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The Relationships among Quality Management System, Knowledge Management and Organizational Performance: An Application of the Heckman Two-step Method

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Abstract

Previous research has shown that the adoption of quality management system and the implementation of knowledge management have effects on organizational performance. Yet, little attention has been paid to moderating conditions on the relationship among these variables. The main purpose of this research is to empirically examine the moderating role of adopting quality management system in the effect of implementing knowledge management on organizational performance by employing the hierarchical regression procedure. And, we utilize the Heckman two-step method to avoid the problem of sample selection bias. The findings reveal that the adoption of the quality management system in business plays a moderating role in the relationship between the implementation of knowledge management and organizational performance. This research is helpful to managers by offering deeper insight into the complex structure of quality management system, knowledge management and organizational performance, which will help them to make better decisions on the adoption of management systems for improving organizational performance.

Jel code: M19, M49, L25, C38

Keywords: *Quality management system, Knowledge management, Organizational performance, Heckman two-step method*

1. Introduction

Organization is a systematic arrangement of people to achieve a series of shared goals. To obtain competitive advantages and accomplish the desired goals, an organization often tries to apply management tools, such as quality management system or knowledge management practice, which should fit its business environment. Previous research (Hung et al. 2010; Lam et al. 2011; Huynh and Lin 2013) has shown that oorganizational performance is reckoned to be predicted by the adoption of the quality management system as well as by the implementation of knowledge management. However, the likelihood that firms adopt the quality management system is suggested to be dependent on the implementation of knowledge management as well as on organizational size, culture, structure and environmental uncertainty (Mellahi and Eyuboglu 2001; Hung et al. 2010; Bello-Pintado and

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Merino-Diaz-de-Cerio 2013; Wang and Huynh 2013). And, Hung et al. (2010) reveal that adopting the quality management system and implementing knowledge management will lead to improved organizational performance, but they ignore the problem of potential sample selection bias. Therefore, this research re-examines the effects of quality management system adoption and knowledge management implementation on organizational performance by adopting the Heckman's (1979) two-step procedure to avoid the problem of sample selection bias and including the control variables of organizational size, culture, structure and environmental uncertainty into the research model.

Moreover, little attention has been paid to moderating conditions on the relationship among quality management system adoption, knowledge management implementation and organizational performance. This research further applies hierarchical regression analysis to investigate the moderating role of adopting the quality management system in the effect of implementing knowledge management on organizational performance. This research offers some contributions to the literature. The paper is the first to apply the Heckman two-step method for investigating the effects of adopting quality management system and implementing knowledge management on organizational performance. It is also the first to provide empirical evidence on the moderating role of adopting quality management system in the relationship between the implementation of knowledge management and organizational performance. To the managerial practice, we provide managers with deeper insight into understanding the complex relationships among the adoption of the quality management system, the implementation of knowledge management and organizational performance. Accordingly, our findings would lead the managers to better decision making on the choice of the management systems in improving organizational performance.

The remainder of the paper is organised as follows. Section two reviews literature and develops the research hypotheses on the relationships among the adoption of the quality management system, the implementation of knowledge management and organizational performance. Data and research methods are then presented, followed by empirical results. The discussion and conclusions are given in the final section.

2. Literature Review and Hypotheses Development

The quality management system is referred to as the management structure and practices as well as procedures required carrying out quality management. The aim of the quality management system is to better satisfy customer needs by lessening and finally eradicating non-conformance to specifications, principles and customer expectations in the most cost effective way, which will improve the quality of processes as well as products and services (Hung et al. 2010). The ISO 9001 is related to the adoption of the quality management system in business, in which the ISO 9001 sets out requirements for the adoption of the quality management system in business. Organizations must satisfy these requirements in order that they can obtain the certificate of the quality management system (or the certificate of ISO 9001) offered by the third party. In this paper, we refer to the quality management system as the one that meets the criteria stipulated by the ISO 9001 and to the organizations having already adopted the quality management system in business as the ones that have obtained the certificate of ISO 9001 granted by the third party certification bodies such as QUACERT, QUATEST and etc. The quality management system plays an important role in leading improved organizational performance.

Gomez-Gras and Verdu-Jover (2005) posit that the organizations, which adopt the quality management system, achieve better performance than those who do not. Lin and Chang (2006) show the positive relationship between the degree of adopting the quality

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management system and organizational performance improvement. In addition, Zakuan et al. (2010) suggests that adopting the system of quality management results in improved organizational performance. The findings obtained from Lam et al. (2011) also report that the organizations adopting the quality management system in business enjoy better organizational performance.

Zetie (2002) implies that the relationship between the implementation of knowledge management and the likelihood of adopting the quality management system has both theoretical and practical significance. Molina et al (2004) recognize the viewpoint of this association and seek to link the two variables together. Following them, Ju et al. (2006) assert that the implementation of knowledge management is related to the adopting likelihood of the quality management system. Additionally, Hung et al. (2010) confirm the positive association between implementing knowledge management and the adoption likelihood of the quality management system.

Gold et al. (2001) emphasize that implementing knowledge management in business creates more value to an organization's overall performance as well as helps the organization become more efficient and more innovative. Moreover, Chen and Huang (2007) suggest that implementing knowledge management plays a critical role in improving organizational performance. Zack et al. (2009) investigate the association of knowledge management with organizational performance and conclude the implementation of knowledge management is related directly to organizational performance. The studies of Hung et al. (2010) and Huynh and Lin (2013) also offer evidence on the positive relationship between implementing knowledge management and organizational performance. Grounded on the above arguments, we come to the following hypotheses.

H1: Adopting the quality management system results in improved organizational performance.

H2: Implementing knowledge management is positively associated with the likelihood of adopting the quality management system.

H3: Implementing knowledge management enhances organizational performance.

In addition to the implementation of knowledge management, the adoption of quality management system is also driven by other factors. Tata and Prasad (1998) reveal that adopting the quality management system is influenced by organizational culture and structure. Martin and Weill (2000) find out a strong correlation between the adoption of the quality management system and business environment uncertainty. Furthermore, Mellahi and Eyuboglu (2001) suggest that organizational culture and organizational structure are critical factors for adopting the quality management system. Bello-Pintado and Merino-Diaz-de-Cerio (2013) propose that the organizations, which face the high levels of environmental uncertainty, are more likely to adopt the quality management system in order to achieve improved business performance. Further, Wang and Huynh (2013) also affirm that environmental uncertainty plays an important role in adopting the quality management system in business. They also evidence that organizational culture and organizational structure are important variables to the adoption of the quality management system in an organization. In addition, Wiele and Brown (2002) imply that large organizations are more likely to adopt the quality management system than small ones. Hoang et al. (2010) examine the relationship of adopting the quality management system with organizational characteristics and find out large organizations had higher adoption levels of the quality management system than small ones. Furthermore, Bello-Pintado and Merino-Diaz-de-Cerio (2013) propose that the likelihood of adopting the quality management system will differ across organizational size. These discussions enable us to conjecture that the adoption of the quality management system is

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determined not only by knowledge management, but also by environmental uncertainty, organizational culture, organizational structure as well as organizational size.

3. Data and Methods

The sample used for this paper comprises the 705 Vietnamese publicly listed organizations in the two Vietnamese Stock Exchanges. The initial solicitations requested responses from key informants with experience in knowledge management and management accounting. The questionnaire was completed with a manager for each targeted organization. We sent questionnaires to 475 organizations by email and in person interviewed managers in 230 organizations. Our final sample comprises 335 good responses with sufficiently required information for analyses.

In order to eliminate the problem of sample selection bias when investigating the role of adopting the quality management system and implementing knowledge management in enhancing organizational performance, we employ the Heckman two-step procedure for analysis. The Heckman two-step procedure is proposed by Heckman (1979) to take account of potential sample selection bias when analyzing the data. This procedure consists of two stages. The first stage is to develop a selection equation (i.e. a model of factors related to survey non-response). A probit regression by maximum-likelihood estimation (MLE) is conducted for all the observations. The estimates of γ from this probit regression are then used to generate consistent estimates of the inverse Mills ratio- $\lambda_i(-Z_i\gamma)$. The inverse Mills ratios are calculated based on the equation 1 "$\lambda_i(-Z_i\gamma)= \varphi(Z_i\gamma)/\Phi(Z_i\gamma)$". The estimate φ denotes the standard normal density function and Φ denotes the standard normal cumulative distribution function. The second stage estimates the outcome equation by OLS, where the outcome equation includes both the original x (explanatory variables) and the constructed value of the inverse Mills ratio, using the equation 2 "$y = a*x + b*\lambda_i(-Z_i\gamma) + e$". The second stage only utilizes the uncensored observations. The estimates 'a' and 'b' gained from the Heckman procedure are consistent and asymptotically normal.

Then, we apply the hierarchical regression procedure to explore the moderating role of adopting the quality management system in the relationship between the implementation of knowledge management and organizational performance.

A five-point scale is employed to measure the *Quality Management System Adoption (QMSA)*, ranging from 1.never considering, 2.favored to introduce, 3.intended to introduce, 4.under adoption within three years, and to 5.under adoption of the quality management system for over three years, adapted from Cinquini et al. (2008). *The likelihood of adopting the quality management system (QMSD)* is coded 1 if QMSA is 4 or 5 (already adopted the quality management system) and 0 otherwise (not already adopted the quality management system). *Knowledge Management Implementation (KMI)* is assessed on knowledge sharing between supervisors and subordinates- KMI1, knowledge sharing among colleagues- KMI2, knowledge sharing across the units- KMI3, effective management of different knowledge sources- KMI4, as well as application of knowledge into practical use- KMI5. A five-point scale used ranges from 1.dissatisfied, 2.a little dissatisfied, 3.a little satisfied, 4.quite satisfied, and to 5.very satisfied with the achievements in each item of knowledge management, adapted from Huynh and Lin (2013).

Organizational Performance (FPE) is based on the five items that are return on asset- FPE1, return on equity- FPE2, innovativeness- FPE3, quality in products or services- FPE4, and customer satisfaction- FPE5, adapted from Huynh and Lin (2013), using a five-point scale from no growth, a little growth, average growth, fast growth to very fast growth. A

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comparison in organizational performance between the last year and the year before implementing the quality management system is made.

Organizational Size (FSE) is 0 (zero) if the organization's total capital is less than VND 50 billion for service sector or smaller than VND 100 billion for other sectors (small), and 1 (one) otherwise (large), modified from Nguyen (2009).

Organizational Structure (FST) consists of three types: decentralization- FST1, mutual adjustment- FST2, and integration- FST3. A five-point scale is used to assess the three types of organizational structures. (1) Decentralization ranges from 1.centralizing decision-making power to 5.decentralizing decision-making power. (2) Mutual adjustment ranges from 1.formalized to 5.informalized. (3) Integration ranges from 1.no integration to 5.integration. The types and scales are adapted from Huynh and Lin (2013).

Organizational Culture (FCU) is based on innovative climate- FCU1, cooperative climate-FCU2, trust-FCU3, communication-FCU4, and coordination-FCU5, using a five-point scale ranging from 1.never occurred to 5.always occurred, adapted from Chen and Huang (2007).

Environmental Uncertainty (EVU) is measured with six dimensions: government policies- EVU1, economy- EVU2, competition- EVU3, technology EVU4, product market and demand- EVU5, and resources and services used by the organization- EVU6, using a five-point scale ranging from 1.always predicted, 2.easily predicted, 3.difficultly predicted, 4.quite difficultly predicted to 5.very difficultly predicted, adapted from Wang and Huynh (2013).

4. Empirical Results

The five of the main variables, which are organizational performance, implementing knowledge management, environmental uncertainty, organizational culture and organizational structure, consist of multiple items. Hence, we employ the exploratory factor analysis to classify the items to their own main variables. The data analysis should use the summated scales of these multiple items and not individual items. We use Likert-type scales to measure the variables; as a result, it is necessary to calculate Cronbach alpha coefficients for internal consistency reliability for any scales.

The results from Cronbach alpha and factor analysis are displayed in Tables 1 and 2. This research applies two models for analyses. One is used for the effects of the factors on the likelihood of adopting the quality management system. This model is examined with the whole sample of 335 observations (Table 1). The other model is utilized to analyze the determinants of organizational performance in the organizations adopting the quality management system, which employs a sample of 174 observations adopting the quality management system (Table 2).

Tables 1 and 2 show the results of factor analysis, which suppresses coefficients below 0.35. In order to assess the construct validity, convergent validity and discriminant validity are tested with the procedure suggested by Nunnally (1978). The results imply that the factor loadings are larger than 0.4 and the cross-loadings are greater than 0.3. These results point out that our data satisfies convergent validity and discriminant validity. Additionally, the Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and communalities obtain the values of greater than 0.7 and 0.5 respectively at the statistical significance of 0.01. Furthermore, the factors attain the Cronbach alpha values of above 0.7, which implies that our measures achieve internal consistency reliability. Consequently, it is reasonably assured that all the

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items used in this paper satisfy the construct validity and reliability and so are suitably retained for further analyses.

Table 1: Results for Cronbach Alpha and Factor Analysis (for QMSD as Dependent Variable)

Item	Factor Loadings				Communalities	Cronbach's Alpha	N of Items
	KMI	FST	FCU	EVU			
KMI1		0.795			0.663		
KMI2		0.807			0.675		
KMI3		0.805			0.666	0.881	5
KMI4		0.835			0.718		
KMI5		0.817			0.700		
FST1				0.863	0.765		
FST2				0.876	0.783	0.860	3
FST3				0.878	0.794		
FCU1			0.738		0.555		
FCU2			0.826		0.698		
FCU3			0.871		0.762	0.861	5
FCU4			0.834		0.715		
FCU5			0.722		0.538		
EVU1	0.765				0.631		
EVU2	0.759				0.594		
EVU3	0.772				0.608	0.854	6
EVU4	0.753				0.582		
EVU5	0.737				0.555		
EVU6	0.756				0.576		
KMO/Sig.	0.830/0.000						
No. of Obs	335						

Table 2: Results for Cronbach Alpha and Factor Analysis (for FPE as Dependent Variable)

Item	Factor Loadings		Communalities	Cronbach's Alpha	N of Items
	FPE	KMI			
FPE1	0.839		0.735		
FPE2	0.855		0.738		
FPE3	0.774		0.633	0.890	5
FPE4	0.800		0.713		
FPE5	0.824		0.702		
KMI1		0.714	0.510		
KMI2		0.708	0.533		
KMI3		0.744	0.604	0.806	5
KMI4		0.789	0.650		
KMI5		0.711	0.549		
KMO/Sig.	0.854/0.000				
No. ofObs	174				

The presence of multicollinearity would cause instability in the ordinary least square coefficients. Hence, we perform the correlation analysis to overcome the problem of multicollinearity. Before conducting the correlation procedure, we create the summated scales that comprise multiple items. Similar to the Cronbach alpha and factor analysis, we carry out the correlation matrices separately for the two models, which are presented in Tables 3 and 4.

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The results provided in Tables 3 and 4 report that all the correlations among the variables used in the analyses are under 0.8, the highest level stipulated by Kennedy (1992). Furthermore, organizational culture is not statistically related to organizational size as well as to the implementation of knowledge management. And, organizational structure has no statistical relationship with environmental uncertainty. These findings indicate that our analysis data does not suffer the problem of multicollinearity.

Table 3: Correlations among the variables (for QMSD as Dependent variable)

	QMSD	FSE	KMI	FST	FCU	EVU
QMSD	1.000	0.534***	0.396***	0.259***	0.194***	0.317***
FSE		1.000	0.445***	0.133**	0.003	0.255***
KMI			1.000	0.170***	-0.013	0.291***
FST				1.000	0.201***	-0.007
FCU					1.000	.201***
EVU						1.000

No. of Obs = 335; Significance Level: ***= 0.01, **=0.05

Table 4: Correlations among the variables (for FPE as Dependent variable)

	QMSA	FSE	KMI	FPE
QMSA	1.000	0.171**	0.486***	0.607***
FSE		1.000	0.340***	0.246***
KMI			1.000	0.411***
FPE				1.000

No. of Obs = 174; Significance Level: ***= 0.01, **=0.05.

After ensuring that our data and measures are suitable for the analyses, we utilize the Heckman two-step procedure to determine the influence of factors on the likelihood of adopting the quality management system as well as the determinants of organizational performance. Table 5 presents the results from the first stage. The results indicate that the likelihood to which organizations adopt the quality management system in business is statistically dependent on the implementation of knowledge management, organizational size, structure, culture as well as environmental uncertainty at the significance level of 0.01. Organizational size is a variable that puts the strongest influence on the likelihood of adopting the quality management system with the coefficient of 1.327. The implementation of knowledge management is the third most important to the likelihood of adopting the quality management system with the coefficient of 0.421. The model-fit attains a statistical significance level of 0.01 and the explanatory power of the model achieves 35.44%. The findings statistically support our hypothesis H2 that knowledge management implementation determines the likelihood of adopting the quality management system.

Table 5: Results from Heckman first step

QMSD	Coef.	Std. Err.	z	P
FSE	1.327	0.188	7.06	0.000
KMI	0.421	0.136	3.10	0.002
FST	0.255	0.070	3.62	0.000
FCU	0.371	0.095	3.89	0.000
EVU	0.563	0.135	4.17	0.000
CONS	-6.242	0.835	-7.48	0.000

No. of Obs = 335, Prob> chi2 = 0.0000, Pseudo R^2 = 0.3544

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The first stage also allows us to calculate the inverse Mill ratios (INVMILLS), based on the equation 1. Then we enter INVMILLS into our outcome equation as described in the equation 2 and perform the second stage of the Heckman procedure. Table 6 exhibits the results obtained from the second stage. The findings show that our outcome equation enjoys the model-fit at a significance level of 0.01. The inverse Mill ratios "INVEMILLS" is statistically different from zero at a significance level of 0.01 with the estimate of 1.131, indicating that the sample selection bias occurs in our research model. Therefore, including the inverse Mill ratios "INVEMILLS" into the research model to eliminate the selection bias is necessary. In addition, the predictive variables explain 49.99% of the variation in organizational performance. Also according to Table 6, the adoption of the quality management system and the implementation of knowledge management are all predictors of organizational performance at the 0.01 significance level. The adoption level of the quality management system plays the most important role in leading to improved organizational performance. The implementation of knowledge management is the second most important to improved organizational performance. In short, the results provide statistical evidence to support our hypotheses H1 and H3 on the relationship of organizational performance with the adoption of the quality management system as well as with the implementation of knowledge management.

Table 6: Results from Heckman second step

FPE	Coef.	Std. Err.	t	P|
QMSA	1.105	0.119	9.29	0.000
KMI	0.347	0.094	3.70	0.000
INVMILL	1.131	0.193	5.86	0.000
CONS	-4.147	0.597	-6.95	0.000

No. of Obs = 174, Prob> F = 0.0000, R^2 = 0.4999

As mentioned above, adopting the quality management system in business will lead to improved organizational performance. In addition, while Molina et al. (2004) and Ju et al. (2006) imply that adopting the quality management system plays a critical role in leading to the implementation of knowledge management. Lin and Chang (2006) ascertain that adopting the quality management system is an important factor in improving organizational performance. Overall, adopting the quality management system both boosts the implementation of knowledge management and enhances organizational performance. Hence, we can argue that the relationship between the implementation of knowledge management and organizational performance may vary with the adopting level of the quality management system in business. However, no research has examined the moderating role of adopting the quality management system in this relationship. We therefore conduct the hierarchical regression procedure to test the moderating role of the quality management system in the relationship between the implementation of knowledge management and organizational performance.

First, the interaction of the adoption of the quality management system (QMSA) and the implementation of knowledge management (KMI) is created by multiplying QMSA with KMI. Second, the hierarchical procedure with the linear regression analyses for the effects of these variables on organizational performance (FPE) is conducted. At the first stage, the predictive variables (QMAS and KMI) are entered in the hierarchical regression procedure. Then, the interaction (QMAS*KMI) is included into the procedure at the second stage. The results are shown in Table 7.

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Table 7: Regression Results for Moderating Effect

Predicted Variable	Predictive Variable	Coeffs	Std. Error	$t_{statistics}$	P_{value}
	(Constant)	-1.836	0.494	-3.717	0.000
FPE	QMSA	1.010	0.130	7.778	0.000
	KMI	0.205	0.092	2.222	0.028
F = 53.818, Prob> F = 0.000, R^2 = 0.386					
	(Constant)	19.335	8.570	2.256	0.025
FPE	QMSA	-4.237	2.124	-1.994	0.048
	KMI	-4.395	1.861	-2.361	0.019
	INTERACTION	1.138	0.460	2.474	0.014
F = 38.994, Prob> F = 0.000, R^2 = 0.408					

The inclusion of the interaction increases the explanation for the model from 38.6% to 40.8%. Additionally, the effect of the interaction on FPE is statistically significant at the 0.05 level with the coefficient of 1.138. Consequently, it is concluded that the adopting level of the quality management system statistically moderates the relationship between the implementation of knowledge management and organizational performance. This reflects that the effect of implementing knowledge management on organizational performance is stronger under the high level of adopting the quality management system than under the low level of adopting the quality management system. Rather, the high level of adopting the quality management system in business will help organizations enhance the efficiency of implementing knowledge management and thereby more considerably improve organizational performance.

5. Discussion and Conclusions

A study by Hung et al. (2010) examined the effects of total quality management and knowledge management on firm performance; however, they measured "total quality management" with the four dimensions: (1) top management support, (2) employee involvement, (3) continuous improvement, and (4) customer focus. This research takes another way by using "the adoption of the quality management system" as the adopting level of the total quality management system in business. Furthermore, Hung et al. s' (2010) study did not take into account control variables, such as organizational size, culture, structure and environmental uncertainty, in the research model. To eradicate the sample selection bias, this research includes organizational size, culture, structure, and environmental uncertainty into the research model as control variables, using the Heckman two-step procedure to examine the associations of organizational performance with adopting the quality management system as well as with implementing knowledge management. The findings reveal that the sample selection bias is serious in our analysis. Hence, the sample selection bias should be overcome, so that the results become more reliable.

In addition, Hung et al. (2010) examined the mediating role of total quality management, but they ignored the moderating role. This study tries to investigate the moderating role of quality management system adoption in the relationships between the implementation of knowledge management and organizational performance. The results show that the adoption of the quality management system plays a moderating role in the influence of implementing knowledge management on organizational performance. The adoption of the quality management system in business will strengthen the link between the implementation of knowledge management in business and organizational performance. Overall, our findings are consistent with the existing literature, in which organizational performance is enhanced by the implementation of knowledge management and the adoption of the quality management

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system in business; whereas, the implementation of knowledge management boosts up the adoption of the quality management system in business.

This paper is the first to explore the relationships among the adoption of the quality management system, the implementation of knowledge management and organizational performance in a joint model with considering other determinants of adopting the quality management system in order to eliminate the problem of sample selection bias. Furthermore, it is also the first to provide empirical evidence on the moderating role of adopting the quality management system in the relationships between the implementation of knowledge management and organizational performance. This research offers managers insight into the complicated relationships among the adoption of the quality management system, the implementation of knowledge management and organizational performance, which will help them to make better decisions on the adoption of management systems for improving organizational performance.

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