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Effects of customer's ICT investment and quality control activities on ICT investment decision and data sharing and usage along production networks in Southeast Asia

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**Effects of customer's ICT investment and quality control activities on
ICT investment decision and data sharing and usage along production
networks in Southeast Asia**

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Abstract

Information and communication technologies (ICTs) generate externalities. A firm adopted an ICT will encourage its partner firms to adopt the compatible ICT to benefit fully from its own ICT investment. Thus, the firm and its partner firms who are collaborative and willing to adopt ICTs are like to transform their collaborations into digital based. Because small group activities for continuous improvement will develop organizational routines for information sharing within and between firms, firms promoting such activities are like to adopt ICTs. This study examines these hypotheses by using a survey data collected in Lao PDR, Thailand, and Vietnam in 2017. Results of two-stage least squares (2SLS) estimations present (1) significant relationships of customer's ICT investments and quality control circle with own ICT investment

decision or planning and (2) significant relationships of the adoption of ICTs with data sharing within and between firms and effective data use. The findings suggest that (1) benefits from ICTs can be diffused along production networks even if firms reactively adopt ICTs and (2) policies for promoting ICT adoption, in tandem with quality management will improve the operation of entire production networks.

Keywords: Information and communication technology (ICT), management information system (MIS), network effect, two-stage least squared, Southeast Asia

1. INTRODUCTION

Firms in developing countries and small and medium-sized enterprises (SMEs) tend to have passive attitudes towards new technical standard and technology adoption (Covin & Slevin, 1988; Ueki, 2016). A lack of technological capabilities looks one of the main reasons. Most of them are not inventors but adopters of new technical standards and technologies. Insufficient financial resources prohibit them from taking the risk entailed in investments in the adoption of new standards and technologies. A scarcity of human resources precludes full use of new technologies (Fabiani, Schivardi & Trento, 2005).

The governance structure of production networks is also associated with passive attitudes of the firms. The will of corporate customers in production networks can affect decisions taken by supplier firms. Especially, SMEs in developing countries that participate in international production networks have business ties with a few multinational corporate (MNC) customers who govern the networks as the lead firms (Gereffi, Humphrey, & Sturgeon, 2005). Endogenous SME suppliers that bear asymmetric power relationships in captive production networks can be forced to introduce new technologies to maintain businesses with their lead firms even when they cannot expect satisfactory risk-adjusted return from the investments.

The diffusion of information and communication technologies (ICTs) and ICT-enabled management systems (i.e., management information systems (MIS)) has been partly driven in captive customer-supplier relationships. However, ICT-based inter-organizational relationships can be more mutually beneficial because of the nature of ICT diffusion that entails network effects or externalities (Katz & Shapiro, 1985, 1986; Zhu, Kraemer, Gurbaxani & Xu, 2006). Therefore, from both managerial and

policy perspectives, it is important to investigate questions regarding whether passive adoption of ICTs and MIS may encourage firms to share data within and between firms and whether such adoption may promote and result in effective use of data. This study empirically examines these research questions by using a questionnaire survey data for Lao PDR, Thailand and Vietnam constructed in 2017.

This paper is structured as follows. Following introduction, Section 2 reviews literatures to develop hypotheses. Section 3 describes the method including the data, variables, and the regression models. Section 4 presents results of the survey and regressions. Section 5 discusses the results and concludes this study with managerial and policy implications.

2. CONCEPTUAL FRAMEWORK

A characteristic of ICTs and data use is that benefits from investment in ICTs by a firm may depend not only on own investment in ICTs by the firm but also investments in ICTs by other partner firms of the firm (Haller & Siedschlag, 2011). Connectivity between ICT systems of the firm and its partner firms (i.e., customers or suppliers) enables effective use of data within the firm and along the customer-supplier network of the firm. Such potential mutual benefits from interconnection of ICT systems can make ICT investments more feasible for both customers and suppliers. This feature of ICT infrastructure indicates that firms cannot always realize the expected benefits from ICT investment when making investment decision individually. It will be necessary for firms to coordinate investment decisions with their partner firms to take full advantage of ICT investment.

What factors will enable or facilitate investment planning and decision that may result in ICT connectivity within and the firms? This study develops two hypotheses to answer this question.

The first hypothesis is based on the perspective from governance of global value chains (GVCs) (Gereffi, Humphrey, & Sturgeon, 2005) that emphasizes a leading role of customers in technology diffusions along the chains. In the manufacturing sector, customers, especially multinational corporations (MNCs) take the initiative in the governance of production networks and industrial development in developing countries. Such observation is applicable to the diffusion of ICTs along production networks. Benders, Batenburg, and Van der Blonk (2006) suggest coercive pressures from customers or headquarters induce firms to introduce compatible ICT systems whereas competitive and institutional pressures promote ERP adoption. Customer pressure affects the adoption of ICT applications in SMEs (Ghobakhloo, Arias-Aranda & Benitez-Amado, 2011).

Therefore, this study proposes the following hypothesis.

H1. Planning or decision on investment in ICT system by a firm in developing countries will be affected by its customer who will encourage the firm to adopt the compatible ICT with customer's ICT system.

The second hypothesis is associated with the process of developing collaborative digital networks among firms. A novel process may allow some innovative firms to invest in ICTs and then find business partners through Internet to enter into digitalized collaborations. A prudent and realistic process for many firms is to transform existing collaborative linkages with their partners into Internet based along with digitalization of

management and operation of business activities. To take the latter process, prior to the introduction of ICT systems, a firm needs to record data and share it within the firm and between the firm and its partner firms. To realize these activities smoothly, firms need to make organizational changes even prior to full-swing introduction of ICT systems.

On such presumption regarding the second approach to digitalized collaboration between firms, the second hypothesis considers a firm's organizational routines that may involve data recording and knowledge sharing among employees within the firm as a prerequisite for smoother introduction of ICT systems. Among various activities, Japanese managerial practices for quality control are primitive and simple but can foster organizational culture and routine that may develop fundamental conditions for recoding and sharing data within a firm and between firms (Marksberry, Badurdeen, Gregory & Kreaflle, 2010; Park, 2011).

As described later, this study uses a survey data for empirical analyses. The survey includes several questions regarding the operation of Japanese style small group activities or so called Kaizen activities including 5S and quality control circle (QCC). This study focuses on the operation of QCC among these Kaizen activities, based on the preliminary data analyses using the dataset.

H2. Operation of QCC facilitates the adoption of ICT systems by firms.

Objectives for a firm to invest in ICTs are to make better use of data across different organizational units within the firm or across firm boundaries and consequently improve performances of the firm. ICTs are useful tools for data recording and sharing in digital forms. Digitized data help firms to use a set of data saved for an

intended purpose and re-use it or combine it with other data for various purposes effectively. Therefore, this study proposes the following hypotheses.

H3. Adoption of ICT systems facilitates data sharing within and between firms.

H4. Adoption of ICT systems enables firms to use data effectively.

The third and fourth hypotheses may be obvious but may not be always materialized, especially in the situation where firms passively adopt a specific ICT system that requires organizational changes painful for employees but indispensable for realizing the expected benefits from investment in ICTs. Firms passively introduced an advanced ICT system may not have employees with sufficient ICT knowledge and skills necessary for fully utilizing the ICT system. Therefore, this study examines empirically these hypotheses.

Figure 1 displays the conceptual framework for this study.

[Figure 1 about here]

3. METHOD

3.1. Survey data

This study uses the survey data for Lao PDR, Thailand, and Vietnam. The survey targeted the manufacturing industries in main industrial districts in these countries. The respondent firms include both local and foreign owned. The author developed a questionnaire in English, which was translated into local languages, distributed to firms, and collected responses from them by the local research institutes during November and December 2017.

The survey teams targeted collecting at least 150 responses for each country. Each survey team took appropriate approaches to each country to collect more valid responses. The Lao survey team visited firms to distribute the questionnaire and then phoned to encourage them to fill the survey. The Lao team interviewed with firms by phone to fill the questionnaire if necessary. As a result, the Lao survey team collected 174 responses with about 85% response rate (i.e., 170 of 200). The Thai survey team distributed 1,000 sets of questionnaires directly to firms operating in Bangkok and vicinity provinces and collected 160 valid responses, equivalent to 16.0% response rate. The Vietnamese team visited 20 firms to test the questionnaire and then sent the questionnaire to 1,000 firms in Hanoi and Ho Chi Minh areas. To raise the respond rate, the Vietnamese survey team contacted some of the firms by e-mail or phone. As a result, the Vietnamese survey team obtained 152 responses, equivalent to 15.2% response rate.

Thus, the dataset that this study developed has 482 observations in total. The observations for Lao PDR, Thailand and Vietnam account for 35%, 33% and 32% of the total respectively (Table 1).

[Table 1 about here]

3.2. Measurement

3.2.1. Data sharing

Data sharing can be a condition to make managerial operations efficient. It also enables data analysis to yield new findings that help streamlining workflows and facilitating organizational change to promote process innovations.

The questionnaire categorized data sharing into two types according to organizational unit: data sharing among different departments within the firm and data sharing with customer or supplier. Data sharing is also categorized according to the type of data content: data on product or process design/development; sales; inventory of products; inventory of material, parts or components; shipping and delivery; and factory operation. For each data type, the degree of data sharing is defined as the following 4 scales: not record (that is coded as 0); not share (= 1); share periodically (= 2); and share in real time (= 3).

The result of the survey is tabulated in Table 2 for data sharing among different departments within the firm and in Table 3 for data sharing with customer or supplier. The variables for data sharing among different departments within the firm are simply summed to develop a composite score for data sharing within the firm (Cronbach's alpha = 0.90). A composite score for data sharing customer or supplier is calculated by summing up the variables for data sharing with customer or supplier (Cronbach's alpha = 0.88).

[Table 2 about here]

[Table 3 about here]

3.2.2. Effective data use

Firms introduce ICTs and MIS to record, share and utilize data for accomplishing specific purposes. To measure how much firms utilize data effectively, the survey asked respondents to make a subjective assessment on effectiveness of data use on a 5 point Likert scale (i.e., 0 = not practicing, 1 = not effectively, 2 = not very effectively, 3 = somewhat effectively, 4 = very effectively). The data use is categorized into 9 purposes

as follows: product and service planning; product and service development; marketing and sales management; production planning; quality control; procurement; inventory control; human resource management; and delivery management.

The collected data for each purpose of data use is formatted as Table 4 respectively. The variables for effective data use are summed up to develop a composite score (Cronbach's alpha = 0.96).

[Table 4 about here]

3.2.3. Adoption of ICTs

Data sharing and use can be realized by adopting ICTs and MIS. The survey asked the adoption of ICT-based management systems. The adoption level for an ICT system is categorized into the following 4 stages: no plan to adopt (that is coded as 0); under evaluation or consideration (= 1); trial adoption (= 2); and adopted (= 3). The survey asked the adoption level for the following four types of ICT system: (1) Electronic Data Interchange (EDI); (2) Enterprise Resources Planning (ERP); (3) Supply Chain Management (SCM); and (4) Customer Relationship Management (CRM).

The adoption of the each ICT system is shown in Table 5 respectively. The variables for the adoption of ICT systems are summed up to define a composite score as the adoption of management information systems (MIS) (Cronbach's alpha = 0.90).

[Table 5 about here]

3.2.4. Influence of customer's ICT investment to own ICT investment

This study explores factors that promote firms to adopt ICT systems for data sharing and use. A characteristic of ICTs and data use is that benefits from investment in ICTs by a firm may depend not only on own investment in ICTs by the firm but also

connectivity of own ICT system with ICT systems of other firms. Therefore ICTs generate externalities so that a firm adopted an ICT system may encourage its partner firms to adopt the same or a compatible ICT system to benefit fully from its own investment in the ICT system.

To measure the influence of a customer to the adoption of ICT systems by its suppliers in customer-driven production networks, this study asked respondents to the survey about whether their establishment's strategic planning or decision on ICT investment is affected by their customer's ICT investments. The degree of the influence is subjectively assessed on a 4 point Likert scale (i.e., 0 = no, 1 = little, 2 = somewhat, 3 = much). Table 6 presents the collected data for this measurement.

[Table 6 about here]

3.2.5. Operation of QCC

The second factor that may affect expected benefits from the adopted ICT systems (i.e. the adoption of ICT systems) is associated with organizational aspects within a firm and between firms that facilitate data sharing and use. A firm who introduces ICT systems needs to record data and share information between departments within the firm and between the firm and its partner firms to benefits from investments in ICTs.

The second hypothesis considers small group activities for Kaizen as a prerequisite for smoother introduction of ICT systems. The survey asked questions regarding whether the respondent's firm has adopted 5S and quality control circle (QCC) and whether the firm has a system and practice to share successful experiences of a QCC group across departments within the firm and with its customers and suppliers. Among these questions related to practices for quality control management, this study used the

question about the operation of QCC to develop the dummy variable that is coded as 1 if a firm operates a QCC, and otherwise 0. The result is summarized in Table 7.

[Table 7 about here]

3.2.6. Attributes of the respondent firms

In addition to these variables described above, the survey contained various questions to ask characteristics of the respondent firms. This study uses four questions associated to firm characteristics as control variables for regression analyses.

The first control variable is based on the question to ask capital structure of the respondent firms to define a dummy variable for local firm that is coded as 1 if the firm is 100% locally owned, and otherwise 0. The second variable is a dummy for country that is defined according to the country surveyed. The third variable is an ordinal variable for total assets that is codified as 1 if the size is less than USD 10,000; 2 if USD 10,000-24,999; 3 if USD 25,000-49,999; 4 if USD 50,000-74,999; 5 if USD 75,000-99,999; 6 if USD 100,000-499,999; 7 if USD 500,000-999,999; 8 if USD 1 million-4.9 million; 9 if USD 5 million-9.9 million; and 10 if USD 10 million or more. The last control variable is dummy variables for industry that is categorized in 20 types of business activities.

Tables 8 and 9 summarize the data for capital structure and asset size, respectively.

[Table 8 about here]

[Table 9 about here]

3.3. Model

To examine the four hypotheses, this study develops two equations. The first equation is formulated as shown below to examine the first and second hypotheses.

$$ICT_i = \alpha_1 + \beta_{11} * CUSTOMER_i + \beta_{12} * QCC_i + \beta_{13} * x_i + u_{1i}$$

where ICT_i , $CUSTOMER_i$, QCC_i , x_i , and u_{1i} are variables for the adoption of ICT, influence of customer's ICT investment to own ICT investment, operation of QCC, a set of the control variables (i.e., the variable for asset size and dummy variables for locally-owned firms, surveyed countries, and industries) and residual for the respondent i , respectively.

The second equation is formulated as shown below to test the third and fourth hypotheses.

$$DATA_i = \alpha_2 + \beta_{21} * ICT_i + \beta_{22} * x_i + u_{2i}$$

where $DATA_i$, is the variable for data sharing or use, whereas ICT_i , x_i , and u_i are variables for the adoption of ICT systems, the same set of the control variables as those in the first equation, and residual for the respondent i , respectively.

The second equation is developed on the presumption that the adoption of ICT systems will facilitate data sharing within the firm and among the firms, and effective data use. However, it may also be possible that firms sharing data or using data effectively are likely to adopt ICT systems. Such possibility of reverse causality is known as endogeneity. When endogeneity, omitted variable or measurement error exists, ordinary least squares (OLS) yields inconsistent and biased estimates.

To identify and solve endogeneity, this study performs a two-stage least squares (2SLS). The first-stage and second-stage equations for the 2SLS estimation are the first and second equations shown above, respectively. The 2SLS model uses the variables for

influence of customer's ICT investment to own ICT investment (*CUSTOMER*) and operation of QCC (*QCC*) as instrumental variables (IVs).

As described above, this study develops 5 measurements for the variable ICT_i (i.e., EDI, ERP, SCM, CRM, and MIS) and 3 measurements for the variable $DATA_i$ (i.e., data sharing within the firm, data sharing with customer or supplier and effective data use). Therefore, this study conducts 2SLS estimations for all possible combinations of ICT_i and $DATA_i$.

Table 10 summarizes describe statistics for the variables used for regression analyses.

[Table 10 about here]

4. RESULTS

4.1. Relationship of data sharing and use with process improvements

Before performing the regression analyses, this study calculates correlation coefficients between data sharing/use and process improvements as an outcome of ICT adoption.

An indicator for process improvements is calculated, using questions in the questionnaire survey regarding how much the respondent firms improved processes during the period of 2016–2017. Process improvements are defined as the reduction of (1) defects during a manufacturing process, (2) labor input, (3) lead time to introduce a new product, (4) unscheduled line stop, (5) worker's injuries, (6) plant accidents, (7) delivery delay, (8) dispersion in product quality, (9) time to changeover (converting production line), (10) claims from customers, and (11) plant maintenance costs.

Respondent firms subjectively assessed the degree of improvements in these 11

processes on a 4 point Likert scale (i.e., 0 = no, 1 = little, 2 = somewhat, 3 = much). These measurements for process innovation are summed into a composite indicator.

The calculated correlation coefficient between composite indicator for process improvement and data sharing among different departments within the firm is 0.32 and significant at the 0.1% level. The correlation coefficients between process improvement and data sharing with customer or supplier and between process improvement and effective data use are 0.26 and 0.19, respectively and both coefficients are significant at the 0.1% level.

These positive significant correlation coefficients can support the validity of this study's focus that is placed on the adoption of ICTs and its effect on data sharing and usage.

4.2. Regression results

Table 11 presents results of the 2SLS regression models that include the adoption of EDI as a measurement for the variable ICT_i and as the instrumented variable.

The estimation of the first equation is summarized in the first column of Table 11. Using the same first equation, the second equations with data sharing within the firm, data sharing with customer or supplier, and effective data use as dependent variable are estimated to show the results in the second, third, and fourth columns of Table 11 accordingly.

Column 1 of Table 11 shows that QCC operation and subjective assessment on influence of customer's ICT investment to own ICT investment, which are introduced as instrumental variables in the 2SLS regression, have significant positive relationships

with the adoption of ERP at the 1% level. Column 2 presents a significant positive relationship between the adoption of ERP and data sharing within the firm at the 1% level.

Column 2 also contains results of the post-estimation tests including the Durbin test of endogeneity, F-statistic for weak instrument, and the Sagan test of overidentifying restrictions (Wooldridge, 2010; StataCorp., 2013). The Durbin test of endogeneity for this two-equation model is significant at the 1% level and rejected the null hypothesis that the variable for ERP is exogenous. Thus the variable for ERP can be treated as endogenous, which means 2SLS estimation can be used. F-statistic for weak instrument is rejected so that the instruments are not weak. The Sagan test of overidentifying restrictions is not rejected, indicating that the instruments are not invalid.

The 2SLS models in Tables 12-14 contain the adoption of EDI, SCM and CRM as a measurement for the variable ICT_i , respectively. The model in Table 15 uses the measurement for MIS, which is defined as the composite score for the adoption of the four ICT systems as instrumented variable.

The estimation results shown in Tables 12-15 provide the similar results to the result in Table 11. Estimated coefficients on QCC operation, subjective assessment on influence of customer's ICT investment to own ICT investment, and the adoption of ICTs are positively significant at the 1% level. The post-estimation tests for all estimation results support the validity of these two-equation models.

[Tables 11-14 about here]

5. CONCLUSION

This study attempts to analyze factors that encourage firms in developing countries to adopt ICTs and whether or not these firms utilize ICTs for data sharing within and between firms effectively. This study proposed four hypotheses and investigated them with 2SLS estimations. The estimation results supported all four hypotheses. Among the hypotheses, the first and second hypotheses regarding effects of passiveness to ICTs and QCC operation on the adoption of ICTs are of importance for deriving managerial and policy implications.

Most of the local firms in developing countries do not have sufficient capabilities to achieve novel innovations with their own internal resources. Competitive local firms are likely to be good at learning from MNCs, rather than inventing. A prioritized activity for local firms to survive international competition is to enhance operational capabilities to comply with high quality and other standards developed by international customers. By doing so, local firms can enter into cooperative customer-supplier relationships with MNCs to have more opportunity for receiving technology transfer and achieve continuous improvements in daily operations (Machikita, Tsuji, & Ueki, 2016).

On the other hand, relationships between MNC customers and local suppliers tend to be captive (Gereffi, Humphrey, & Sturgeon, 2005) as MNC customers take the role of lead firms in East Asian production networks. In such relationships, customers expect suppliers, especially SMEs, to be specialized in particular processes and dedicated to learning by operating to achieve continued process improvements, instead of investigating new technologies and expanding technological spheres. As a result, local suppliers tend to develop a passive attitude to introducing radically new technologies and management practices including ICTs.

The estimation results of the study display robust evidences that ICTs promote data sharing among and between firms in Southeast Asia and effective use of ICTs for improving business operations, even in the situation that firms are reactive to the adoption of ICTs. The operation of QCC also facilitates data sharing and effective data use. These results based on the realistic assumption in Southeast Asia imply that governments can provide SMEs with policy supports to promote the diffusion of ICTs and spread benefits from network effects of ICTs to the society.

A limitation of this study is that ICT applications this study focused on are based on well-established ICTs and widely diffused to large firms and developed countries. It is not obvious whether or not the findings from this study are just as valid for emerging ICTs such as Internet of Things (IoT) and Industry 4.0. Further studies on such new technology adoption are needed to derive managerial and policy implications.

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REFERENCES

Benders, J., Batenburg, R., & Van der Blonk, H. (2006). Sticking to standards; technical and other isomorphic pressures in deploying ERP-systems. *Information & Management*, 43(2), 194–203.

- Covin, J. G., & Slevin, D. P. (1988). The influence of organization structure on the utility of an entrepreneurial top management style. *Journal of Management Studies*, 25(3), 217–234.
- Fabiani, S., Schivardi, F., & Trento, S. (2005). ICT adoption in Italian manufacturing: firm-level evidence. *Industrial and Corporate Change*, 14(2), 225–249.
- Gereffi, G., Humphrey, J., & Sturgeon, T. (2005). The governance of global value chains. *Review of International Political Economy*, 12(1), 78–104.
- Ghobakhloo, M., Arias-Aranda, D., & Benitez-Amado, J. (2011). Adoption of e-commerce applications in SMEs. *Industrial Management & Data Systems*, 111(8), 1238–1269.
- Haller, S. A., & Siedschlag, I. (2011). Determinants of ICT adoption: Evidence from firm-level data. *Applied Economics*, 43(26), 3775–3788.
- Katz, M. L., & Shapiro, C. (1985). Network externalities, competition, and compatibility. *The American Economic Review*, 75(3), 424–440.
- Katz, M. L., & Shapiro, C. (1986). Technology adoption in the presence of network externalities. *Journal of Political Economy*, 94(4), 822–841.
- Machikita, T., Tsuji, M., & Ueki, Y. (2016). Does Kaizen create backward knowledge transfer to Southeast Asian firms? *Journal of Business Research*, 69(5), 1556–1561.
- Marksberry, P., Badurdeen, F., Gregory, B., & Kreamle, K. (2010). Management directed kaizen: Toyota's Jishuken process for management development. *Journal of Manufacturing Technology Management*, 21(6), 670-686.
- Park, B. I. (2011). Knowledge transfer capacity of multinational enterprises and technology acquisition in international joint ventures. *International Business Review*, 20(1), 75-87.

StataCorp. (2013). *Stata: Release 13. Statistical Software*. College Station, TX: StataCorp LLC.

Ueki, Y. (2016). Customer pressure, customer–manufacturer–supplier relationships, and quality control performance. *Journal of Business Research*, 69(6), 2233–2238.

Wooldridge, J. M. (2010). *Econometric analysis of cross-section and panel data 2nd edition*. Cambridge, MA: MIT Press.

Zhu, K., Kraemer, K. L., Gurbaxani, V., & Xu, S. X. (2006). Migration to open-standard interorganizational systems: Network effects, switching costs, and path dependency. *MIS Quarterly*, 30, 515–539.

Figure 1: Conceptual framework

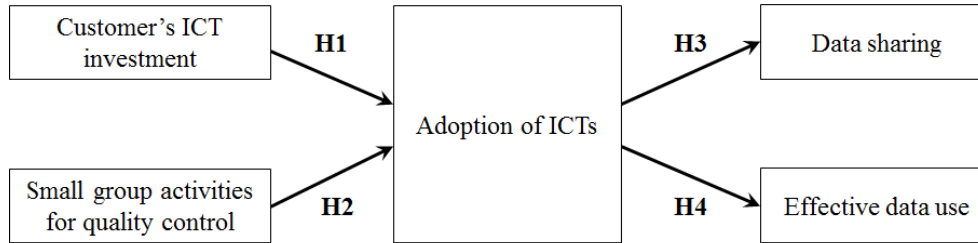


Table 1: The number of respondents

	Lao PDR	Thailand	Vietnam	Hanoi	Ho Chi Minh	Total
Obs.	170	160	152	92	60	482
Percent	35%	33%	32%	19%	12%	100%

Table 2: Data sharing within the firm

(1) Data on product or process design/development

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not record	34	(20.0)	37	(23.1)	13	(8.6)	84	(17.4)
Not share	39	(22.9)	28	(17.5)	72	(47.4)	139	(28.8)
Share periodically	73	(42.9)	67	(41.9)	50	(32.9)	190	(39.4)
Share in real time	24	(14.1)	23	(14.4)	17	(11.2)	64	(13.3)
N.A.	0	(0.0)	5	(3.1)	0	(0.0)	5	(1.0)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(2) Data on sales

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not record	34	(20.0)	12	(7.5)	8	(5.3)	54	(11.2)
Not share	50	(29.4)	26	(16.3)	94	(61.8)	170	(35.3)
Share periodically	58	(34.1)	83	(51.9)	44	(28.9)	185	(38.4)
Share in real time	28	(16.5)	36	(22.5)	6	(3.9)	70	(14.5)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	3	(0.6)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(3) Data on inventory of products

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not record	33	(19.4)	15	(9.4)	9	(5.9)	57	(11.8)
Not share	45	(26.5)	20	(12.5)	73	(48.0)	138	(28.6)
Share periodically	64	(37.6)	81	(50.6)	63	(41.4)	208	(43.2)
Share in real time	28	(16.5)	40	(25.0)	7	(4.6)	75	(15.6)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(4) Data on inventory of material, parts or components

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not record	33	(19.4)	24	(15.0)	15	(9.9)	72	(14.9)
Not share	47	(27.6)	24	(15.0)	88	(57.9)	159	(33.0)
Share periodically	64	(37.6)	74	(46.3)	40	(26.3)	178	(36.9)
Share in real time	26	(15.3)	32	(20.0)	9	(5.9)	67	(13.9)
N.A.	0	(0.0)	6	(3.8)	0	(0.0)	6	(1.2)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(5) Data on shipping, delivery

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not record	35	(20.6)	11	(6.9)	32	(21.1)	78	(16.2)
Not share	49	(28.8)	20	(12.5)	78	(51.3)	147	(30.5)
Share periodically	60	(35.3)	69	(43.1)	30	(19.7)	159	(33.0)
Share in real time	26	(15.3)	58	(36.3)	12	(7.9)	96	(19.9)
N.A.	0	(0.0)	2	(1.3)	0	(0.0)	2	(0.4)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(6) Data on factory operation

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not record	51	(30.0)	23	(14.4)	15	(9.9)	89	(18.5)
Not share	66	(38.8)	26	(16.3)	64	(42.1)	156	(32.4)
Share periodically	28	(16.5)	75	(46.9)	60	(39.5)	163	(33.8)
Share in real time	25	(14.7)	32	(20.0)	13	(8.6)	70	(14.5)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 3: Data sharing with customer or supplier**(1) Data on product or process design/development**

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not share	76	(44.7)	71	(44.4)	80	(52.6)	227	(47.1)
Share periodically	79	(46.5)	66	(41.3)	51	(33.6)	196	(40.7)
Share in real time	15	(8.8)	16	(10.0)	21	(13.8)	52	(10.8)
N.A.	0	(0.0)	7	(4.4)	0	(0.0)	7	(1.5)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(2) Data on sales

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not share	86	(50.6)	54	(33.8)	134	(88.2)	274	(56.8)
Share periodically	68	(40.0)	79	(49.4)	11	(7.2)	158	(32.8)
Share in real time	16	(9.4)	26	(16.3)	7	(4.6)	49	(10.2)
N.A.	0	(0.0)	1	(0.6)	0	(0.0)	1	(0.2)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(3) Data on inventory of products

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not share	103	(60.6)	53	(33.1)	126	(82.9)	282	(58.5)
Share periodically	53	(31.2)	75	(46.9)	23	(15.1)	151	(31.3)
Share in real time	14	(8.2)	26	(16.3)	3	(2.0)	43	(8.9)
N.A.	0	(0.0)	6	(3.8)	0	(0.0)	6	(1.2)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(4) Data on inventory of material, parts or components

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not share	105	(61.8)	60	(37.5)	146	(96.1)	311	(64.5)
Share periodically	52	(30.6)	78	(48.8)	6	(3.9)	136	(28.2)
Share in real time	13	(7.6)	18	(11.3)	0	(0.0)	31	(6.4)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(5) Data on shipping, delivery

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not share	96	(56.5)	37	(23.1)	94	(61.8)	227	(47.1)
Share periodically	55	(32.4)	82	(51.3)	46	(30.3)	183	(38.0)
Share in real time	19	(11.2)	40	(25.0)	12	(7.9)	71	(14.7)
N.A.	0	(0.0)	1	(0.6)	0	(0.0)	1	(0.2)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(6) Data on factory operation

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not share	134	(78.8)	67	(41.9)	118	(77.6)	319	(66.2)
Share periodically	21	(12.4)	67	(41.9)	24	(15.8)	112	(23.2)
Share in real time	15	(8.8)	23	(14.4)	10	(6.6)	48	(10.0)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	2	(0.4)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 4: Effective data use**(1) Data use for product and service planning**

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	91	(53.5)	29	(18.1)	15	(9.9)	135	(28.0)
Not effectively	3	(1.8)	16	(10.0)	5	(3.3)	24	(5.0)
Not very effectively	3	(1.8)	24	(15.0)	14	(9.2)	41	(8.5)
Somewhat effectively	33	(19.4)	64	(40.0)	76	(50.0)	173	(35.9)
Very effectively	40	(23.5)	24	(15.0)	42	(27.6)	106	(22.0)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	3	(0.6)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(2) Data use for product and service development

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	89	(52.4)	34	(21.3)	28	(18.4)	151	(31.3)
Not effectively	3	(1.8)	16	(10.0)	7	(4.6)	26	(5.4)
Not very effectively	5	(2.9)	28	(17.5)	28	(18.4)	61	(12.7)
Somewhat effectively	31	(18.2)	57	(35.6)	69	(45.4)	157	(32.6)
Very effectively	42	(24.7)	22	(13.8)	20	(13.2)	84	(17.4)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	3	(0.6)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(3) Data use for marketing and sales management

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	88	(51.8)	23	(14.4)	17	(11.2)	128	(26.6)
Not effectively	2	(1.2)	13	(8.1)	3	(2.0)	18	(3.7)
Not very effectively	3	(1.8)	26	(16.3)	21	(13.8)	50	(10.4)
Somewhat effectively	31	(18.2)	61	(38.1)	78	(51.3)	170	(35.3)
Very effectively	46	(27.1)	34	(21.3)	33	(21.7)	113	(23.4)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	3	(0.6)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(4) Data use for production planning

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	88	(51.8)	29	(18.1)	4	(2.6)	121	(25.1)
Not effectively	3	(1.8)	7	(4.4)	2	(1.3)	12	(2.5)
Not very effectively	6	(3.5)	29	(18.1)	14	(9.2)	49	(10.2)
Somewhat effectively	27	(15.9)	53	(33.1)	67	(44.1)	147	(30.5)
Very effectively	46	(27.1)	38	(23.8)	65	(42.8)	149	(30.9)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(5) Data use for quality control

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	86	(50.6)	24	(15.0)	18	(11.8)	128	(26.6)
Not effectively	3	(1.8)	12	(7.5)	10	(6.6)	25	(5.2)
Not very effectively	6	(3.5)	25	(15.6)	31	(20.4)	62	(12.9)
Somewhat effectively	29	(17.1)	58	(36.3)	75	(49.3)	162	(33.6)
Very effectively	46	(27.1)	39	(24.4)	18	(11.8)	103	(21.4)
N.A.	0	(0.0)	2	(1.3)	0	(0.0)	2	(0.4)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(6) Data use for procurement

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	90	(52.9)	25	(15.6)	19	(12.5)	134	(27.8)
Not effectively	3	(1.8)	11	(6.9)	15	(9.9)	29	(6.0)
Not very effectively	7	(4.1)	24	(15.0)	37	(24.3)	68	(14.1)
Somewhat effectively	27	(15.9)	67	(41.9)	67	(44.1)	161	(33.4)
Very effectively	43	(25.3)	29	(18.1)	14	(9.2)	86	(17.8)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(7) Data use for inventory control

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	87	(51.2)	23	(14.4)	9	(5.9)	119	(24.7)
Not effectively	3	(1.8)	9	(5.6)	6	(3.9)	18	(3.7)
Not very effectively	5	(2.9)	27	(16.9)	39	(25.7)	71	(14.7)
Somewhat effectively	35	(20.6)	65	(40.6)	70	(46.1)	170	(35.3)
Very effectively	40	(23.5)	33	(20.6)	28	(18.4)	101	(21.0)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	3	(0.6)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(8) Data use for human resource management

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	87	(51.2)	29	(18.1)	34	(22.4)	150	(31.1)
Not effectively	4	(2.4)	12	(7.5)	16	(10.5)	32	(6.6)
Not very effectively	5	(2.9)	40	(25.0)	60	(39.5)	105	(21.8)
Somewhat effectively	30	(17.6)	53	(33.1)	33	(21.7)	116	(24.1)
Very effectively	44	(25.9)	22	(13.8)	9	(5.9)	75	(15.6)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(9) Data use for delivery management

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Not Practicing	88	(51.8)	27	(16.9)	32	(21.1)	147	(30.5)
Not effectively	4	(2.4)	10	(6.3)	11	(7.2)	25	(5.2)
Not very effectively	6	(3.5)	25	(15.6)	56	(36.8)	87	(18.0)
Somewhat effectively	33	(19.4)	53	(33.1)	40	(26.3)	126	(26.1)
Very effectively	39	(22.9)	42	(26.3)	13	(8.6)	94	(19.5)
N.A.	0	(0.0)	3	(1.9)	0	(0.0)	3	(0.6)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 5: Adoption of information and communication technology (ICT) systems**(1) Electronic Data Interchange (EDI)**

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
No plan to adopt	88	(51.8)	54	(33.8)	70	(46.1)	212	(44.0)
Under evaluation	44	(25.9)	39	(24.4)	29	(19.1)	112	(23.2)
Trial adoption	20	(11.8)	27	(16.9)	22	(14.5)	69	(14.3)
Adopted	18	(10.6)	36	(22.5)	31	(20.4)	85	(17.6)
N.A.	0	(0.0)	4	(2.5)	0	(0.0)	4	(0.8)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(2) Supply Chain Management (SCM)

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
No plan to adopt	97	(57.1)	56	(35.0)	50	(32.9)	203	(42.1)
Under evaluation	39	(22.9)	42	(26.3)	46	(30.3)	127	(26.3)
Trial adoption	17	(10.0)	29	(18.1)	36	(23.7)	82	(17.0)
Adopted	17	(10.0)	24	(15.0)	20	(13.2)	61	(12.7)
N.A.	0	(0.0)	9	(5.6)	0	(0.0)	9	(1.9)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(3) Enterprise Resources Planning (ERP)

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
No plan to adopt	91	(53.5)	44	(27.5)	43	(28.3)	178	(36.9)
Under evaluation	47	(27.6)	48	(30.0)	57	(37.5)	152	(31.5)
Trial adoption	20	(11.8)	30	(18.8)	22	(14.5)	72	(14.9)
Adopted	12	(7.1)	30	(18.8)	30	(19.7)	72	(14.9)
N.A.	0	(0.0)	8	(5.0)	0	(0.0)	8	(1.7)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

(4) Customer Relationship Management (CRM)

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
No plan to adopt	71	(41.8)	29	(18.1)	68	(44.7)	168	(34.9)
Under evaluation	48	(28.2)	40	(25.0)	38	(25.0)	126	(26.1)
Trial adoption	31	(18.2)	29	(18.1)	15	(9.9)	75	(15.6)
Adopted	20	(11.8)	53	(33.1)	31	(20.4)	104	(21.6)
N.A.	0	(0.0)	9	(5.6)	0	(0.0)	9	(1.9)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 6: Influence of customer's ICT investments to own ICT investment decision

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
No	116	(68.2)	27	(16.9)	53	(34.9)	196	(40.7)
Little	35	(20.6)	51	(31.9)	29	(19.1)	115	(23.9)
Somewhat	10	(5.9)	60	(37.5)	56	(36.8)	126	(26.1)
Much	9	(5.3)	20	(12.5)	14	(9.2)	43	(8.9)
N.A.	0	(0.0)	2	(1.3)	0	(0.0)	2	(0.4)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 7: Operation of a quality control circle (QCC)

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
No	52	(30.6)	55	(34.4)	115	(75.7)	222	(46.1)
Yes	118	(69.4)	104	(65.0)	37	(24.3)	259	(53.7)
N.A.	0	(0.0)	1	(0.6)	0	(0.0)	1	(0.2)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 8: Capital structure

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
100% locally-owned	88	(51.8)	121	(75.6)	124	(81.6)	333	(69.1)
100% foreign-owned	61	(35.9)	14	(8.8)	22	(14.5)	97	(20.1)
Joint Venture	21	(12.4)	23	(14.4)	6	(3.9)	50	(10.4)
N.A.	0	(0.0)	2	(1.3)	0	(0.0)	2	(0.4)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 9: Total assets (US\$)

	Lao PDR		Thailand		Vietnam		Total	
	Obs.	(%)	Obs.	(%)	Obs.	(%)	Obs.	(%)
Less than 10,000	3	(1.8)	3	(1.9)	1	(0.7)	7	(1.5)
10,000-24,999	9	(5.3)	6	(3.8)	0	(0.0)	15	(3.1)
25,000-49,999	6	(3.5)	7	(4.4)	6	(3.9)	19	(3.9)
50,000-74,999	8	(4.7)	5	(3.1)	6	(3.9)	19	(3.9)
75,000-99,999	7	(4.1)	4	(2.5)	9	(5.9)	20	(4.1)
100,000-499,999	56	(32.9)	21	(13.1)	18	(11.8)	95	(19.7)
500,000-999,999	33	(19.4)	8	(5.0)	21	(13.8)	62	(12.9)
1 million-4.9 mil.	33	(19.4)	34	(21.3)	48	(31.6)	115	(23.9)
5 mil.-9.9 mil.	7	(4.1)	8	(5.0)	25	(16.4)	40	(8.3)
10 million and above	8	(4.7)	48	(30.0)	18	(11.8)	74	(15.4)
N.A.	0	(0.0)	16	(10.0)	0	(0.0)	16	(3.3)
Total	170	(100.0)	160	(100.0)	152	(100.0)	482	(100.0)

Table 10: Summary statistics

Variable	Obs	Mean	Std. Dev.	Min	Max
Data sharing within the firm	482	9.131	4.589	0	18
Data sharing with customer/supplier	482	9.116	3.183	0	18
Data use effectiveness	482	19.060	11.937	0	36
EDI	478	1.056	1.140	0	3
SCM	473	1.002	1.059	0	3
ERP	474	1.080	1.063	0	3
CRM	473	1.243	1.156	0	3
MIS	472	4.362	3.858	0	12
QCC	481	0.538	0.499	0	1
Influence of customer's ICT investment to own ICT planning	480	1.033	1.015	0	3
Asset	466	7.069	2.183	1	10
Local	480	0.694	0.461	0	1
Lao PDR	482	0.353	0.478	0	1
Thailand	482	0.332	0.471	0	1
Vietnam	482	0.315	0.465	0	1

Table 11: ERP and data sharing/use

	(1) first ERP	(2) second Data sharing within the firm	(3) second Data sharing btw. firms	(4) second Data use effectiveness
ERP		3.449*** (0.459)	1.561*** (0.316)	8.607*** (1.238)
QCC	0.327*** (0.099)			
Influence of customer's ICT investment to own ICT planning	0.422*** (0.048)			
Asset	Yes	Yes	Yes	Yes
Local	Yes	Yes	Yes	Yes
Contry dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	457	457	457	457
R-squared	0.333	0.192	0.186	0.155
Adj. R-squared	0.295			
F-stat	8.616			
Wald		157.675	132.366	158.000
IV F-stat		49.540	49.540	49.540
Durbin		19.630	8.579	21.696
Durbin p-value		0.000	0.003	0.000
Sargan		0.601	0.013	0.025
Sargan p-value		0.438	0.910	0.875

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 12: EDI and data sharing/use

	(1) first EDI	(2) second Data sharing within the firm	(3) second Data sharing btw. firms	(4) second Data use effectiveness
EDI		2.679*** (0.357)	1.194*** (0.250)	6.740*** (0.937)
QCC	0.342*** (0.104)			
Influence of customer's ICT investment to own ICT planning	0.550*** (0.050)			
Asset	Yes	Yes	Yes	Yes
Local	Yes	Yes	Yes	Yes
Contry dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	461	461	461	461
R-squared	0.351	0.217	0.176	0.216
Adj. R-squared	0.314			
F-stat	9.416			
Wald		163.352	130.191	171.746
IV F-stat		71.428	71.428	71.428
Durbin		17.183	9.753	17.975
Durbin p-value		0.000	0.002	0.000
Sargan		1.783	0.003	0.448
Sargan p-value		0.182	0.959	0.503

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 13: SCM and data sharing/use

	(1) first SCM	(2) second Data sharing within the firm	(3) second Data sharing btw. firms	(4) second Data use effectiveness
SCM		3.490*** (0.449)	1.549*** (0.320)	8.526*** (1.220)
QCC	0.475*** (0.098)			
Influence of customer's ICT investment to own ICT planning	0.381*** (0.047)			
Asset	Yes	Yes	Yes	Yes
Local	Yes	Yes	Yes	Yes
Contry dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	456	456	456	456
R-squared	0.339	0.234	0.166	0.184
Adj. R-squared	0.301			
F-stat	8.820			
Wald		167.512	128.494	161.906
IV F-stat		49.832	49.832	49.832
Durbin		17.635	9.762	19.198
Durbin p-value		0.000	0.002	0.000
Sargan		0.264	0.874	1.022
Sargan p-value		0.608	0.350	0.312

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 14: CRM and data sharing/use

	(1) first CRM	(2) second Data sharing within the firm	(3) second Data sharing btw. firms	(4) second Data use effectiveness
CRM		3.114*** (0.399)	1.388*** (0.280)	7.627*** (1.040)
QCC	0.500*** (0.107)			
Influence of customer's ICT investment to own ICT planning	0.438*** (0.052)			
Asset	Yes	Yes	Yes	Yes
Local	Yes	Yes	Yes	Yes
Contry dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	455	455	455	455
R-squared	0.335	0.236	0.198	0.254
Adj. R-squared	0.296			
F-stat	8.641			
Wald		167.657	134.005	177.192
IV F-stat		53.248	53.248	53.248
Durbin		17.291	7.799	14.843
Durbin p-value		0.000	0.005	0.000
Sargan		0.070	0.562	0.625
Sargan p-value		0.791	0.453	0.429

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 15: MIS score and data sharing/use

	(1) first MIS	(2) second Data sharing within the firm	(3) second Data sharing btw. firms	(4) second Data use effectiveness
MIS		0.804*** (0.095)	0.361*** (0.071)	1.978*** (0.258)
QCC	1.673*** (0.339)			
Influence of customer's ICT investment to own ICT planning	1.774*** (0.164)			
Asset	Yes	Yes	Yes	Yes
Local	Yes	Yes	Yes	Yes
Contry dummies	Yes	Yes	Yes	Yes
Industry dummies	Yes	Yes	Yes	Yes
Observations	455	455	455	455
R-squared	0.408	0.345	0.232	0.311
Adj. R-squared	0.374			
F-stat	11.845			
Wald		195.446	140.403	192.549
IV F-stat		78.982	78.982	78.982
Durbin		8.064	5.284	9.594
Durbin p-value		0.005	0.022	0.002
Sargan		0.087	0.174	0.088
Sargan p-value		0.769	0.677	0.767

Note: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1