Dating to the 1960s, this theory suggests that agency problems occur when the goals of the principal and the agent are in conflict (Eisenhardt, 1989).

Does the decision on the choice of governance mode, however, rest upon finding the ideal (or most efficient) mode under a static economic perspective? Below, we offer another two alternatives:

2.2 Macro-level institutional determinants of inter-firm coordination

The macro-level determinants of governance structure are elements of the institutional environment such as the rules and norms, polity, judiciary, contract law, social norms, and culture in a particular setting or country. These shape the formation of inter-firm relationships. Williamson (1996) himself has acknowledged that previous research in the TCT tradition has taken institutional environment as a given, which has led to some criticisms. A study of the Japanese auto industry suggests that formal and informal institutions have shaped the structure of inter-firm governance, where the institutional

embedded relational-governance mode prevails (Ahmadjian & Lincoln, 2001; Hemmert, 1999). Similarly, macro-level institutional factors could be significant in the transport biofuel industry, in the Maritime Silk Road countries, due to the nature of its value chain - leading from agricultural to energy sectors.

2.3 Evolutionary and learning perspectives of inter-firm governance

Past studies of multinational firms suggest that a firm evolves in form in response to changes in its environment. From an evolutionary and learning perspective, managerial preferences regarding the formation of inter-firm governance changes according to resources, capability, knowledge, embedded transaction history as well as the technological context of the firm (Barney, 1991; Osborn & Hagedoorn, 1997; Teece *et al.*, 1997; Argyres, 1996; Tallman & Faldmoe-Lindquist, 2002; Grant, 1996; Kogut & Zander, 1993). Research in the Japanese auto industry, however, demonstrates that changes in the national institutional environment do not necessarily lead to a modification of the governance mode (McGuire & Dow, 2003). Instead, changes in governance mode in the auto industry could be explained by the learning perspective (Dyer, 1996; Oliver & Wilkinson, 1992; Ahmadjian & Lincoln, 2001).

In addition, a firm's growth is conditioned on, and constrained by, the resources it owns. The Resource-Based View (Wernerfelt, 1984), as a theory of the individual firm and its growth process, investigates the value-added benefits of a transaction. Instead of economizing on costs of transaction, as proposed by TCT, a firm could maximize the transaction value by exploiting and developing its resources and capabilities (Nelson & Winter, 1982).

It is not surprising that firms in the Maritime Silk Road face constraints in resources including resources to organize their value chain and for expansion. The constraints of resources and capabilities are expected to be even more severe for small family farmers producing feedstock for transport biofuels.

Therefore, in analyzing governance modes and their determinants in the biofuel industry in BRI countries, we cannot take a single perspective in understanding a firm's behavior. We agree with Hoskisson *et al.* (2000) that institutional forces are preeminent in shaping firms' strategies in interfirm coordination in emerging market economies, but other theories might also play an increasingly important role as the economy continues through liberalization. We therefore advocate a holistic approach, applying a series of different theoretical lenses in analyzing inter-firm formation and motivations.

3. Analytical framework

The global value chain (GVC) literature suggests that the intricacy and complexity of global trade requires sophisticated forms of coordination. Coordination is required not merely in logistics and operations, but also in fields related to the integration of product and process information, i.e. from design to marketing of the final products (Kaplinsky, 2000). It can be examined from a systems perspective, concerning all stages in the value chain. Improving 'systemic' efficiency may create significant changes in the effectiveness of the entire value chain (Kaplinsky, 2000). To achieve this, a firm can optimize its supply chain and logistics, and there is already a substantial literature investigating these important aspects applied to the bioethanol industry (Chen & Fan, 2012; Gonela *et al.*, 2015; Marufuzzaman *et al.*, 2014). Alternatively, a firm can reconsider the governance mode chosen.

The GVC literature proposes three key explanatory variables of governance mode in a value chain: (i) the complexity of a transaction with respect to goods/services; (ii) the possibility of codifying information and knowledge of the transaction; and (iii) the level of supplier competence in relation to the requirements placed upon them (Gereffi *et al.*, 2005). GVC models propose five types of governance mode, on a continuum of coordination that describes inter-firm relationship; i.e. "modular", "relational", "captive" in-between the two extremes of "market" and "vertical integration".

However, different stages of a chain might be characterized by different forms of governance, and the nature of coordination is dynamic over time and different market conditions (Gibbon & Ponte, 2005:82). Recognizing the dynamics of governance type and power relationships, Gereffi *et al.* (2005) and Humphrey and Schmitz (2008) argue that the nature of governance evolves over time, motivated by changes in the complexity of transactions and codification, and the enhancement of supplier competences - an evolutionary and learning perspective.

However, many factors along the value chain and the firms are dynamic. For instance, supplier competencies could be enhanced over time, and the product and transaction requirements could become more complex too. In addition, this GVC framework, although capturing some important elements that influence the forms of coordination, has only limited explanatory power to determine the overall form of governance in a value chain (Gibbon and Ponte, 2005: 82). Different stages of a chain might be characterized by different forms of governance and the nature of coordination is dynamic over time and varies with market conditions. Recognizing the dynamics of governance types and power relationships, Gereffi *et al.* (2005) and Humphrey and Schmitz (2008) argue that the nature of governance evolves over time, motivated by changes in the complexity of transactions and codification, and the enhancement of supplier competences.

We adopt the Global Value Chain approach because it provides the level of analysis necessary to characterize the overall configuration of governance decisions along a chain (Gibbon, 2008), while keeping a strong focus on specific dynamics at the micro level of individual stages in the chain. We analyze the coordination between firms based on four different types of governance mode prevailing in the industry. Additionally, two emerging categories are proposed, i.e. regulatory captive and plural mode.

Hierarchical and equity-based

This is the classical vertical integrated structure with an intra-firm governance mode. The firm integrates upstream or downstream to adjacent stages along the value chain and gains control over the operation of acquired firms. The asymmetry of power of this governance mode is the highest among all modes. A firm will enjoy greater security of supply in the case of integration with upstream feedstock farming or trading. Similarly, if the firm integrates downstream to blending/distribution/retailing, it will gain greater autonomy in expanding markets for fuel ethanol.

Captive

Captive governance exists when either one or both parties are locked in to the relationship. The global value chain literature (Gereffi *et al.*, 2005) proposes that some degree of power asymmetry exists in the relationship in favor of the larger and more powerful lead firm. Nevertheless, the relationship can also involve a form of symbiosis. This inter-firm relationship could involve multiple interdependencies that ensure mutual benefits, which is the main element binding parties together. Therefore, switching costs might be forbiddingly

high under this governance mode. There are three different factors that give rise to captive inter-firm coordination: contractual arrangements and asset specificity; and regulatory or administrative directives, which we will discuss in greater detail below.

The third factor is a new and emerging category, which we propose based on the evidence gathered. The relationship is a result of regulatory or administrative directives and is very secure as long as there is no change in government policy. However, coordination can easily be broken up by removing government directives even without the consent of the firms. In the Global Value Chain literature, there is typically no inter-firm governance mode delivered by the direct intervention of government. However, the evidence, as presented later, suggests that government action (e.g. regulations and directives) plays an important role with unique characteristics that other governance modes cannot possibly replicate.

Relational

This mode of governance is characterized by strong but informal social ties built between firms through reputation, long-term business exchange, trust, and various kinds of kinship. Tacit knowledge is exchanged between buyers and sellers and third parties might find it difficult to break in. If the relationship is strong, it can sustain short-term fluctuations or stresses and allow for the sharing of risks and costs. However, the relationship can break if one party feels the exchange to be unfair over an extended period. The direct switching cost might be low but there may be higher indirect social costs.

Market

Market governance mode has a low cost of switching to new partners for either party. It is characterized by standard product and transaction with a low informational complexity. Both parties are exposed to the volatility of the market and have very little influence over each other's operation and strategic decisions. In addition, a short-term contractual arrangement is categorized as market-based governance because it exhibits similar characteristics.

Plural mode (emerging mode)

This is an emerging mode for Global Value Chain analysis as evidenced in our data. Some manufacturers employ more than one type of governance mechanism simultaneously at a single stage of the value chain. In addition, some manufacturers also deploy a mixture of governance modes with respect to a single supplier for the same input or a single buyer for the same output.

Plural mode has also been discussed in other settings, notably, for make-or-buy or -ally decisions in the sourcing literature (Heide et al., 2014; Krzeminska et al., 2013; Parmigiani, 2007). Sako et al. (2016), having studying sourcing for legal services, call for more research "to continue developing plural sourcing theories and evidence relevant to different organizational forms in variety of industry contexts."

Figure 1 summarizes two important characteristics of these governance modes. Ease of switching transaction partners is normally higher at the market end of the spectrum of governance modes. By contrast, the power of coordination is higher at the hierarchical end of the spectrum. Therefore, a firm will enjoy a higher level of security of supply if the governance mode of the transaction is hierarchical. Moreover, a firm employing hierarchical mode will be able to exercise proactive approach to develop the end-user market. In the case of fuel-ethanol, the manufacturer who integrates further downstream to ethanol blending and distribution/retail need not depend on government mandates or face reluctant or even hostile incumbents, i.e. oil companies.

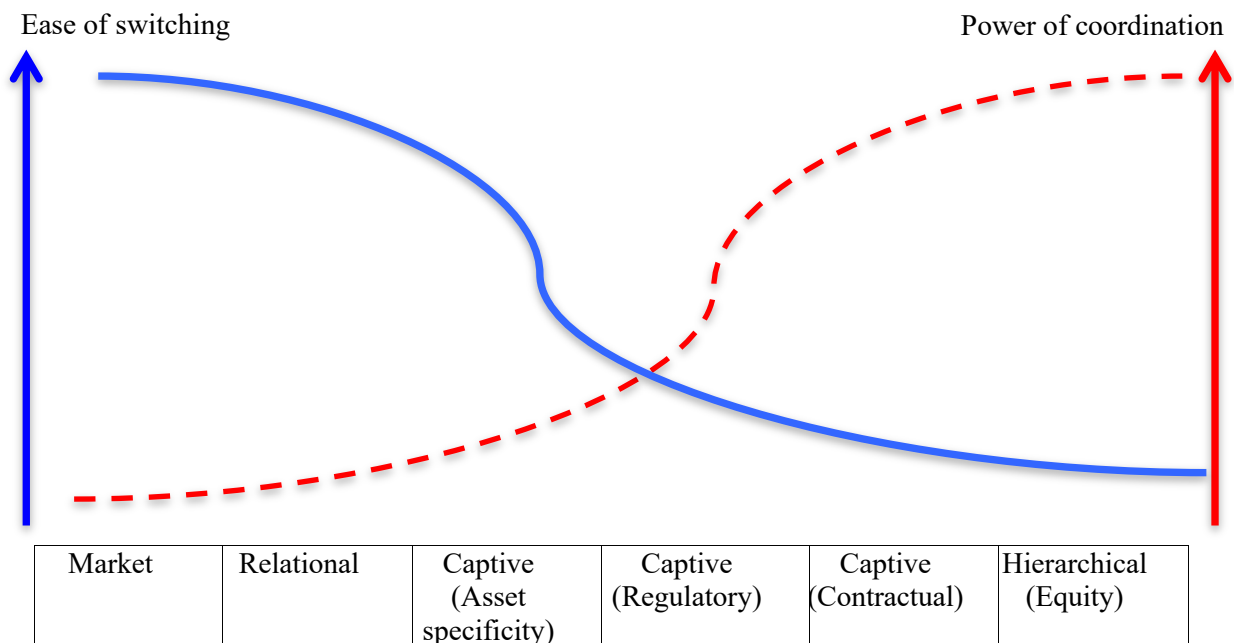


Figure 1: Ease of switching transaction partners and power of coordination in the spectrum of governance modes

4. Methods: Multiple-case study

BRI is a major endeavor to integrate the economies along both maritime and inland Silk Roads. Research has already been undertaken to consider how BRI will lead to a reconfiguration of logistics and transportation networks and the implications for energy security (Sheu & Kundu, 2017).

Moreover, the value chains in and across various countries along the silk roads are governed under different political economy regimes and therefore understanding the governance modes are a crucial step for any attempt to integrate the value chains of any products and services.

Our research adopts a multiple case study approach (Eisenhardt, 1989) to understand the structure and determinants of the formation of inter-firm governance modes. Giving the need to obtain in-depth insights of empirical phenomena and their contexts, the authors choose multi-case studies (Eisenhardt, 1989; Yin, 2009). It also provides a unique means of developing a theory or refining existing theories (Dubois & Gadde, 2002). Compared to the classic single case study, the multiple or comparative case study approach is more objective and takes a positive theory-building stance (Yin, 2009; Eisenhardt & Graebner, 2007).

4.1 Research context and case selection

We investigate the rapidly expanding transport biofuel value chain in four countries along the Maritime Silk Road, with major fuel-ethanol policy and production capacity. The four countries are China, Thailand, Vietnam, the Philippines. The other two large southeast Asia countries, Indonesia and Malaysia both produce large volumes of biofuels, but both countries place their policy emphasis on biodiesel, which would be better served as the subject of a

separate study given the differences in feedstocks and supply chains. There are also active cross-border trading of raw material and transport biofuel among these four BRI economies. For example, China imports cassava root from Thailand and Vietnam, and the Philippines imports transport fuel-ethanol from Vietnam and Thailand.

The transport fuel-ethanol industry was selected because the industry has developed extremely quickly, particularly during our main study period of 2002 - 2011. As of 2017, the size of the biofuel industry (where fuel-ethanol is the major type of biofuels) is about 3% of the global transport energy consumption (2.8 billion tonnes of oil equivalent) (BP, 2018), which is not insignificant. Global production growth over 2002 -2011 was rapid (15% per annum). Since 2012, global growth has slowed to 5% per annum (Based on F.O. Licht's annual World Ethanol and Biofuels Reports).

While global biofuels went through a wave of horizontal and vertical integration over a decade of rapid expansion, there is little known about the structure of the value chain of key producers in the Maritime Silk Road and their inter-firm governance. From the Global Value Chain perspective, we analyze the types and determinants of governance mode in the fuel-ethanol industry.

Manufacturers were selected in the case-countries along the Maritime Silk Road. The four main selection criteria employed were: (i) size of the existing production of ethanol and fuel-ethanol; (ii) size of the near future production - facilities in construction or announced; potential (iii) size of production based on indigenous feedstock; and (iv) the existence of domestic biofuel policies or programs (either fully implemented or in advanced discussions).

A scoping study was performed for case-country selection with data on production and potential production (See **Table 1a** and **1b**). Eighteen major manufacturers in these four countries were selected for analysis. We then gained access to sixteen of these leading manufacturers and conducted detailed interviews with top managers and relevant stakeholders along their value chains (5 in China, 6 in Thailand, 1 in the Philippines and 4 in Vietnam).

Production	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Thailand	467	521	613	790	1,048	1,070	1,190	1,290	1,385	1,500
China	2,466	2,479	2,566	2,858	2,934	2,951	3,078	3,155	3,550	3,950
Philippines	23	10	4	35	72	115	168	230	274	280

Table 1a: Ethanol Production (million liters)

Number of Refineries	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018
Thailand	11	19	19	19	21	21	21	21	23	22
China	5	5	5	6	6	7	7	10	11	11
Philippines	2	3	3	4	4	8	8	10	11	13

Table 1b: Ethanol production in maritime silk road countries

Source: GAIN (2017a, 2017b, 2017c)

Data sources and management

The data is based primarily on field research conducted in China, Thailand, Vietnam, and the Philippines between 2008 and 2009 as part of a seven-month long field study. Selected manufacturers in these four countries were interviewed. The purpose of the interviews was to discover the type of inter-firm governance mode(s) which the manufacturers employed along every stage of the value chain and to understand their reasons for selecting a particular mode.

This data was used to analyze the distribution and the fundamental forces that shape the inter-firm governance structure of the biofuel value chain in developing countries. Some additional interviews were also conducted with other players along the value chain in order to gain a broader view of the governance structure and to triangulate the information obtained. Triangulation of data is performed to double checking information (Yin, 2009; Denzin, 1978; Huberman & Miles, 1994) by interviewing key informants across the value chain.

There were sixteen core semi-structured interviews conducted with sixteen manufacturers. Among the informants were senior leaders including chairmen, directors, and top managers of the manufacturers. The interviews lasted from about 30 minutes to over two hours. There were also an additional six employees of the manufacturers who were interviewed for clarification and better understanding of their value chain. In addition, we interviewed another 36 stakeholders, i.e. policy makers and researchers, employees of oil companies, representatives of trade associations, farmers and traders and other industry experts in the Maritime Silk Road.

The majority of interviews were conducted face-to-face supplemented by a small number of exchanges via email, skype, and telephone. The main language was English with the exceptions of interviews in China, where the semi-structured questionnaire was translated into Chinese and most interviews were conducted in the Chinese language, since one of the authors is proficient in Chinese. In a few instances local research assistants helped in interpretation during interviews conducted in Thai and Vietnamese. Several interviews were audio recorded. Interview notes were taken in all instances, in particular when the interviewees objected to any audio recording. Local research assistants were also employed to take notes of the interviews. The case studies were then written up and analyzed.

5. Data analysis

There are two parts to this study. First of all, **Part 1** examines the level of integration of these top eighteen Maritime Silk Road manufacturers from across four leading BRI economies. Then, a discussion on the trend in particular comparing it with the structure of the global top forty manufacturing firms as in Chan and Reiner (2010).

The analysis process for **Part 2** involved analyzing interview data, identifying the inter-firm governance modes and their determinants along all the stages of the value chain. First, we designed a set of categories of governance modes based on the classification of Global Value Chain analysis (Gereffi, 1995). Then, data was placed into these categories - an approach similar to the axial coding method (Creswell, 2003). **Table 2** is an example of the category tree for classifying the governance mode.

No	Category: governance mode	Sub-category	Definition/keywords
1	Hierarchical/ vertical integration		Ownership, equity, shareholding
2	Captive	Contractual	Signing contract, agreement, MOU, long-term supply arrangement, accepting farm credits
3		Regulatory (emerging)	Regulation/Act/Directive, official requirement
4		Asset specificity	Spatial proximity, time/cost of transport
5	Relational		Long-term business partner, relationship, trust, old friend, reputation
6	Market		Selling based on price, no long-term relationship, ease of switching partners
7	Plural mode (emerging)		Using more than a single mode from the above

Table 2: Category tree diagram

5.1 Vertical integration in the transport fuel-ethanol industry

As the industry grew, there has been a strong trend towards merger and acquisition in the global ethanol value chain (Chan & Reiner, 2010). A firm's history and the market structure of the industry can have a substantial effect on firm performance, (Klepper & Simons, 2000; Carroll *et al.*, 1996; Mitchell, 1991). These firms have been classified, based on their industry of origin, into: (i) Technology, engineering and construction firms; (ii) Farmer and farmer cooperatives, and agro-food and sweetener manufacturers; (iii) Agriculture commodities traders; (iv) *De novo* entrepreneurial start-ups; and (v) Oil firms. Their vertical involvement in the value chain has also been investigated.

The eighteen largest ethanol manufacturers in these four countries have been selected for analysis. From the results of interviews and other secondary sources, **Table 3** provides an overview of the role each of these major manufacturers plays along the value chain and the scale of operation. Estimation on market share is based on the production capacity because sales figures are not available although many facilities will have operated at differing utilization rates throughout the years. Nevertheless, capacity share still provides a fairly reliable picture of their respective market power due to the homogeneous nature of ethanol.

In China, the largest manufacturer is COFCO(9)¹, a state-owned conglomerate in agro-commodity trading. COFCO holds majority stakes in three out of five fuel-ethanol facilities in China. It also has a 20% stake in a CNPC(17)-controlled facility in Jilin. CNPC is the largest Chinese state-owned oil firm. The other ethanol manufacturer, which has license to produce fuel-ethanol, is Tianguan(1) in Henan province, in which the provincial government has some interest. Another giant state-owned oil firm, Sinopec(16), is also integrated upstream to ethanol manufacturing. Its first ethanol facility with controlling stake is still under construction. Nonetheless, the two major private manufacturers, Jian Shenghua (2) and Taixing (3), produce bio-ethanol but do not have any license to sell in the fuel market.

In 2010, Petrogreen(4) of the Mitr Phol sugar group was the largest producer in Thailand, capturing almost 50% of the fuel-ethanol market share from the production at its four

¹ The ID number of the company as in **Table 2**.

facilities (GOT-DEDE, 2010). Its position is being challenged by PTK Ethanol (12), which is constructing the largest ethanol facility in Thailand.

In Vietnam, the state oil company PetroVietnam invested directly and indirectly in three out of four major fuel-ethanol plants, i.e. Petrosecto(11), PVB(15), and PVOil(28). However, all three plants were still under construction at the end of 2010². Minh Anh, the largest private cassava trader and exporter, controls DongXanh (8), the only major producing plant in Vietnam at the time of the study.³

In the Philippines, there are only three operating fuel-ethanol distilleries, with a total capacity of 70 million liters per year in 2010 (GAIN, 2010). San Carlos Bioenergy(14) is the only major operating plant with an annual capacity of about 35 million liters. As clearly depicted in **Table 3**, the permeability of boundaries at the manufacturing stage is high. There is heterogeneity of entrants from neighboring industries from either upstream or downstream of the value chain into the manufacturing stage. The findings agree with similar observations for leading global manufacturers in Chan and Reiner (2010).

Agro-food producers and commodity traders building on their capability in sourcing of feedstock have integrated downstream to ethanol manufacturing - forming vertical integration governance mode at these stages. Examples of companies include major sugar groups - Petrogreen(4), Rungroung(5), Thai Sugar(7), cassava chip traders - Saphip(10) and DongXanh(8) and agro-commodity giant - COFCO(9). Similarly, oil companies in China and Vietnam are also integrated upstream into the ethanol manufacturing stage.

Nonetheless, there is no major engineering firm diversifying into ethanol manufacturing in East and South East Asia as shown in **Table 3**. However, there is an example of upstream integration by Taixing(3) in China, which has diversified into plant building and engineering design as it is the builder of the DongXanh(8) distillery⁴. Taixing(3) has capitalized on its experience in the construction and operation of its own distillery.

Nonetheless, our study does not observe any trend towards extensive vertical integration as seen among their global counterparts (Chan & Reiner, 2010). Neither any evidence of further downstream integration to gain access to the market for ethanol by the upstream players, nor has there been any further upstream integration to secure the supply of feedstock by the oil companies as shown in **Table 3**. But, what are the reasons for these differences? The next section investigates governance structures, and the explanatory factors for how these structures emerge.

² Obtained from personal conversations with 3 directors of 3 ethanol plants, between Feb - Mar 2009.

³ Personal conversations with Chairman of Minh Anh and DongXanh, 19 - 21 Mar 2009.

⁴ Personal conversation with the Chairman of DongXanh, 19 Mar 2009 and the Chairman and CEO of Taixing, 21 Mar 2009.

No	Holding Company	Industry of Origin	Eng/Const	2nd Gen Tech	Plantation	Agro service	Agro Food	Ethanol Manuf (MLY)	Blender	Distributor/Retailer
1	TianGuan, CN	Alcohol Producer						375		
2	Jian Shenghua, CN*	Alcohol Producer						750		
3	Taixing Jinjing, CN	Alcohol Producer						250		
4	Petro Green, TH	Food & Sweetener						240		
5	ThaiRungRoung Energy, TH	Food & Sweetener						36		
6	Rachaburi Ethanol, TH	Food & Sweetener						45		
7	Thai Sugar Ethanol, TH	Food & Sweetener						30		
8	Dong Xanh, VN	Commodity Trader						125		
9	COFCO, CN	Commodity Trader						925		
10	SapThip, TH	Commodity Trader						60		
11	Petrosecto (Petrovietnam), VN	Commodity Trader						100		
12	PTK Ethanol, TH**	Entrepreneurial						306		
13	Thai Nguan, TH	Entrepreneurial						84		
14	San Carlos Bioenergy, PH	Entrepreneurial						35		
15	PVB (Petrovietnam), VN	Entrepreneurial						100		
16	Sinopec, CN***	Refiner/Oil						375		
17	CNPC (Jilin), CN	Refiner/Oil						500		
18	Petrovietnam (PVOil), VN	Distributor						100		

Table 3: Entrants and vertical integration in ethanol value chain in Maritime Silk Road

Legends:	
The first two columns are i) auxiliary stages of first and ii) second generation technology suppliers. The agro-food processing column does not belong to the fuel-ethanol value chain. It is included to show the industry of origin of some entrants. Cells shaded in the color of the corresponding firm denote the industry of origin of the firm. Whereas, cells shaded in green indicate new business stages along the value chain that the firm is involved in.	
	Engineering and construction company who builds plants and supplies technology
	Farmer/farmer cooperative and agro-food processor with a history in alcohol/sweetener production
	Global/National agro-commodity trader
	<i>De novo</i> entrepreneurial start-up with minimum or no background in the supply chain
	Oil company, either integrated or in downstream business
	Involvement in a stage of ethanol value chain

Note:

* Jian Shenghua is a privately-owned company located in the Jilin Province. It is a bio-ethanol producer without government permission to sell its product as fuel-ethanol. Production capacity is claimed to be substantially higher, but the actual production was low during 2008-2010. The company ran into financial trouble and was restructured at the end of 2010.

** The author did not interview PTK Ethanol. PTK Ethanol facilities were still under construction.

*** Sinopec holds minority stakes in some fuel-ethanol plants in China. The author did not interview Sinopec.

5.2 Cross-case comparison of governance mode

This section presents the cases and stories of manufacturers' value chain governance structures and their determinants. The top sixteen manufacturers in the four case-countries were selected and interviewed. The detailed analysis of the cases in these four countries along the Maritime Silk Road, with evidence collected from interviews and field observations, are available in the **Online Supplement**. We examine the inter-firm governance mode and the motivations for the formation of each mode at every stage along the fuel-ethanol value chain.

This section distils the information from the sixteen cases discussed in the **Online Supplement** using a proposed matrix (see **Figure 2**) to combine the governance modes of the entire value chain of these cases. The inter-firm governance mode of every stage along the value chain of an ethanol manufacturer is mapped onto the matrix. This figure shows a complex landscape of inter-firm governance modes across the value chain.

Table 4 summarizes the main determinants of governance mode according to the three major theoretical perspectives, i.e. efficiency, institutional, evolutionary and learning. **Table 4** also shows the list of cases from whom corresponding evidence was collected to support the analysis. Institutional factors are among the most prominent determinants of governance mode, irrespective of the effects on the value chain. However, there are two factors that clearly emerge from the analysis of the data, i.e. security of supply and access to retail market. These two motivations encourage manufacturers to consider alternative governance modes in both upstream (security of supply) and downstream (access to retail market) stages.

Moreover, amid various institutional barriers, manufacturers employ a number of strategies to enhance security of supply and access to the retail market, as shown in **Table 5**. In many cases, ethanol manufacturers have very little influence on the price of feedstock because they are minor actors in the market. They therefore consider a type of governance arrangement which enables a high power of coordination to secure their critical production factor – the feedstock. However, vertical integration into feedstock supply chain is not always possible, particularly when subject to institutional barriers. In that case, they deploy a range of governance modes to diffuse the risks of supply.

There are also manufacturers trying to overcome resource constraints and institutional barriers in downstream integration. The size of the ethanol market is not only constrained by government policy but also the willingness of oil companies to provide access. Oil companies have very limited interest in promoting ethanol to replace their main product - gasoline.

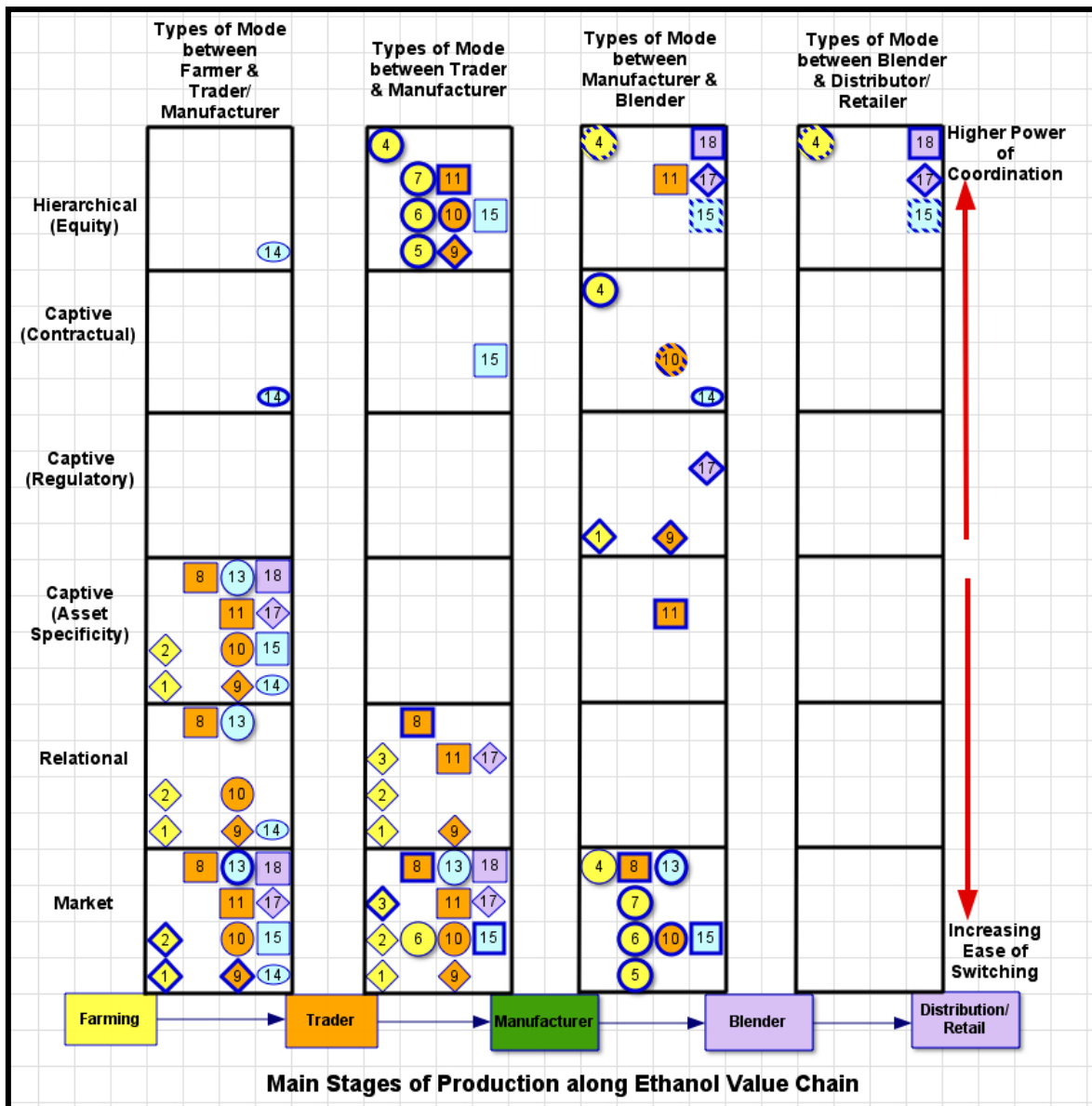


Figure 2: Distribution of inter-firm governance modes along ethanol value chain in Maritime Silk Road

Legend:			
Number in a shape is the case identification number.			
Color denotes the industry of origin for the manufacturer.			
	Diamond: China (1,2,3,9,16 and 17)		Circle: Thailand (4,5,6,7,10,12 and 13)
	Oval: The Philippines (14)		Square: Vietnam (8,11,15,18)
	Bold borderline denotes main mode of governance		Dashed borderline denotes governance mode under development
	Farmer/farmer cooperative & agro-food processor, experience in alcohol/sweetener production		
	Global/national agro-commodity trader		
	<i>De novo</i> entrepreneurial start-up with minimum or no background in the supply chain		
	Oil company, either integrated or in downstream blending, distribution and retail		

Note: Data is based on interviews with senior management of the manufacturers.

Theoretical perspectives	Key aspects of the determinants	Case number as in Figure 2
Upstream stages (Farming-trading-manufacturing)		
Efficiency perspective	Despite incurring substantial transaction costs in obtaining feedstock, manufacturers have limited choices in altering the default governance mode.	
Institutional perspective	Socialist land policy, small farm size and high number of poor and uneducated farmers are among structural factors that determine the prominent governance mode. Business norms determine how a manufacturer deals with traders and farmers. Long-term relationship is a cultural element that has been used frequently to reduce transaction costs.	1,2,3,9,10,11,13,14,15,18
Evolutionary and learning perspective	Manufacturers try to work with farmers to enhance security of supply. They have to work to upgrade the capability and knowledge of farmers in order for them to comprehend a certain types of governance mode (e.g., contract, pricing mechanism).	1,2,14
Emerging factor	Security of feedstock supply is a main concern prompting manufacturers to choose vertical integration or use multiple modes. Security of supply is also a pre-qualifying criterion for financing.	1,2,3,6,8,9,10,11,13,14,15,17,18
Downstream stages (Manufacturing-blending-distribution-retailing)		
Institutional perspective	Government policy is the main factor that prevents downward vertical integration by manufacturers. It also prevents entrance into the fuel-ethanol market.	1,2,3,4,9
	In contrast, government policy is also the main factor that encourages forward integration to manufacturing by oil companies.	16,17,18 (partly 11 and 15)
Evolutionary and learning perspective	Limitation in resources and capability prevents manufacturer integrating downstream.	4,10,14
Emerging factor	Access to retail market is a motivation for firm integrating or planning to integrate downstream	4,11,15

Table 4: Determinants of governance mode

Note: Data is based on interviews with senior management of the manufacturers.

Strategy of manufacturer	Case number as in Figure 2
Upstream stages (Farming-trading-manufacturing)	
Vertical integration - reducing transaction cost and increasing security of supply	4,5,6,7,9,10,11,15
Relational approach in addition to market-based	1,2,3,8,9,10,11,13,14,17
Multiple governance modes - on a single supplier or different mode for different supplier to diffuse risks of feedstock supply	1,2,3,6,9,10,11,13,14,15,17,18
Downstream stages (Manufacturing-blending-distribution-retailing)	
Vertical integration	11,17,18. and 4,15 (in planning)
Multiple governance modes	4, 10,11,15,17

Table 5: Strategy of manufacturers in governance mode selection

Note: Data is based on interviews with senior management of the manufacturers.

In summary, we offer five main observations:

1.) At the upstream stages, the market governance mode is the dominant mode between farmer and trader; farmer and manufacturer; and trader and manufacturer. However, it is not a pure market mechanism in their transactions. In a large number of cases, market factors are intertwined with relational considerations and constrained by asset specificity. Asset specificity becomes an overriding factor of governance mechanism particularly for farmers when their harvest cannot be transported long distances without prohibitive costs or compromising the quality. By contrast, traders (of corn or cassava) do not encounter this particular problem because they have altered the characteristics of the products (via drying to reduce weight and increase life).

2.) The group of manufacturers who can employ the hierarchical governance mode in procuring feedstock will enjoy the highest level of security of supply. For the majority of them, their industry of origin is in either feedstock farming, in trading or in the processing sector. They have integrated forward to ethanol manufacturing forming a hierarchical governance structure.

3.) For manufacturers without any history in the feedstock sector, the risks associated with feedstock supply and price volatility are high. It is desirable for them to find a governance mode that offers a high power of control such as hierarchical or contractual captive modes of coordination. Nevertheless, these governance arrangements are rare as shown in **Figure 2**. The primary reasons are constraints in firm level resources and, most importantly, macro-level institutional barriers for farm acquisitions. These firms, therefore, employ multiple governance modes to diffuse the risk of supply.

4.) The majority of ethanol manufacturers will need to sell their product based on a market governance mode to oil companies who dominate downstream blending, distribution and retail segments. The exceptions are the Chinese firms, which could only sell their product to designated state-owned oil companies as directed by the central government. Moreover, there are also a few oil firms that have integrated backward to ethanol manufacturing, with controlling or minority stakes.

5.) Due to a highly regulated downstream market, ethanol manufacturers encounter high barriers to downstream integration. Despite this, some manufacturers see downstream integration as the key step to breaking the domination of oil companies in blending and distribution. It is a strategic move to expand the market by reaching out to end customers and selling high ethanol blended fuel.

6. Discussion and propositions

The findings suggest there are three important forces at play in the evolution of governance structures: security of supply, access to retail market, and permeability of stage boundaries. In taking the value chain perspective, we propose that critical success factors - two of the emerging factors as in **Table 5** - of an industry are important strategic determinants of governance structure. In the case of the fuel-ethanol industry, security of supply for feedstock is crucial for the viability of the manufacturer. Irrespective of the type of governance mode, the manufacturer's primary objective is to ensure availability of feedstock, at a desirable price. As a new substitute in competition with a powerful incumbent, the

manufacturer has to be decisively proactive. Breaking the grip of the incumbent and gaining market access is crucial for the long-term growth and survival of the biofuel industry. Selection of the governance mechanism becomes an important strategic decision to achieve this objective.

Based on the above evidence and analysis of these cases, we offer five propositions, as follows:

Proposition 1: *In a resource-intensive industry, firms organize themselves to secure strategic supplies of resources using an inter-firm governance mode with a high level of controlling power such as hierarchy. Security of supply - as a key success factor for firms - is an important determinant of the governance mode.*

An ethanol manufacturer could have a production cost exposure of as high as 60% on feedstock (depending on the price of feedstock and other inputs which are also fluctuating). As feedstock cost and ethanol output price are de-coupled, therefore, a manufacturer has to mitigate the risk of its margin being squeezed from both ends. High security of supply with a low risk of price volatility is the key success factor for an ethanol manufacturer. There is a higher performance and stability for entrants with a history in upstream stages of trading and farming of feedstock. In addition, some manufacturers are integrating upstream in order to ensure security of supply.

Proposition 2: *The limitation in firm's resources and macro level determinants are the barriers to the firm integrating further upstream into farming.*

Although a fully equity-based upstream integration to farming will provide the greatest security of supply, not all ethanol manufacturers are able to do so. Moreover, there are more hierarchical relationships in the manufacturer-trader link than in trader/manufacturer-farming link. Vertical integration to farming may encounter high barriers where there are numerous institutional and resources considerations such as the socio-cultural practices found in the rural agricultural economy; regulation of land use/right/ownership, financial and human capital to manage farmers/contracts, acquire land and working capital, and secure access to information and networks.

Proposition 3: *Firms, which are unable to integrate further upstream, employ multi-governance modes to diffuse the risk of security of supply.*

Despite the fact that upstream integration would provide higher security of supply, some manufacturers employ multiple governance modes to diffuse the risk when they are unable to integrate further upstream. The traditional agricultural commodity market comprises of layers of middleman as traders, who play a number of crucial roles in this rural agricultural setting by holding resources such as information, relationships, transportation infrastructure and credits. Although the exchange is nominally market-based, it is tainted with a time/space specific captive and relational elements. In these circumstances, manufacturers use a number of means to procure feedstock, as shown in the first column of **Figure 2**.

In addition to sourcing from open markets, firms employ governance modes: hierarchical arrangements, varying lengths of contractual arrangement, capture mechanisms, and relational coordination to purchase feedstock. Similarly, at the other end of the value chain, some firms employ various modes of coordination to market their product. On one hand, an ethanol manufacturer may enter into a medium-term supply contract with oil companies in

order to establish a more stable market. On the other hand, the same manufacturer can reserve some of its produce to be sold in the spot market. With an appetite for higher potential profit in the spot market, the manufacturer is willing to stomach a higher risk.

***Proposition 4:** The heterogeneity of entrants at the manufacturing stage is due to the high permeability of stage boundaries.*

In the absence of technological barriers, the midstream manufacturing stage is highly permeable as suggested by the intensity of integration from neighboring stages shown in **Table 3**. The exception to this is China, which has imposed high regulatory barriers. But the actual risks are on feedstock supply and pricing. Some manufacturers, benefitting from their corporate pre-entry knowledge and resources in feedstock supply, are able to cushion supply risks better but others suffer at a time of volatile supply and price of feedstock.

***Proposition 5:** A firm producing a new product substituting those of incumbents requires a high level of control over its marketing channels, which could be better achieved by an inter-firm governance mode with a high level of controlling power such as the hierarchical governance mode.*

Access to market is another critical success factor for the long-term growth of the ethanol business. The downstream stages in these four countries are largely dominated by state-owned and global oil companies. Despite government support, the development of the industry is at the mercy of the strategy of these large actors. As incumbent of the motor fuel market, they have extensive interests, particularly those with excess refinery capacity or upstream oil businesses. Manufacturers in Thailand and Vietnam have an appetite for downstream integration to gain access to market particularly exploring high-blend fuels with 20% to 85% of ethanol. But there are regulatory barriers, particularly in Thailand and China. As an example of the challenges, in Vietnam, the pilot rollout of gasohol by a private producer faced opposition from major oil companies.

7. Conclusions

7.1 Summary

The nature of inter-firm governance in the transport biofuels industry has yet to receive sufficient attention in comparison to the vast amount of study in the automotive industry. In view of the complexity of this newly formed but rapidly growing industry, little is known about the structure of inter-firm governance in producing countries along the Maritime Silk Road; i.e. China, Thailand, Vietnam and the Philippines. By offering a deep contextual understanding of the industry in these countries, our study provides a rich description of the formation and evolution of inter-firm governance structures along the value chain. It provides insights to managers and firms working along the Silk Road in their decision in inter-firm governance choices. We offer some explanations for the forces driving the changes of governance mechanisms with reference to major theoretical perspectives in industrial organizations. This insight could possibly extend beyond the transport biofuel sector to other sectors integrating along the Silk Road.

Our study contributes to the understanding of inter-firm relationships as well as providing some insights - for managers and policy makers - especially those from developing countries - of the governance challenges in the fuel-ethanol industry, which hinder competitiveness.

The insight from the four-country studies suggests that two important determinants; i.e. security of supply and access to market, emerge as undercurrents in shaping the inter-firm governance mode along the value chain of the fuel-ethanol industry. Under the shadow of larger competitors for feedstock, ethanol manufacturers experiment with multiple governance modes to diffuse the risks of feedstock supply and pricing fluctuation. However, the permeability of upstream stage boundaries can be extremely low. Important barriers are those such as social-cultural, information and relationship, financial and human capacity and government policy. Because of low technological barriers, the permeability of the midstream manufacturing stage is high as evidenced by substantial integration from neighboring industries coming from both downstream and upstream stages. Despite a strong motivation to gain access to the market as a substitute for the existing incumbent product, efforts by ethanol manufacturers to integrate downstream encounters low permeability of stage boundaries due to regulatory and capital barriers. Moreover, we observe a phenomenon of evolving governance modes. As the industry develops from its infancy, firms are learning and experimenting in governance modes to mix and match with local institutional and relational factors.

Reflecting on how existing theoretical perspectives explain the forces shaping the formation of the governance structure, we find complementarity of the four theoretical perspectives (see **Section 2**) in provided relevant explanations of the empirical phenomena. Similarly, a manager will need to take a holistic perspective in evaluating the choice of governance mode(s), weighting the prevalent factors that dictate the decision.

We find that security of supply and access to the end customer are the two critical strategic factors that motivate firms to seek vertical integration at this specific stage of the transport bio-ethanol industry's development. Our study proposes a new theoretical perspective in which an inter-firm governance structure evolves out of critical success factors analysis on an industrial level.

7.2 Contributions

Drawing on our analysis of the empirical data gathered, we have sought to make contributions to three broad streams of literature as well as to strategic thinking for managers considering re-structuring their value chain governance in similar industries.

(1) Entrant: Pre-entry resources and capabilities

Chan & Reiner (2010) demonstrated the heterogeneity of entrants and their pre-entry's resources and capabilities in the early stages of development in the fuel-ethanol industry. In addition, we also argue that some pre-entry resources are more crucial than others and the degree of difficulty in acquiring those resources may differ. We substantiate these claims with empirical data that the upstream feedstock sourcing capability is of high importance. It requires a longer period to acquire in a market, especially where a relational governance mode is very prominent. This finding contributes to the understanding of new entrants and early stages of an industry life cycle such as works of Geroski (1995), Klepper and Simon (2000), and Helfat and Lieberman (2002).

(2) Evolutionary economics: forces shaping the dynamics of evolution

We identify four fundamental forces responsible for the evolutionary dynamic in the industry: (i) permeability of industry boundaries, which eases active entries from neighboring industries creating a topology of entrants as noticed by Fransman (2001) when analyzing the telecommunications industry; (ii) security of supply of crucial inputs, which

motivates managers to consider vertical relationships; (iii) access to the retail market by breaking through the monopoly of well-established incumbents, which also motivates managers to consider vertical relationships in downstream stages; and (iv) macro-level institutional factors such as government policy and the social-political structure of the agricultural sector.

(3) Determinants of inter-firm governance mode

We deploy four main strains of theory and lenses to examine inter-firm coordination in the biofuel value chain: (i) economic theories based on efficiency maximization, such as transaction cost theory and agency theory; (ii) macro-institutional perspective; (iii) evolutionary and learning perspective; and (iv) global commodity/value chain perspective.

There are multiple factors that motivate and constrain managers in selecting governance modes. We find a necessarily contextual approach has been employed in governance mode choice. Managers make decisions taking into consideration the political, industrial and market-based exogenous factors as well as the firm's internal resources and capabilities.

i) Strategic factors as determinant: security of supply and access to market

We demonstrate two additional determinants of inter-firm governance mode:

- (a) A firm organizes its relationship with other firms along its value chain to secure the supply of critical resource(s) by deploying the governance mode with the highest level of controlling power; e.g., in a hierarchical arrangement ("security of supply"). This is especially important for a firm to survive in an industry with high resource intensity and/or in a very competitive resource market;
- (b) A firm, producing new products that substitute for the product of a well-established incumbent requires a greater control over its marketing channels, which could be better achieved by the type of governance mode with greater control; e.g., hierarchical arrangements ("access to the retail market"). These two determinants of governance mode have been described in Perry (1988:206) and Porter (1980) but have not been the subject of much empirical analysis.

Our findings provide empirical evidence on the two determinants described above regarding security of supply and the effort to seek greater control in the retail market. Under these market conditions, firms are inclined to choose coordination mechanisms capable of ensuring supply of critical resources and exerting greater control over retail marketing channels. Although there is no general theory for vertical integration as suggested by Joskow (2010), these two determinants are among the leading motivations for why a firm may choose to internalize transactions instead of employing other modes of coordination over which they would have less control.

ii) From ideal type to plural modes

We have also put forward a third proposition on plural governance modes based on the phenomenon observed in the fuel-ethanol industry. Most firms do not confine themselves to adopting a single mode of governance for any given stage of a value chain. Although there might be an ideal type of governance under some conditions, organizations simultaneously deploy distinct coordination mechanisms for a function in the value chain for various reasons, such as mitigating against uncertainty and opportunism.

The observations on plural mechanism are not new, particularly in the upstream activities in sourcing. The sourcing literature also refers to plural and other terminology such as dual, concurrent or parallel sourcing (Parmigiani & Mitchell, 2009). Walker and Weber (1984) postulated a tactical motive of automotive firms employing and changing governance modes in order to learn about the operation of suppliers. When a firm makes as well as buys, it will acquire information allowing it to manage suppliers and gain insights regarding suppliers (Bradach & Eccles, 1989). Other preconditions for plural sourcing are demand uncertainty, technological volatility, information asymmetry, and complementarity in knowledge and incentives and learning or dynamic capacity building (Sako et al., 2016).

We propose including the plural governance mechanism in the Global Value Chain analytical structure, which could also represent the concurrent governance strategy deployed by any lead firm in a GVC analysis. In addition, plural governance mode could also be applied to a single supplier or downstream channel.

7.3 Practical implications in BRI context

Our study demonstrates that normative institutional factors are important consideration for firms in their selection of governance mode. Scott (1995) has argued that such institutional factors are important in establishing legitimacy in specific social settings. For the four Asian countries we have selected, relational governance mode operates in these BRI countries, in addition to market-based transactions. Particularly in China, relational institutions built on long-term personal ties continue to prevail even though the use of impersonal legal-based contracts has become more common in its increasingly market-driven economy (Zhou et al., 2008). Firms should consider institutional factors in host countries, such as the importance of establishing long-term relationships rather than simply aiming exclusively at achieving low cost production from a transaction cost perspective.

As value chains in BRI economies are increasingly integrated (Boffa, 2018), the coercive effects of formative institutional factors could become key barriers for firms. In the fuel-ethanol market, we find that formative institutional factors are coercive forces in distribution and retailing segments in the BRI countries. By contrast, market-based modes are prevalent between manufacturers and blenders of fuels in Thailand and Vietnam, but not in China. Moreover, trading of raw materials and finished biofuels are increasing across these BRI economies. Given the diversity across just the four BRI countries we consider, a plural governance mode should be considered in any further cross-border integration of transport biofuel value chain in order to gain legitimacy in the host country.

7.4 Limitations and future work

Our study is based on data from a single industry in one region and so we need to take care in drawing inferences from our study. Nevertheless, the propositions we offer should be further examined using similar methodologies and verified in the sectors with similarly complicated value chain landscapes. Geographically, we would want to verify our findings in other leading ethanol producers such as Brazil and the United States. In addition, verification would also be required for different stages of the industry lifecycle, which might have different dynamics and considerations in governance mode selection.

The most obvious parallel in terms of sector is to biodiesel, which is produced in a somewhat different set of countries, notably other BRI countries like Thailand, Malaysia and Indonesia as well as a number of European countries. Other sectors which may have similar characteristics include natural rubber, oils used in non-energy end uses such as palm oil and other forestry and genetic resources sectors. Further afield, other complicated supply chains include automotive supply chains, and increasingly, electricity and other energy markets. These are key sectors in many BRI countries. Improving our understanding of the dynamics of the evolution of their value chain governance would promote better integration of value chains, both within China and other BRI countries and across BRI countries.

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