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Supply Chain Collaboration and Responsiveness: A Comparison between Thai Automotive and Electronics Industries

Yasushi UEKI*

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

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Yasushi Ueki

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

Abstract

This paper examines factors that promote firms to develop supply chain collaborations (SCC) with their partners and relationships between SCC and supply chain operational performances (SCOP), using a questionnaire survey on Thai automotive and electronics industries in 2012. This paper also carries out a comparative study on these questions between the electronics and automotive industries. Two-stage least squares (2SLS) regressions verify that supplier evaluation and audit is a foundation for firms to share information and synchronize decision makings with their partners, and that such SCC are significantly related to SCOP indictors such as on-time delivery, fast procurement, and flexibility to customer need irrespective of industry type. On the other hand, competitive pressure motivates only electronics firms to develop SCC in order to be more innovative.

Keywords: supply chain, information sharing, decision synchronization, responsiveness, automotive, electronics, Thailand

1. Introduction

Competition in the global market has been changing from the cost to time-based (Hum & Sim, 1996) as Nagel and Dove (1991) foresaw that "agile manufacturing will become the strongest competitors in the global marketplace." Currently manufacturing firms are competing in shortening of lead-time and on-time delivery of quality products even in an environment of continuous and irregular change while maintaining cost competitiveness. Firms also need to be flexible and highly responsive to customer needs and unpredictable changes. These backgrounds underline the increase in management literature paying attention to the concepts of agility (Yusuf, et al. 1999, 2004), flexibility (Lummus, et al., 2003), and responsiveness (Bernardes & Hanna, 2009; Gunasekaran, et al., 2008; Reichhart & Holweg, 2007). Sometimes there concepts were made overlapping use (Bernardes & Hanna, 2009; Reichhart & Holweg, 2007). But it can be considered that firms can be responsive when they have agile or flexible operational managements.

The literature initially focused mainly on manufacturing operations. Currently the scope has been extended to supply chains (Reichhart & Holweg, 2007). In reality, there is of limit effectiveness for firms to make improvements individually. Firms are needed to optimize their operations along a supply chain. To take on such challenge, firms in a supply chain are more likely to create tighter collaborative relationships with their partners in the chain. Thus the related literature investigates agility, flexibility and responsiveness in the level of supply chains.

Although these issues have its root in the competitive challenge faced by firms from developed countries, enhancing agility, flexibility, and responsiveness are of increasing importance for firms from Southeast Asia, especially middle income countries, which are being caught up by less developed Asian countries with ample and cheap labor forces. Because they have limited internally available resources,

external resources that become available through supply chain collaborations (SCC) are indispensable to improve operational performance (Machikita & Ueki, 2012).

Even so, previous studies investigate mostly the relationship between SCC and operational performances in developed countries. A few studies investigated supply chain management (SCM) in Southeast Asian countries such as Malaysia (Chong, & Ooi, 2008; Ooi, et al., 2012) and Thailand (Banomyong & Supatn, 2011). On the other hand, factors influencing the formation of collaborative relationships among firms, especially from developing countries, are remained unclear (Zhao, et al., 2008) even though indigenous firms from developing countries face difficulties in engaging in global value chains.

This paper attempts to combine two investigations of firms in developing countries on (1) factors that promote firms to develop SCC with their partners and (2) relationships between SCC and supply chain operational performances (SCOP) at the firm level. To be more precise, using a questionnaire survey on Thai automotive and electronics industries conducted in the period of January and February, 2012, SCOP indictors such as on-time delivery, fast procurement, and flexibility to customer need are regressed on SCC indicators like information sharing and decision synchronization by two stage least squares (2SLS). Furthermore, this paper makes an in-depth comparative study between automotive and electronics industries that have different technological and supply chain governance architectures.

The structure of this paper is as follows. Section 2 provides hypotheses that are tested in this paper. Section 3 explains the dataset and main variables for regressions. Section 4 shows our empirical models and results of the regressions. Section 5 summarizes our findings.

2. Supply Chain Collaboration and Operational Performance

2.1. Drivers of Supply Chain Collaboration

Literatures have investigated antecedents, mechanisms and forms of inter-firm networks (Grandori & Soda, 1995). One of the rationales to form an inter-firm network is synergies between resources owned by independent establishments (Eisenhardt & Schoonhoven, 1996). Transaction costs are also an element that allows firms to create a closer relationship with specific partners to obtain resources through non-market mechanism more efficiently than market (Chen & Chen 2003).

Among several drivers to form alliance, competition has been considered as an essential factor (Stuart, 1998; Gimeno, 2004). Eisenhardt and Schoonhoven (1996) found alliances are formed when firms are in vulnerable strategic positions to obtain resources necessary for technical strategies or compete effectively.

De Leeuw and Fransoo (2009) discussed the similar issue focusing on the imbalanced competitive position between parties that foster close SCC. Zhao, et al. (2008) examined the relationship between customer's power and its supplier's relational commitment. Benton and Maloni (2005) investigated the effect of power influence on supplier satisfaction. These previous studies suggest that competition promote firms to develop SCC.

H1: Firm under more competitive pressures from either markets or supply chain partners are more likely to enter into collaboration with their partners in a supply chain.

Although competitive pressure may encourage firms to make improvements, it is not necessarily promote collaboration. If a dominant firm put an excess pressure on its suppliers, the suppliers will not be satisfied with participating in collaborations (Benton & Maloni, 2005). In the worst scenario, overpressure may force firms to take opportunistic behaviors. Therefore buyers may develop a monitoring mechanism

to ensure their requirements by closing contracts with their suppliers that stipulate supplier audit or evaluation. Supplier audit or evaluation also can be a proactive tool to develop capabilities of suppliers, which provide improvements in operations not only to suppliers but also to buyers and other parties along a supply chain. But simple exchanges of audit and evaluation documents do not generate recurring exchange of information and collaboration for making improvements. Effective inter-firm communication efforts and strategies are essential to suppler development and improve supplier performances (Krause, 1999; Prahinski & Benton, 2004). Humphreys and Chan (2004) recognized supplier evaluation as infrastructure factors for supplier development. Wagner and Krause (2009) found that the evaluations alone are insufficient investments to build suppliers' capabilities and buyers' efforts for tacit knowledge transfer are associated with buyers' goals. But track records of supplier's performance, which could be accumulated through evaluation and audit, develop trusts and consequently cooperation among parties involved in a supply chain (Dyer & Chu, 2000). Verification efforts also significantly enhance the level of joint actions in the machinery industries (Heide and John, 1990). Thus, it can be expected that supplier evaluation and audit can be a foundation to form buyer-supplier collaborations.

H2: Supplier evaluation and audit promote suppliers to develop SCC to meet target levels of operational efficiencies.

2.2. Supply Chain Collaboration and Operational Performance

As supply chain can be a channel of knowledge transfer, which influences operational performances including supply chain flexibility (Blome, et al., 2013), management literature has investigated relationships between supply chain collaboration and operational performance. In the concept proposed by Gunasekaran, et al. (2008),

knowledge management, collaborative network of partners and information technology and systems are key enablers of responsive supply chain, which lead a supply chain to be more speedy, responsive and flexible. Empirically, Handfield, et at. (2009) presented a significant relationship between supplier integration and sourcing enterprise performance composed of lead-time reduction and improvement in product design and quality. Zhou and Benton Jr. (2007) found effective information sharing improves supply chain planning and other enhances effective supply chain practices such as just-in-time (JIT) production and delivery. Prajogo and Olhager (2012) demonstrated information sharing is influential to logistics integration. Chen, et al. (2004) confirmed communication and long-term orientation in the strategic purchasing are positively correlated to customer responsiveness. Sánchez and Pérez (2005) showed a significant relation between flexibility capabilities and firm performance in the Spanish automotive suppliers. These empirical evidences allow postulating a hypothesis that SCC will improve supply chain operational performances (SCOP) in Thai automotive and electronics companies.

H3: Supply chain collaborations improve operational timeliness, flexibility and responsiveness.

2.3. Influence of Industrial Characteristics

There are a variety of inter-firm collaborative networks that have different characteristics. Gereffi, et al. (2005) categorized types of the value chain governance, which are affected by the complexity of complexity of transactions, ability to codify transactions, and capabilities in the supplier base. Leeuw and Fransoo (2009) emphasized factors affecting close supply chain collaborations such as market, product, and partner. Their arguments imply that drivers of supply chain collaborations can be sector-specific.

For example, the automotive and electronics sectors, to which this paper pays attention, have different characteristics. The electronic sector produce codified information and modularized components so that arms' length transactions will bring benefits such as speed, flexibility, access to low-cost inputs, and lower costs of switching to new partners (Gereffi, et al., 2005). On the other hand, the automotive sector produces more integral and complex products, while there is a different degree of modularity at the component level (Ge, & Fujimoto, 2004). Lead firms in the sector such as Toyota and Honda hold a dominant position in their supply chain.

From such observations, a comparative study between the automotive and electronic sectors is worthy to attempt.

H4: There are differences in supply chain collaboration drivers between the automotive and electronic sectors. Such differences may affect the relationship between SCC and SCOP.

Based on the discussions above, Figure 1 was developed to present the conceptual framework that is empirically examined by econometric analysis using the dataset constructed by a questionnaire survey. Details are explained from the following sections.

3. The Data

3.1. Sampling

In order to examine the hypotheses, a mail survey on firms in the automotive and electronics industries in 2012 in Thailand was carried out. The questionnaire is composed of three parts: (1) demographic characteristics; (2) innovation factors and achievements; and (3) supply chain collaboration. 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, 10 firms were selected for pre-test and in-depth interview, while the questionnaire was mailed to the rest of the firms. As a result, 195 valid responses were collected. In order to examine SCC drivers and relationships between SCC induced by the drivers and business performance exclusively in the automotive and electronics industries, the observations were restricted to the respondents that did answer the question on whether they are an assembler, tier 1 supplier or tier 2 or 3 supplier for either the automotive or electronics sector. As a result, 161 observations, including 87 respondents that ship their products only to electronics industry, 61 engaging only in the automotive industry, and 13 participating in the both sectors, can be utilized for the econometric analysis.

Table 1 presents summary statistics for the variables used for the econometric analysis. The summary statistics for characteristics of the respondents calculated with the whole sample, which are included as control variables in the regressions, illustrate the observations are not extremely biased to a specific group of the firms. Some 54% of the respondents produce only electronic parts, components and final products, while 38% of them manufacture only automotive parts or assemble automobiles. Only 8% of them engage in production of automotive and electronic products. Although these sectors in Thailand are dominated by multinationals, especially Japanese firms, 50% of the respondents are wholly Thai-owned indigenous and the rest consists of foreign-owned (27%) and joint venture (23%) firms. The average annual sales in the period of 2007 through 2011 are categorized into the six sizes. About 58% of the respondents recorded the sales amount of 499.9 million or smaller Thai baht.

When the same variables are observed using the sample restricted to those producing either automotive or electronics products, the respondents from the electronics industry are more likely to be locally owned (55% of the respondents) than

those from the automotive industry (45%). Even so, there is not a considerable difference in the percentage for firms booked the sales amount of 499.9 million or smaller Thai baht: 68% of the respondents from the electronics and 64% of the automotive industries.

3.2. Supply Chain Collaboration Drivers (SCCD)

As SCC drivers, the respondents were asked to indicate on a five point Likert scale their perception that (1) *competition is a factor to seek new innovation*, and (2) *supplier evaluation and audit* is a factor that promotes SCC. The variable for *competition* is not necessarily directly associated with collaboration between the respondents and their supply chain partners. As shown in Table 1, the mean of variable *competition is a factor to seek new innovation* is 3.93, while the mean for variable *supplier evaluation and audit* is 3.47 for the whole sample.

When the sample was divided into the electronics and automotive industries, there are not statistically significant differences in the average scores between the two groups. The means of variable *competition* for the electronics and automotive industries are 3.94 and 3.90 respectively, while the means for variable *supplier evaluation and audit* are 3.45 and 3.49 correspondingly. The null hypothesis of the equality of means was not rejected by *t* tests, while details are not reported in table 1.

3.3. Supply Chain Collaborations (SCC)

Supply chain literature has defined SCC as a variety of concepts such as information sharing, goal congruence, decision synchronization, incentive alignment, resource sharing, collaborative communication, joint knowledge creation, and so on (Cao, et al., 2010). The questionnaire survey asked the respondents about (1) *information sharing* (Sheu, et al., 2006; Simatupang & Sridharan, 2005) and (2) *decision synchronization*

(Simatupang & Sridharan, 2005) with supply chain partners. Thus this paper makes in-depth analysis on relationships between these SCC indicators and operational performance.

In this paper, 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 12.77 and 13.19 respectively as in table 1. Such magnitude relationship is observed even when the scores are calculated for electronics and automotive firms individually. The fact that *decision synchronization* was given higher score as SCC factor than *information sharing* may imply that information sharing is a fundamental practice to establish a closer cooperation like decision synchronization.

An additional finding from a comparison between electronics and automotive firms are the fact that there are not statistically significant difference in mean values for *information sharing* and its four composing elements as well as *decision synchronization* and its four composing elements described above.

3.4. Supply Chain Operational Performance (SCOP)

There are three indicators for supply chain operational performance at the firm level introduced in this paper as follows: (1) on-time production and delivery; (2) responsiveness to fast procurement; and (3) more flexibility to customer need. All these items are on a five point Likert scale. Table 1 present the mean values for

on-time production and delivery, *fast procurement*, and *flexibility to customer need* are 3.82, 3.75, and 3.70 respectively.

As in the explanations for other indicators, *t* tests on the equality of means were not rejected. In other words, there are not statistically significant differences between electronics and automotive firms in the mean values for *on-time production and delivery*, *fast procurement*, and *flexibility to customer need*.

4. Results of regressions

4.1. The Model

To examine the hypotheses H1 and H2, the following regressions of supply chain collaboration (SCC) on supply chain collaboration drivers (SCCD) are performed.

$$SCC_i = \alpha_1 + \beta_1 * SCCD_i + \gamma_1 * x_i + u_i \quad (1)$$

As describe above, SCC_i is one of the indicators related to *information sharing* and *decision synchronization* and SCCD indicators are based on subjective ratings on (1) *competition* as a factor to seek new innovation, and (2) *supplier evaluation and audit* as a factor to promote SCC. 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.

In the same way, to examine the hypothesis H3, to examine the relationship between SCCD and supply chain operational performance (SCOP), the following equation 2 is formulated to regress SCOP on SCC indicators.

$$SCOP_i = \alpha_2 + \beta_2 * SCC_i + \gamma_2 * x_i + u_i \quad (2)$$

As explained already, the variable $SCOP_i$ is one of the five point Likert scale indicators of *on-time production and delivery*, *fast procurement*, and *flexibility to customer need*. The independent variable SCC_i, which is the dependent variable in the equation 1, and control variables x_i are same as those in equation 1.

The model presumes that SCC will cause better SCOP. In other words, SCOP will not be determined jointly with SCC. If there is such a possible problem of endogeneity produced by opposite causality from the presumption, as well as omitted variables and measurement error in the variable for SCC, ordinary least squares (OLS) yields inconsistent and biased estimates.

In order to solve the problem of endogeneity, this paper performs two-stage least squares (2SLS), running the equation 1 as the first-stage auxiliary regression and the equation 2 in the second stage. In the 2SLS, the instrumental variables are the variables for two SCCD (*competition is a factor to seek new innovation* and *supplier evaluation and audit*) and the instrumented variables are one of the variables for SCC (*information sharing* or *decision synchronization*).

4.2. Results (Whole Sample)

Table 2 and table 3 present results of the estimations using the whole dataset. The column 1 in each table summarizes the result of the first stage regression based on the equation 1 and the columns 2-4 present the results of the second stage regressions formulated as the equation 2 thath include *on-time production and delivery*, *responsiveness to fast procurement*, and *more flexibility to customer need* as the dependent variable respectively.

The dependent variable for the first stage estimation in table 2 is *information sharing*, which has significant relationships with the variables for *competition is a factor to seek new innovation*, and s*upplier evaluation and audit* at the 10% and 1% level respectively as shown in the column 1. The columns 2-4 in table 2 show *information sharing* has significant positive correlations with *on-time production and delivery*, *responsiveness to fast procurement*, and *more flexibility to customer need* at the 1% level. 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.

Table 3 present results of 2SLS estimations introducing the variable *decision synchronization* as dependent variable in the first stage estimation and as independent variable in the second stage estimations. Key findings from table 3 are same as table 2 except the significant level of the coefficient on *competition* that was improved from the 10% to 5% significant level. The post estimation tests again support the validity of performing 2SLS estimations.

In sum, the results presented in tables 2 and 3 can support the hypotheses H1, H2 and H3 when they are tested using the whole sample.

4.3. Comparison between the automotive and electronics industries

The same models are separately applied to the two sub-samples composed of the respondents who ship their products only to automotive and to electronics industries. Tables 4 5 show the estimation results for the subsample of the electronics industry. In both tables, the SCC indicators (*information sharing* and *decision synchronization*) have significant positive relationships with *competition* and s*upplier evaluation and audit* at the 5% and 1% level respectively (column 1 of tables 4 and 5) and the SCOP indicators are correlated with the SCC indicators at the 1% level (column 2-4 of tables 4 and 5). The post estimation tests support the validity of performing 2SLS estimations.

Tables 6 and 7 summarize the estimation results for the subsample of the automotive industry. As in the case of the electronics industry, the SCC indicators (*information sharing* and *decision synchronization*) have significant positive relationships with s*upplier evaluation and audit* at the 1% level (column 1 of tables 6 and 7) and the SCOP indicators are correlated with the SCC s*upplier evaluation and audit* at the 1% level (column 2-4 of tables 6 and 7). However, the coefficients on *competition* are not statistically significant in the column (1) of both tables 6 and 7. In addition, although the post estimation tests support the validity of applying 2SLS estimations, the first-stage regression F statistics for the subsample of the automotive industry are much smaller than those estimated using the whole sample and the subsample of the electronics industry.

In sum, the validity of H4 is confirmed with respect only to collaboration drivers. The hypotheses H2 and H3 are supported for both the automotive and electronics industries while H1 is confirm only for the electronics industry.

5. Conclusions

This paper had a threefold in-depth analysis. Firstly investigations were conducted to identify drivers for firms to develop collaborative relationships in the form of share information or synchronize decision making with their supply chain partners. Secondly a hypothesis that SCC induced by the SCCD will cause improvements in SCOP was examined. Thirdly, a comparative analysis on the above two analysis was carried out.

The results of the 2SLS regressions provide robust evidence that supply chain collaborations such as information sharing and decision synchronization have significant positive impacts on operational practices that improve firm-level timeliness and responsiveness to customer need. The rigorous quantitative analysis

also verified that supplier evaluation and audit are a foundation for firms to develop close collaborative relationships with their partners along a supply chain. These second and third hypotheses were supported irrespective of the two industrial sectors.

The difference between the automotive and electronics industries that was confirmed from the regressions is the impact of competitive pressure on supply chain collaboration formation. Only firms in the electronics industry are encouraged to do so when they are under a competitive pressure enough to motivate them to be more innovative.

Additional implications can be derived from the coefficients on the control variables estimated by the 2SLS regressions. Although there are significant positive coefficients on joint ventures, most of the coefficients on domestic company are not significant. This indicates insignificant differences in supply chain collaboration (column 1 of tables 2-7) and operational performances (columns 2-4 of tables 2-7) between domestic and foreign company, which is a baseline category to which the other company type categories are compared. In the same manner, most of the coefficients on average annual sales amount of 100 million or larger Thai baht are not robustly significant, indicating insignificant differences in supply chain collaboration and operational performances between large and small company that recorded the sales amount of less than 50 million Thai baht. These findings imply firms engaging in automotive or electronic supply chains are required to achieve continuous improvements regardless of nationality and size.

One of the limitations of this paper is the lack of explanation on the factors that cause the difference in the effect of competitive pressure on the formation of supply chain collaboration between the two sectors. Although a variation in supply chain architecture is one of the possible reasons, further researches are needed.

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┌─────────────────────────┐      ┌─────────────────────────┐      ┌─────────────────────────┐
│          CPF            │      │          SCC            │      │          SCR            │
│                         │      │                         │      │ On-time Production &    │
│ Competition             │ ───▶ │ Information Sharing      │ ───▶ │ Delivery                │
│ Supplier Evaluation     │      │ Decision Synchronization│      │ Fast procurement        │
│ & Audit                 │      │                         │      │ Flexibility to customer │
│                         │      │                         │      │ need                    │
└─────────────────────────┘      └─────────────────────────┘      └─────────────────────────┘
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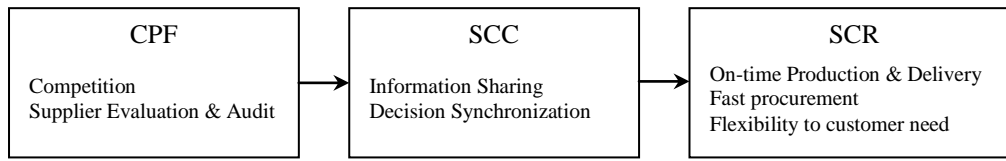
Figure 1: Conceptual framework

Notes: CPF (collaboration promotion factors), SCC (supply chain collaborations), SCR (supply chain responsiveness).

Table 1: Summary Statistics

Variable	Min	Max	Whole Mean	Std. Dev.	Electronics Mean	Std. Dev.	Automotive Mean	Std. Dev.
Supply Chain Responsiveness								
On-time production and delivery	1	5	3.82	0.98	3.76	1.02	3.90	0.94
Responsiveness to fast procurement	1	5	3.75	0.97	3.75	0.99	3.82	0.92
More flexibility to customer need	1	5	3.70	0.89	3.75	0.91	3.67	0.85
Supply Chain Collaboration								
Information sharing	4	20	12.77	3.54	13.00	3.66	12.92	3.34
Sharing information of manufacturing	1	5	3.31	1.04	3.37	1.11	3.34	0.95
Sharing information of warehouse level	1	5	3.02	1.02	3.03	0.98	3.15	0.98
Sharing information of processing	1	5	3.21	1.00	3.24	1.03	3.25	0.94
Sharing information with supply chain member	1	5	3.23	1.03	3.36	1.08	3.18	0.97
Cronbach's alpha			0.89		0.89		0.89	
Decision Synchronization	4	20	13.19	3.90	13.25	3.98	13.54	3.91
Helping to solve the operation problem	1	5	3.68	1.02	3.72	1.07	3.70	0.94
Making a decision to market planning	1	5	3.01	1.16	2.99	1.18	3.18	1.15
Planning to improve and develop product	1	5	3.25	1.13	3.24	1.19	3.34	1.06
Planning to improve and develop process	1	5	3.25	1.15	3.30	1.15	3.31	1.16
Cronbach's alpha			0.90		0.89		0.93	
Collaboration Promoting Factor								
Competition is a factor to seek new innovation	1	5	3.93	1.00	3.94	1.05	3.90	1.00
Supplier evaluation and audit	1	5	3.47	1.07	3.45	1.12	3.49	1.01
Company Type								
Foreign company	0	1	0.27	0.44	0.28	0.45	0.25	0.43
Joint venture	0	1	0.23	0.42	0.17	0.38	0.30	0.46
Domestic group company	0	1	0.11	0.32	0.09	0.29	0.11	0.32
Single domestic company	0	1	0.39	0.49	0.46	0.50	0.34	0.48
Average annual sales in 2007-2011								
Less than 50 mil THB	0	1	0.11	0.32	0.09	0.29	0.13	0.34
50 - 99.9 mil THB	0	1	0.19	0.39	0.18	0.39	0.18	0.39
100 - 499.9 mil THB	0	1	0.38	0.49	0.41	0.50	0.33	0.47
500 - 999.9 mil THB	0	1	0.14	0.34	0.14	0.35	0.15	0.36
1000 - 3000 mil THB	0	1	0.11	0.32	0.10	0.31	0.15	0.36
More than 3000 mil THB	0	1	0.07	0.26	0.07	0.25	0.07	0.25
Sector								
Electronics	0	1	0.54	0.50	1	0	0	0
Automotive	0	1	0.38	0.49	0	0	1	0
Both	0	1	0.08	0.27	0	0	0	0
Observations			161		87		61	

Source: SIIT Thai Automotive and Electronics Industries Survey 2012.

Table 2: Information sharing and Supply Chain Responsiveness (Whole Sample)

VARIABLES	(1) 1st stage Information sharing	(2) 2nd stage Production and Delivery	(3) 2nd stage Procurement	(4) 2nd stage Customer Need
Supply Chain Collaboration				
Information sharing		0.265***	0.262***	0.239***
		(0.041)	(0.035)	(0.032)
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	0.600*			
	(0.316)			
Supplier evaluation and audit	1.623***			
	(0.280)			
Company Type				
Joint venture	-0.729	0.316	0.395*	0.481**
	(0.708)	(0.223)	(0.222)	(0.225)
Domestic group company	0.195	-0.197	0.126	0.113
	(0.724)	(0.243)	(0.204)	(0.178)
Single domestic company	0.258	0.054	0.183	0.065
	(0.557)	(0.180)	(0.161)	(0.163)
Average annual sales in 2007-2011				
50 - 99.9 mil THB	-0.160	-0.454	-0.133	-0.296
	(0.942)	(0.315)	(0.264)	(0.267)
100 - 499.9 mil THB	-0.094	-0.252	-0.011	-0.102
	(0.933)	(0.265)	(0.234)	(0.239)
500 - 999.9 mil THB	-0.638	-0.030	0.074	0.282
	(0.989)	(0.260)	(0.238)	(0.255)
1000 - 3000 mil THB	1.053	-0.498*	-0.356	-0.388
	(0.926)	(0.291)	(0.240)	(0.256)
More than 3000 mil THB	1.298	0.138	0.486	0.300
	(1.305)	(0.349)	(0.333)	(0.368)
Sector				
Electronics	0.058	-0.136	-0.079	0.104
	(0.469)	(0.164)	(0.155)	(0.151)
Both automotive and electronics	-2.345**	0.553	0.197	0.385
	(1.006)	(0.371)	(0.340)	(0.343)
Constant	4.926***	0.627	0.284	0.489
	(1.382)	(0.572)	(0.491)	(0.511)
Observations	161	161	161	161
R-squared	0.414	0.003	0.129	0.050
Wald chi2		59.56	98.64	80.83
Prob > chi2		1.12e-08	0	0
Tests of endogeneity				
Robust score chi2		14.28***	11.49***	15.38***
Robust regression F		30.51***	21.60***	26.93***
Test of overidentifying restrictions				
Score chi2		0.02	0.12	0.02
First-stage regression summary statistics				
Robust F		42.01		

Notes: Instrumented: Supply Chain Collaboration (Information sharing). Instruments: Collaboration Promoting Factor (Competition is a factor to seek new innovation, Supplier evaluation and audit). Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 3: Decision Synchronization and Supply Chain Responsiveness (Whole Sample)

VARIABLES	(1) 1st stage Decision Synchronization	(2) 2nd stage Production and Delivery	(3) 2nd stage Procurement	(4) 2nd stage Customer Need
Supply Chain Collaboration				
Decision Synchronization		0.215***	0.211***	0.193***
		(0.028)	(0.026)	(0.027)
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	0.568*			
	(0.332)			
Supplier evaluation and audit	2.116***			
	(0.294)			
Company Type				
Joint venture	-1.158	0.373**	0.452**	0.533**
	(0.734)	(0.185)	(0.203)	(0.208)
Domestic group company	0.974	-0.359*	-0.033	-0.032
	(0.680)	(0.215)	(0.181)	(0.167)
Single domestic company	0.163	0.093	0.223	0.101
	(0.604)	(0.153)	(0.158)	(0.151)
Average annual sales in 2007-2011				
50 - 99.9 mil THB	0.093	-0.515*	-0.192	-0.351
	(0.879)	(0.272)	(0.249)	(0.236)
100 - 499.9 mil THB	0.626	-0.418*	-0.174	-0.250
	(0.907)	(0.240)	(0.227)	(0.212)
500 - 999.9 mil THB	-0.178	-0.147	-0.041	0.177
	(1.129)	(0.241)	(0.278)	(0.266)
1000 - 3000 mil THB	0.650	-0.360	-0.218	-0.263
	(0.954)	(0.293)	(0.252)	(0.258)
More than 3000 mil THB	0.767	0.337	0.684**	0.481
	(1.143)	(0.290)	(0.290)	(0.319)
Sector				
Electronics	-0.388	-0.035	0.021	0.195
	(0.478)	(0.140)	(0.149)	(0.144)
Both automotive and electronics	-2.548***	0.485*	0.127	0.322
	(0.894)	(0.276)	(0.262)	(0.293)
Constant	3.767***	1.177***	0.838**	0.992**
	(1.325)	(0.411)	(0.383)	(0.416)
Observations	161	161	161	161
R-squared	0.4959	0.271	0.235	0.187
Wald chi2		81.10	109.3	71.63
Prob > chi2		0.000	0.000	0.000
Tests of endogeneity				
Robust score chi2		11.13***	12.57***	15.66***
Robust regression F		16.66***	19.10***	21.79***
Test of overidentifying restrictions				
Score chi2		0.07	0.70	0.35
First-stage regression summary statistics				
Robust F		55.61		

Notes: Instrumented: Supply Chain Collaboration (Decision Synchronization). Instruments: Collaboration Promoting Factor (Competition is a factor to seek new innovation, Supplier evaluation and audit). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 4: Information sharing and Supply Chain Responsiveness (Electronics)

VARIABLES	(1) 1st stage Information sharing	(2) 2nd stage Production and Delivery	(3) 2nd stage Procurement	(4) 2nd stage Customer Need
Supply Chain Collaboration				
Information sharing		0.266***	0.256***	0.253***
		(0.051)	(0.044)	(0.035)
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	0.851**			
	(0.418)			
Supplier evaluation and audit	1.440***			
	(0.436)			
Company Type				
Joint venture	-1.804	0.761**	0.848**	1.066***
	(1.215)	(0.359)	(0.374)	(0.373)
Domestic group company	-0.810	-0.347	-0.038	0.626**
	(1.240)	(0.391)	(0.306)	(0.261)
Single domestic company	-0.172	0.067	0.176	0.236
	(0.735)	(0.208)	(0.182)	(0.191)
Average annual sales in 2007-2011				
50 - 99.9 mil THB	-0.208	0.183	0.299	0.198
	(1.200)	(0.374)	(0.308)	(0.290)
100 - 499.9 mil THB	-0.555	0.094	0.049	0.385*
	(1.096)	(0.258)	(0.242)	(0.226)
500 - 999.9 mil THB	-1.117	0.104	0.128	0.691**
	(1.195)	(0.269)	(0.268)	(0.286)
1000 - 3000 mil THB	0.159	-0.134	-0.109	0.042
	(1.152)	(0.278)	(0.255)	(0.220)
More than 3000 mil THB	0.285	0.205	0.270	0.181
	(1.664)	(0.357)	(0.338)	(0.429)
Constant	5.531***	0.080	0.100	-0.205
	(1.601)	(0.732)	(0.646)	(0.562)
Observations	87	87	87	87
R-squared	0.4403	0.167	0.268	0.217
Wald chi2		42.08	53.73	74.28
Prob > chi2		0.000	0.000	0.000
Tests of endogeneity				
Robust score chi2		6.78***	5.47**	8.23***
Robust regression F		14.63***	10.03***	16.18***
Test of overidentifying restrictions				
Score chi2		0.04	0.71	1.08
First-stage regression summary statistics				
Robust F		24.47		

Notes: Instrumented: Supply Chain Collaboration (Information sharing). Instruments: Collaboration Promoting Factor (Competition is a factor to seek new innovation, Supplier evaluation and audit). Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 5: Decision Synchronization and Supply Chain Responsiveness (Electronics)

VARIABLES	(1) 1st stage Decision Synchronization	(2) 2nd stage Production and Delivery	(3) 2nd stage Procurement	(4) 2nd stage Customer Need
Supply Chain Collaboration				
Decision Synchronization		0.223***	0.213***	0.211***
		(0.038)	(0.033)	(0.025)
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	0.914**			
	(0.453)			
Supplier evaluation and audit	1.797***			
	(0.449)			
Company Type				
Joint venture	-1.770	0.683**	0.773**	0.990***
	(1.192)	(0.275)	(0.334)	(0.311)
Domestic group company	0.137	-0.591*	-0.273	0.392*
	(1.187)	(0.344)	(0.262)	(0.204)
Single domestic company	-0.047	0.036	0.146	0.206
	(0.855)	(0.182)	(0.185)	(0.169)
Average annual sales in 2007-2011				
50 - 99.9 mil THB	-0.245	0.173	0.291	0.190
	(1.119)	(0.338)	(0.301)	(0.239)
100 - 499.9 mil THB	-0.138	-0.028	-0.068	0.269
	(1.102)	(0.252)	(0.261)	(0.197)
500 - 999.9 mil THB	-1.681	0.183	0.203	0.764**
	(1.479)	(0.280)	(0.352)	(0.307)
1000 - 3000 mil THB	-0.237	-0.037	-0.016	0.134
	(1.186)	(0.296)	(0.288)	(0.226)
More than 3000 mil THB	-0.438	0.392	0.450	0.359
	(1.450)	(0.309)	(0.305)	(0.352)
Constant	4.155**	0.656	0.662	0.355
	(1.629)	(0.547)	(0.502)	(0.383)
Observations	87	87	87	87
R-squared	0.503	0.382	0.324	0.392
Wald chi2		48.89	65.08	102.6
Prob > chi2		0.000	0.000	0.000
Tests of endogeneity				
Robust score chi2		5.23**	6.58**	7.53***
Robust regression F		7.96***	9.57***	10.07***
Test of overidentifying restrictions				
Score chi2		0.19	1.05	1.81
First-stage regression summary statistics				
Robust F		32.10		

Notes: Instrumented: Supply Chain Collaboration (Decision Synchronization). Instruments: Collaboration Promoting Factor (Competition is a factor to seek new innovation, Supplier evaluation and audit). Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 6: Information sharing and Supply Chain Responsiveness (Automotive)

VARIABLES	(1) 1st stage Information sharing	(2) 2nd stage Production and Delivery	(3) 2nd stage Procurement	(4) 2nd stage Customer Need
Supply Chain Collaboration				
Information sharing		0.187***	0.196***	0.207***
		(0.049)	(0.044)	(0.052)
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	0.619			
	(0.465)			
Supplier evaluation and audit	1.731***			
	(0.512)			
Company Type				
Joint venture	0.705	-0.152	-0.288	-0.158
	(1.074)	(0.324)	(0.315)	(0.299)
Domestic group company	1.671	0.084	0.192	-0.235
	(1.121)	(0.363)	(0.364)	(0.299)
Single domestic company	1.210	-0.072	0.100	-0.200
	(0.947)	(0.326)	(0.297)	(0.313)
Average annual sales in 2007-2011				
50 - 99.9 mil THB	0.277	-1.525***	-0.932**	-0.852*
	(1.895)	(0.395)	(0.376)	(0.451)
100 - 499.9 mil THB	1.056	-0.492	-0.005	-0.414
	(1.715)	(0.364)	(0.353)	(0.393)
500 - 999.9 mil THB	0.756	-0.411	-0.323	-0.201
	(1.887)	(0.411)	(0.396)	(0.403)
1000 - 3000 mil THB	2.267	-0.721*	-0.489	-0.646
	(1.653)	(0.410)	(0.377)	(0.419)
More than 3000 mil THB	2.262	-0.108	0.319	0.335
	(2.384)	(0.551)	(0.570)	(0.530)
Constant	2.651	2.161***	1.581***	1.539*
	(2.704)	(0.605)	(0.573)	(0.786)
Observations	61	61	61	61
R-squared	0.4746	0.333	0.366	0.163
Wald chi2		53.18	59.48	31.73
Prob > chi2		0.000	0.000	0.000
Tests of endogeneity				
Robust score chi2		10.02***	6.49**	8.09***
Robust regression F		16.30***	8.75***	11.74***
Test of overidentifying restrictions				
Score chi2		0.20	0.03	0.48
First-stage regression summary statistics				
Robust F		13.26		

Notes: Instrumented: Supply Chain Collaboration (Information sharing). Instruments: Collaboration Promoting Factor (Competition is a factor to seek new innovation, Supplier evaluation and audit). Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1.

Table 7: Decision Synchronization and Supply Chain Responsiveness (Automotive)

VARIABLES	(1) 1st stage Decision Synchronization	(2) 2nd stage Production and Delivery	(3) 2nd stage Procurement	(4) 2nd stage Customer Need
Supply Chain Collaboration				
Decision Synchronization		0.148***	0.153***	0.167***
		(0.027)	(0.035)	(0.048)
Collaboration Promoting Factor				
Competition is a factor to seek new innovation	0.211			
	(0.483)			
Supplier evaluation and audit	2.572***			
	(0.444)			
Company Type				
Joint venture	-0.290	0.042	-0.085	0.057
	(1.173)	(0.263)	(0.285)	(0.269)
Domestic group company	2.041*	0.097	0.215	-0.229
	(1.217)	(0.314)	(0.338)	(0.336)
Single domestic company	0.812	0.080	0.259	-0.032
	(0.994)	(0.261)	(0.279)	(0.303)
Average annual sales in 2007-2011				
50 - 99.9 mil THB	0.045	-1.436***	-0.844**	-0.747*
	(1.675)	(0.321)	(0.341)	(0.382)
100 - 499.9 mil THB	1.209	-0.491	0.003	-0.419
	(1.685)	(0.332)	(0.323)	(0.342)
500 - 999.9 mil THB	1.187	-0.389	-0.297	-0.180
	(2.007)	(0.370)	(0.412)	(0.377)
1000 - 3000 mil THB	1.091	-0.465	-0.217	-0.366
	(1.754)	(0.426)	(0.385)	(0.441)
More than 3000 mil THB	1.189	0.211	0.652	0.690
	(2.109)	(0.484)	(0.506)	(0.458)
Constant	2.490	2.374***	1.842***	1.736**
	(2.548)	(0.436)	(0.531)	(0.677)
Observations	61	61	61	61
R-squared	0.5677	0.469	0.388	0.153
Wald chi2		124.0	73.33	28.08
Prob > chi2		0.000	0.000	0.000
Tests of endogeneity				
Robust score chi2		8.18***	5.83**	8.45***
Robust regression F		11.17***	10.99***	17.53***
Test of overidentifying restrictions				
Score chi2		0.08	0.46	0.00
First-stage regression summary statistics				
Robust F		19.85		

Notes: Instrumented: Supply Chain Collaboration (Decision Synchronization). Instruments: Collaboration Promoting Factor (Competition is a factor to seek new innovation, Supplier evaluation and audit). Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$.