INSTITUTE OF DEVELOPING ECONOMIES

Formation of Supply Chain Collaboration and Firm Performance in the Thai Automotive and Electronics Industries

Yasushi UEKI*

March 2013

Abstract

This paper examines factors that encourage firms to go into supply chain collaborations (SCC) and relationships between SCC and supply chain performances (SCP), using a questionnaire survey on Thai automotive and electronics industries in 2012. OLS regression results show firms established supplier evaluation and audit system, system of rewards for high-performance supplier and long-term transactions with their supply chain partners under a competitive pressure are more closely cooperate with these partners on information sharing and decision synchronization. Instrumental variables regression indicates SCC arisen from competitive pressure, supplier evaluation and audit, a system of rewards for high-performance supplier and long-term relationship causally influence SCP such as on-time delivery, responsiveness to fast procurement, flexibility to customer need, and profit..

* Research Fellow, Inter-disciplinary Studies Center, IDE (yasushi_ueki@ide.go.jp)

Formation of Supply Chain Collaboration and Firm Performance in the Thai Automotive and Electronics Industries

Yasushi Ueki

Institute of Developing Economies, Chiba, Japan
Email: yasushi_ueki@ide.go.jp

Abstract

This paper examines factors that encourage firms to go into supply chain collaborations (SCC) and relationships between SCC and supply chain performances (SCP), using a questionnaire survey on Thai automotive and electronics industries in 2012. OLS regression results show firms established supplier evaluation and audit system, system of rewards for high-performance supplier and long-term transactions with their supply chain partners under a competitive pressure are more closely cooperate with these partners on information sharing and decision synchronization. Instrumental variables regression indicates SCC arisen from competitive pressure, supplier evaluation and audit, a system of rewards for high-performance supplier and long-term relationship causally influence SCP such as on-time delivery, responsiveness to fast procurement, flexibility to customer need, and profit.

Keywords: Supply chain collaboration, Supply chain performance, Automotive, Electronics, Thailand

1. Introduction

Manufacturing firms today are required to satisfy customer needs for quick and on-time delivery of quality products at lower prices even in unpredictable economic crises and natural disasters. Firms in a supply chain collaborate with their partners in the chain to try to cope with such challenges in the more efficient way than doing so individually. Thus supply chain management (SCM) has been gaining its importance in global production networks.

SCM and supply chain collaborations (SCC) are becoming essential management practices for firms from Southeast Asia and other developing countries. Their internally available resources are so limited that they are dependent on external resources accessible through SCC to achieve improvements (Machikita & Ueki, 2012). Practitioners are eager to get a better understanding of how to participate in supply chains and how to get benefits from SCC.

Even so, previous studies provide mostly anecdotal evidence of SCM, SCC or internal management practice in Southeast Asian countries. Only a few studies quantitatively investigated SCM and related practices in middle income countries such as Malaysia (Chong, & Ooi, 2008; Ooi, et al., 2012) and Thailand (Banomyong & Supatn, 2011).

This paper examines factors that encourage firms to go into SCC and causal relationships between SCC and supply chain performances (SCP) at the firm level, using a questionnaire survey on Thai automotive and electronics industries conducted in the period of January and February, 2012. Instrumental variables (IV) regressions verify SCC causally influence SCP such as on-time delivery, fast procurement, flexibility to customer need, and profit.

This paper is structured as follows. Section 2 describes testable hypotheses. Section 3 explains the dataset and main variables for regressions. Section 4 presents empirical

models and results of the regressions. Finally Section 5 summarizes and discusses findings.

2. Collaboration and Performance

2.1. Formation of Supply Chain Collaboration

Strategic alliance and supply chain literatures have investigated reasons why firms form inter-firm networks (Grandori & Soda, 1995). A perspective highlights synergies between resources owned by two independent organizations (Eisenhardt & Schoonhoven, 1996). Another important reason is related to transaction costs that prevent firms from obtaining resources through the market mechanism efficiently (Chen & Chen 2003).

In addition to these structural elements, we need to consider what may motivate firms to make investments in developing alliances and SCC. Among several motives, competition has been widely recognized as a fundamental factor to form alliances (Stuart, 1998; Gimeno, 2004). Especially firms in vulnerable strategic positions are expected to have higher propensity to form alliances to access additional resources indispensable to execute innovative technical strategies or compete effectively (Eisenhardt & Schoonhoven, 1996). Based on these evidences, we can assume that competition encourage firms to enter into SCC to improve physical and financial performance.

H1: Competitive pressures stimulate firms to build collaborative relations.

Meanwhile excessive competition may promote firms to take opportunistic behaviors especially in arm's length transactions. To avoid such potential troubles, buyers obligate their suppliers to accept audit or evaluation when they enter into agreements. Thus

supplier audit and evaluation can be considered as a monitoring mechanism embedded in agreements to assure the minimum technical and other requirements.

Although supplier audit and evaluation are documented and fed back to suppliers, such process does not necessarily mean daily exchange of information or collaborations among supply chain partners. Even so, track records for a supplier's performance foster trusts between the supplier and its buyer (Dyer & Chu, 2000), which may result in customer-supplier cooperation. Heide and John (1990) found verification efforts significantly increase the level of joint actions in the machinery industries. Therefore, we can expect a supplier evaluation and audit can be a foundation or motivation for suppliers to form buyer-supplier collaborations.

H2: Supplier evaluation and audit encourage suppliers to enter into SCC to accomplish requirements from customers.

Formation of SCC will enable a buyer to give its suppliers competition, especially when the buyer holds a leading position in a supply chain or the suppliers have difficulties in switching to new buyers. Such intra-supply chain competition among the existing suppliers can motivate the suppliers in a supply chain to make proactive efforts for accomplishing a buyer's requirements or make better improvements than the buyer expects. Although a buyer in a position to lead a supply chain can make use of bargaining power. such coercive power relationship can negatively affect its suppliers' commitment

To mitigate such a negative effect, the buyer will be able to design rewarding systems in hopes of eliciting from the suppliers favorable reactions. If the suppliers expect benefits from the rewarding systems, like a continuous transaction with the buyer, the

expected mutual benefits for the buyer and its suppliers will promote collaborations (Zhao, et al., 2008).

H3: Reward system for suppliers stimulates SCC.

Although firms with coercive power may force their partners to collaborate in the competitive market, such subordinate partners can be vulnerable to competition. Firms will take strategic joint actions to reinforce their whole supply chain in prospect of continued, trustworthy, and long-term transactional relationships (Heide & John, 1990; Tomkins, 2001; Prajogo & Olhager, 2012). If we assume that the length and continuity in customer-supply relationships foster trust among supply chain partners (Dyer & Chu, 2000), the following hypotheses can be examined.

H4: Long-term relationships stimulate SCC.

H5: Longer-term relationships promote closer SCC.

2.2. Collaboration and Performance

Both SCM and innovation literature have focused on effects of inter-firm collaboration along a supply chain on business performance at the firm level. Among various business performance indicators, firms place more importance on enhancing flexibility to be competitive and profitable and mitigate risks in uncertain globalized business environments. SCM and SCC are considered as key business practices to enhance flexibilities. There are empirical evidences that support such perspectives. Zhou and Benton Jr. (2007) found effective information sharing significantly enhances effective supply chain practices such as supply chain planning, JIT production, and delivery practice. Prajogo and Olhager (2012) illustrated information sharing has a significant effect on logistics integration, which result in operational performance. Chen, et al.

(2004) verified communication and long-term orientation in the strategic purchasing are significantly related to customer responsiveness and financial performance. Sánchez and Pérez (2005) also found a positive relation between a superior performance in flexibility capabilities and firm performance in the Spanish automotive suppliers. Thus we postulate SCC will improve flexibility in business managements and consequently increase profits in Thai automotive and electronics companies.

H6: SCC improve process management.

H7: SCC improve profits.

The conceptual framework is summarized as Figure 1.

3. The Data

3.1. Sampling

In order to empirically examine the hypotheses based on the model, we conducted a mail survey on firms in the automotive and electronics industries in 2011 that are main machinery industries in Thailand. The questionnaire we designed is made up of three parts. The first part consists of the questions about demographic characteristics including capital structure, hierarchical position in the industries, the number of employees, and so on. The second part is related to innovation factors and achievements. The last part asks the respondents about SCC.

The sampling frame consists of 558 manufacturers listed in Thai Auto Parts Manufacturers Association (TAPMA) and 1,499 member firms of Electrical and Electronics Institute (EEI). From these 2,057 firms, we selected 10 firms for pre-test and in-depth interview. We also mailed the questionnaire. As a result, we collected 195 valid responses.

In order to examine factors promoting the SCC and effects of the SCC on business performance exclusively in the automotive and electronics industries, we narrowly defined the observations from these industries by excluding the respondents that did not answer the question on their place in the multi-tiered hierarchical production system of these industries. As a result, 160 observations can be utilized for the econometric analysis.

Table 1 presents summary statistics for the variables we used for the econometric analysis. The summary statistics for characteristics of the respondents, which are included as control variables in the regressions, indicate the observations are not considerably biased to a specific group of the firms categorized according to the sector, nationality, and size. More than half of the respondents are from the electronics industry. Some 54% of them produce only electronic parts, components and final products, while 38% of them manufacture only automotive parts or assembled cars. Only 8% of them ship their products to customers in both automotive and electronics industries. Although these sectors in Thailand are dominated by multinationals, especially Japanese firms, half of the respondents are wholly Thai-owned indigenous and the other half is foreign-owned, composed of foreign-owned (27%) and joint venture (23%) firms. The firm size in terms of average annual sales in the period of 2007 through 2011 is fallen into one of the six categories. About 38% of the respondents are lower middle sized firms recorded the sales of 100-499.9 million Thai baht.

3.2. Collaboration Promotion Factors (CPF)

As factors promote SCC, the respondents were asked to indicate on a five point Likert scale their perception that (1) *competition is a factor to seek new innovation*, (2) *supplier evaluation and audit* is a factor that promotes SCC, and (3) *rewarding high*

performance suppliers is a SCC promotion factor. As an indicator for the level of trust the respondents place in their supply chain partners, the dummy variable for *collaboration for more than six years* was coded 1 if they have had any form of collaborations with their customers and/or suppliers for six years or longer. As in Table 1, the mean of variable *competition is a factor to seek new innovation* is 3.93, which is higher than that of *Supplier evaluation and audit* (3.49) and *Rewarding high performance suppliers* (2.73). The table also shows 79.0% of the respondents have been collaborating for more than six years.

3.3. Supply Chain Collaborations (SCC)

There are a variety of forms of SCC. In this paper, we focus on (1) *information sharing* and (2) *decision synchronization* with supply chain partners, assuming that the former is a fundamental practice for the respondents to establish a closer cooperation like the latter.

The variable for *information sharing* is defined as the sum of the scores for the four items related to sharing information on (1) manufacturing, (2) warehouse, (3) processing, and (4) others, all of which are measured on a five point Likert scale. The variable for *decision synchronization* was calculated in the same manner as *information sharing*, by summing up the scores for collaborations in (1) solving operational problems, (2) market planning, (3) planning product improvement and development, and (4) planning process improvement and development. The mean for *information sharing* and *decision synchronization* is 12.78 and 13.18 respectively as in Table 1.

3.4. Supply Chain Performance (SCP)

There are four indicators for supply chain performance at the firm level introduced in this paper as follows: (1) on-time production and delivery; (2) responsiveness to fast procurement; (3) more flexibility to customer need; and (4) profit increase. All these items are on a five point Likert scale. Table 1 present the mean for *on-time production and delivery* is 3.82, while that for *profit increase* is 3.58. This implies that improvements in production and delivery through SCC do not necessarily lead to bigger profit.

4. Results

4.1. Relationship between Collaboration Promoting Factors and Collaboration

Using these variables, we examine the hypotheses by applying econometric approaches. Firstly, we perform the method of ordinary least squares (OLS) to estimate the regression of SCC on CPF formulated as the following equation (1).

$$SCC_i = \alpha_1 + \beta_1 * CPF_i + \gamma_1 * x_i + u_i \qquad (1)$$

The variables x_i are control variables for attributes of a respondent (*i*) such as company type, average annual sales in the period of 2007-2011, and sector, all of which are dummy variables.

Table 2 summarizes the result of estimations. The dependent variable in the columns 1-5 is *information sharing* while that in the columns 6-10 is *decision synchronization*. The four collaboration factors are included in the model individually before including all four independent variables as in columns 5 and 10.

The CPF are positively significant when included individually. The variables for *competition is a factor to seek new innovation*, s*upplier evaluation and audit*, and *rewarding high performance suppliers* are positively significant at the 1% level irrespective of the dependent variables. The dummy variable for *collaboration for more*

than six years is positively significant at the 5% level when the dependent variable is *information sharing* (column 4) and at the 1% level for the regression of *decision synchronization* (column 9).

When we regress *information sharing* on all four variables and control variables, s*upplier evaluation and audit*, and *rewarding high performance suppliers* are positively significant at the 1% and 5% level respectively (column 5). When *decision synchronization* is regressed on all these independent variables, *collaboration for more than six years* becomes positively significant at the 5% level (column 10).

The robustly significant impacts of s*upplier evaluation and audit*, and *rewarding high performance suppliers* on the formation of SCC indicates the design of supplier development and supply chain governance would influence firm-level decision making on whether parties in a supply chain enter into collaborative relationships with their supply chain partners.

This difference in the significant level for *collaboration for more than six years* indicates that more complex inter-firm collaboration involving denser information exchange among parties in a supply chain like *decision synchronization* are based on trust that would be fostered through long-term supply chain transactions and information exchanges, while a relatively simple *information exchange* might be necessitated in the standard SCM in these industries or incorporated into contracts closed before firms start business transactions.

4.2. Relationship between Collaboration and Performance (OLS)

In order to examine the relationship between SCC and business performance, the OLS estimations are performance to regress supply chain performance on SCC formulated as the equation 2.

$$SCP_i = \alpha_2 + \beta_2 * SCC_i + \gamma_2 * x_i + u_i \qquad (2)$$

The control variables x_i are the same as those in the equation 1. There are four indicators for supply chain performance as explained in the section 3.4. One of the two indicators for SCC, which are dependent variables in the equation 1, is included in the estimations. The columns 1-4 in Table 3 present the results of OLS estimations when the variable for SCC is *information sharing* and the columns 5-8 summarize the results of the regression of supply chain performance on *decision synchronization*.

Table 3 show all of the estimated coefficients on SCC are positively significant at the 1% level. This result indicates a robust relationship between the measures for SCC and supply chain performance. The R-squareds are increased for the regressions of *decision synchronization*, indicating denser collaborative partnerships along a supply chain will improve firm performances.

4.3. Relationship between Collaboration and Performance (2SLS)

Although we assume that more intense SCC will cause better supply chain performance or the dependent variable for the equation 2 will not be determined jointly with the independent variable, a firm achieving better performance can be more likely to be selected as a collaboration partner. If there is such a possible problem of reverse causality as well as omitted variables and measurement error in the variable for SCC, OLS will yield inconsistent and biased estimates.

In order to solve this problem of endogenous regressors, we perform two-stage least squares (2SLS), running the equation 1 shown in the columns 5 and 10 in table 2 as the first-stage auxiliary regression and the equation 2 in the second stage. Thus, in the 2SLS, the instrumental variables are the variables for four collaboration promoting factor (*competition is a factor to seek new innovation*, *supplier evaluation and audit*,

rewarding high performance suppliers, *collaboration for more than 6 years*) and the instrumented variables are the variables for SCC (*information sharing*, *decision synchronization*).

All coefficients on SCC estimated by 2SLS shown in table 4 are positively significant at the 1% level. These coefficients estimated by 2SLS are larger than the OLS estimators in table 3, which indicate the biased results of OLS. Score tests and regression-based tests of endogeneity reject the null hypothesis that the variables for SCC are exogenous in all of the eight estimations for the regression of firm performance. The first-stage regression F statistics are larger than 20, indicating that the instruments are not weak (Stock & Yogo, 2005). The tests of overidentifying restrictions do not reject the null hypothesis that the instrumental variables are valid. These results of post-estimation tests suggest the validity of 2SLS estimators.

5. Conclusions

This paper had twofold objectives. Firstly we attempted to identify motivations for firms to share information or synchronize decision making with their supply chain partners. Secondly we examined if SCC cause better SCP.

The results of the regressions provide robust evidence that support the hypotheses we tested. These similar findings to the past studies indicate Thailand machinery industries, of which development have been led by Japanese and western multinationals, have learned globally adopted SCM practices. The results of the analysis on the factors influential to SCC, which are different between information sharing and decision synchronization, imply long-term relationship with supply chain partners foster denser information exchange that facilitate decision synchronization. Such decision synchronization has statistically robust impact on business performances.

In this paper, we didn't attempt to identify key differences in SCM between the automotive and electronics industries, which are a challenge for the future research.

References

Banomyong, R. & Supatn, N. (2011). Developing a supply chain performance tool for SMEs in Thailand, *Supply Chain Management: An International Journal*, 16(1), 20-31.

Chen, H. & Chen, T.-J. (2003). Governance structures in strategic alliances: transaction cost versus resource-based perspective, *Journal of World Business*, 38(1), 1-14.

Chen, I.J., Paulraj, A. & Lado, A.A. (2004). Strategic purchasing, supply management, and firm performance, *Journal of Operations Management*, 22(5): 505-523.

Chong, A. Y.-L. & Ooi, K.-B. (2008). Adoption of interorganizational system standards in supply chains: An empirical analysis of RosettaNet standards, *Industrial Management & Data Systems*, 108(4), 529-547.

Dyer, J.H. & Chu, W. (2000). The Determinants of trust in supplier-automaker relationships in the U.S., Japan, and Korea, *Journal of International Business Studies*, 31(2), 259-285.

Eisenhardt, K.M.& Schoonhoven, C.B. (1996). Resource-based view of strategic alliance formation: strategic and social effects in entrepreneurial firms, *Organization Science*, 7(2), 136-150.

Gimeno, J. (2004). Competition within and between networks: the contingent effect of competitive embeddedness on alliance formation, *The Academy of Management Journal*, 47(6), 820-842.

Grandori, A. & Soda, G. (1995). Inter-firm networks: antecedents, mechanisms and forms, *Organization Studies*, 16(2), 183-214.

Heide, J.B. & John, G. (1990). Alliances in industrial purchasing: the determinants of joint action in buyer-supplier relationships, *Journal of Marketing Research*, 27(1), 24-36.

Machikita, T. & Ueki, Y (2012). Impacts of incoming knowledge on product innovation: technology transfer in auto-related industries in developing economies, *Asian Journal of Technology Innovation*, 20(Sup 1), 9-27.

Ooi, K.-B., Cheah, W.-C., Lin, B., Teh, P.-L. (2012). TQM practices and knowledge sharing: An empirical study of Malaysia's manufacturing organizations, *Asia Pacific Journal of Management*, 29(1), 59-78.

Prajogo, D. & Olhager, J. (2012). Supply chain integration and performance: The effects of long-term relationships, information technology and sharing, and logistics integration, *International Journal of Production Economics*, 135(1), 514-522.

Sánchez, A.M. & Pérez, M.P. (2005). Supply chain flexibility and firm performance: A conceptual model and empirical study in the automotive industry, *International Journal of Operations & Production Management*, 25(7), 681-700.

Stock, J. & Yogo, M. (2005). Testing for Weak Instruments in Linear IV Regression. In Andrews, D.W.K. & Stock, J.H. (eds.) *Identification and Inference for Econometric Models: Essays in Honor of Thomas Rothenberg*, 80–108, Cambridge: Cambridge University Press.

Stuart, T.E. (1998). Network positions and propensities to collaborate: an investigation of strategic alliance formation in a high-technology industry, Administrative Science Quarterly, 43(3), 668-698.

Tomkins, C. (2001). Interdependencies, trust and information in relationships, alliances and networks, *Accounting, Organizations and Society*, 26(2), 161-191.

Zhao, X., Huo, B., Flynn, B.B. & Yeung, J. H.-Y. (2008) The impact of power and relationship commitment on the integration between manufacturers and customers in a supply chain, *Journal of Operations Management*, 26(3), 368-388.

Zhou, H. & Benton Jr., W.C. (2007). Supply chain practice and information sharing, *Journal of Operations Management*, 25(6), 1348-1365.
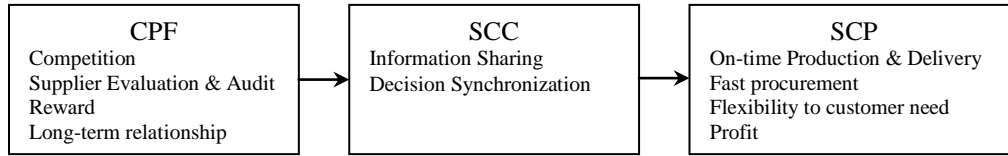
```
┌─────────────────────────┐     ┌─────────────────────────┐     ┌─────────────────────────┐
│          CPF            │     │          SCC            │     │          SCP            │
│ Competition             │     │ Information Sharing      │     │ On-time Production & Delivery│
│ Supplier Evaluation & Audit│ → │ Decision Synchronization │  → │ Fast procurement        │
│ Reward                  │     │                         │     │ Flexibility to customer need│
│ Long-term relationship  │     │                         │     │ Profit                  │
└─────────────────────────┘     └─────────────────────────┘     └─────────────────────────┘
```

Figure 1. Conceptual framework

Notes: CPF (collaboration promotion factors), SCC (supply chain collaborations), SCP (supply chain performances).

Table 1. Summary statistics

Variable	Mean	Std. Dev.	Min	Max
Supply Chain Performance				
On-time production and delivery	3.82	0.98	1	5
Responsiveness to fast procurement	3.75	0.97	1	5
More flexibility to customer need	3.70	0.89	1	5
Profit increase	3.58	1.08	1	5
Supply Chain Collaboration				
Information sharing	12.78	3.55	4	20
Sharing information of manufacturing	3.31	1.05	1	5
Sharing information of warehouse level	3.02	1.02	1	5
Sharing information of processing	3.21	1.01	1	5
Sharing other information with supply chain member	3.23	1.04	1	5
Decision Synchronization	13.18	3.91	4	20
Helping to solve operational problems	3.68	1.02	1	5
Making a decision in market planning	3.01	1.16	1	5
Planning to improve and develop product	3.24	1.14	1	5
Planning to improve and develop process	3.25	1.15	1	5
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	3.93	1.00	1	5
Supplier evaluation and audit	3.46	1.07	1	5
Rewarding high performance suppliers	2.73	1.35	1	5
Collaboration for more than 6 years (dummy)	0.79	0.41	0	1
Company Type (dummy)				
Foreign company	0.27	0.44	0	1
Joint venture	0.23	0.42	0	1
Domestic group company	0.11	0.32	0	1
Single domestic company	0.39	0.49	0	1
Average annual sales in 2007-2011 (dummy)				
Less than 50 million THB	0.11	0.32	0	1
50 - 99.9 million THB	0.19	0.39	0	1
100 - 499.9 million THB	0.38	0.49	0	1
500 - 999.9 million THB	0.14	0.35	0	1
1 - 2.9 billion THB	0.11	0.32	0	1
More than 3 billion THB	0.08	0.26	0	1
Sector (dummy)				
Automotive	0.38	0.49	0	1
Electronics	0.54	0.50	0	1
Both	0.08	0.27	0	1
Observations	160			

Source: SIIT Thai Automotive and Electronics Industries Survey 2012.

Table 2. Relationship between collaboration promoting factor and supply chain collaboration

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
	Information Sharing					Decision Synchronization				
Collaboration Promoting Factor										
Competition is a factor to seek new innovation	1.55***				0.46	1.78***				0.37
	(0.25)				(0.29)	(0.30)				(0.33)
Supplier evaluation and audit		1.93***			1.33***		2.40***			1.77***
		(0.22)			(0.29)		(0.23)			(0.33)
Rewarding high performance suppliers			1.24***		0.45**			1.48***		0.51**
			(0.22)		(0.22)			(0.21)		(0.21)
Collaboration for more than 6 years				1.70**	0.67				2.41***	1.17**
				(0.73)	(0.54)				(0.74)	(0.56)
Company Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average annual sales in 2007-11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	160	160	160	160	160	160
R-squared	0.253	0.396	0.275	0.105	0.438	0.264	0.481	0.303	0.120	0.523
F statistic	6.012***	12.41***	5.953***	1.949**	11.04***	5.719***	13.12***	6.728***	2.915***	15.15***

Notes: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3. Effect of supply chain collaboration on supply chain performance (OLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Production and Delivery	Procurement	Customer Need	Profit	Production and Delivery	Procurement	Customer Need	Profit
Supply Chain Collaboration								
Information sharing	0.12***	0.14***	0.11***	0.13***				
	(0.02)	(0.02)	(0.02)	(0.02)				
Decision Synchronization					0.14***	0.13***	0.11***	0.16***
					(0.02)	(0.02)	(0.02)	(0.02)
Company Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average annual sales in 2007-11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	160	160	160	160
R-squared	0.26	0.32	0.29	0.26	0.36	0.34	0.32	0.39
F statistic	5.544***	7.184***	5.477***	5.695***	8.111***	8.119***	5.420***	9.418***

Notes: Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 4. Effect of supply chain collaboration on supply chain performance (2SLS)

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	Production and Delivery	Procurement	Customer Need	Profit	Production and Delivery	Procurement	Customer Need	Profit
Supply Chain Collaboration								
Information sharing	0.25***	0.26***	0.23***	0.29***				
	(0.04)	(0.03)	(0.03)	(0.04)				
Decision Synchronization					0.20***	0.21***	0.18***	0.23***
					(0.03)	(0.02)	(0.03)	(0.03)
Company Type	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Average annual sales in 2007-11	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Sector	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Constant	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Observations	160	160	160	160	160	160	160	160
R-squared	0.046	0.143	0.093	0.031	0.295	0.248	0.215	0.324
Wald chi2	60.34***	101.4***	73.69***	86.49***	85.15***	114.9***	69.97***	120.4***
Tests of endogeneity								
Robust score chi2	13.16***	10.84***	13.19***	13.48***	9.01***	11.54***	13.28***	9.29***
Robust regression F	29.77***	23.37***	26.64***	28.67***	13.44***	19.15***	20.60***	13.12***
Test of overidentifying restrictions								
Score chi2	2.54	3.38	2.92	2.27	3.83	5.73	3.02	4.28
First-stage regression Robust F	22.28	22.28	22.28	22.28	35.96	35.96	35.96	35.96

Notes: Instrumented: Supply Chain Collaboration (*Information sharing*, *Decision Synchronization*). Instruments: Collaboration Promoting Factor (*Competition is a factor to seek new innovation*, *Supplier evaluation and audit*, *Rewarding high performance suppliers*, *Collaboration for more than 6 years*). Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.