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Marketing Knowledge Management and Innovation Performance: Examining the Moderating Role of Business Environmental Volatility

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This study empirically examines the link between marketing knowledge management and innovation performance focusing on the moderating role of business environmental volatility. We define marketing knowledge management as the integration of knowledge generation, knowledge dissemination and knowledge storage. Using a unique data set that consists of 439 employees at 156 firms in China, we find that knowledge dissemination and knowledge storage have a positive effect on innovation performance. Also found is the negative moderating effect of business environmental volatility on innovation performance. Our findings suggest that firms should strengthen their marketing knowledge management to improve innovation performance and stay flexible to cope with the ever-changing and often volatile market environments.

Keywords: Business environmental volatility, Innovation performance, Marketing knowledge management

Ⅰ. Introduction

Innovation is the process of firms flexibly applying new ideas to pursue profits from products/services through the implementation of new ideas (Naidoo 2010). Firm innovation performance is closely related to the development of new products such as putting creative ideas into practice to make research and development possible. Although marketing innovation among competitors tends to be quite similar, marketing

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knowledge can be used as a source of differentiation. Galunic and Rodan (1998) show that market knowledge leads to better product performance because it allows for differences in cross-functional logics. Thus, the capability of marketing management is an essential factor for firm innovation performance.

From the knowledge-based view, Morgan et al. (2003) emphasize that the level of acquisition and utility of relative knowledge is crucial to analyze a firm's performance. They classify that setting targeted markets, forming creative marketing strategies and refining marketing plans are the components of marketing knowledge management. Although marketing competencies have been developed in theoretical perspectives, few empirical studies examined the dimensional characteristics of marketing capabilities focusing on knowledge management, and how these factors influence firm's innovation performance. Previous studies focusing on the relationship between marketing knowledge management and innovation performance are lacking. Moreover, extant research in marketing knowledge management has paid little attention to business environmental volatility. To bridge this gap, we aim to investigate the relationship between marketing knowledge management and innovation performance through empirical analysis and provide practical implications for this research area.

The knowledge-based view focused in this study has more significant potential to understand the innovation performance than the traditional resource-based view and favorable environment-induced performance view. While the traditional resource-based view has relative strengths over the physical environment view, the knowledge-based view is more comprehensive. It can also actively and flexibly respond to environmental changes. For these reasons, this study focuses on a knowledge-based view that is highly adaptable to the changes in business environmental dynamics and in the flow between marketing knowledge management and innovation performance.

In the process of achieving innovation performance, firms can be influenced by many external factors. For example, the effects of business environmental volatility, a major representative factor, are known to be large. Rapid changes in the market environment and the turmoil of the technology environment intensify the uncertainty of the external environment. The uncertain marketing environment results in the diversity of competitiveness and the difficulties of innovation (Grant 1996). Thus, it is crucial for firms to manage the uncertainty that stems from the business environment (Johnson, Sohi and Grewal 2004). Against this backdrop, we will study the moderating effects of business environmental volatility on innovation performance.

In this paper, we emphasize the importance of the possession and utilization of marketing knowledge management to enhance innovation performance. We also show the importance of staying adaptive to a fast-changing marketing

environment in the process of achieving innovation performance. This research makes a contribution by filling the deficiency of studies related to marketing knowledge management and provides empirical results in the field of a firm's innovation performance.

We use a unique data set that consists of 439 employees at 156 firms in Hangzhou Province, China. As China is going through an "active" period of innovation, it is timely to investigate the use of marketing knowledge management at Chinese firms. We find that knowledge dissemination and knowledge storage have a positive effect on innovation performance. We also find the negative moderating effect of environmental volatility on innovation performance. Our findings suggest that firms should strengthen their marketing knowledge management to improve innovation performance and stay flexible to cope with the ever-changing, often volatile market environments.

This paper is organized as follows. Section 2 presents a theoretical framework and hypotheses to be tested. Section 3 presents the research model. Section 4 discusses the empirical methodology. Section 5 presents and discusses the empirical analysis and results. Section 6 summarizes the findings, and implications for further discussion. Section 7 concludes.

Ⅱ. Theoretical framework and Hypotheses development

2.1 The nature of marketing knowledge management

A full utilization of knowledge can deepen the understanding of the complexity of knowledge, which provides rich information to various types of firms (Menon and Varadarajan 1992). Marketing knowledge can be shared, switched, integrated and recreated by effective communication between a firm's internal departments and external stakeholders (Valle and Avella 2003). The core of marketing knowledge is market intelligence, and its generation, dissemination and responsiveness to market information (Kohli and Jaworski 1990; Narver, Slater and MacLachlan 2004). Therefore, marketing knowledge management can be seen as the process that firms utilize to transform the input of marketing into output. This process is achieved from the integration of technology and knowledge, which is closely related to learning procedures. According to the knowledge-based view and contingency theory, Tsai and Shih (2004) argue that marketing knowledge management contributes to the full use of tangible and intangible assets, which consolidate business performance. We argue that marketing knowledge needs to be integrated and applied properly to contribute to performance achievement.

Following Jaworski and Kohli (1993) and Tsai and Shih (2004), we analyze marketing knowledge management specifically focusing on the generation, dissemination and storage of marketing knowledge. Knowledge generation mainly reflects whether a firm possesses abundant professional knowledge in the field of marketing, which is also known as marketing knowledge reservation. Knowledge dissemination reflects the effective process of obtaining and sharing new knowledge from different units. Knowledge dissemination has a transitional effect in the process of connecting existing knowledge to related implementation. Knowledge storage contributes to the flexible and effective implementation of marketing knowledge in the future. It helps firms to analyze market situations and achieve higher performance.

2.2 Marketing knowledge management and innovation performance

Hurley and Hult (1998) define innovation as the understanding and cognition of new ideas or new marketing activities, which can be interpreted as the degree of firms' responses to innovation. Innovation is also defined as a "key mechanism for organizational growth and renewal" (Lawson and Samson, 2001). Furthermore, marketing innovation contributes to providing solutions associated with low-risk product modifications, extensions and design changes (Bennett and Cooper, 1979, 1981). Also, a firm's innovation performance is closely related to the development of new products. For example, firms put creative ideas into practice to improve research and development.

Previous studies have shown that close relationships exist between marketing knowledge management and innovation performance. Joshi and Sharma (2004) posit that emphasizing more on developing customer information based on customer preference and demand, which forms the foundation of marketing knowledge management capability, is likely to ensure innovation success.

This paper shows that knowledge is a key factor for firms to reach innovation goals. According to previous literature, we argue that marketing knowledge management has a positive effect on innovation performance. Thus, the better a firm is at marketing knowledge management, the more likely the firm will achieve better innovation performance. Given this, we develop our first hypothesis as follows:

Hypothesis 1: Marketing knowledge management, including (a) knowledge generation, (b) knowledge dissemination, (c) knowledge storage, is positively associated with innovation performance.

2.3 The moderating role of environmental volatility

Faced with the rapid changes of the social environment and market opportunities, firms

should possess the adaptability to cope with competition from the business environment. In a stable environment, firms are less likely to change their patterns of behavior. However, in an environment with high volatility, firms should be able to utilize their marketing knowledge management to respond efficiently and effectively to the varying environment. This is because the previous patterns of behavior will be no longer appropriate (Mintzberg and Waters, 1985; Johnson, Sohi and Grewal, 2004). Slater and Narver (1994) show that in turbulent environmental settings, firms with superior market knowledge have superior responsiveness in coping with environmental volatility. Thus, in turbulent environments, it is crucial for firms to strengthen marketing knowledge management.

Johnson, Sohi and Grewal (2004) show that the full use of knowledge across different environments is required for firms to utilize any potential capability-related advantage. Song and Parry (1997) study the moderating effect of environmental volatility on new products and performance. Kumar, Venkatesan and Leone (2011) show that environmental turbulence moderates the main effect of market orientation on business performance. We aim to fill the gap by highlighting the moderating effects of environmental volatility on the relationship between marketing knowledge management and innovation performance.

Kumar et al. (2011) provide theoretical arguments for the effects of environmental conditions on business performance over time. Following this research, we divide environmental volatility into the following three factors:

(1) Market uncertainty. Customer demand uncertainty is directly related to market uncertainty (Kohli and Jaworski, 1990). Kumar et al. (2011) show that in a market with higher customer demand uncertainty, firms will gain the capability of understanding and meeting customer needs better, which helps firms to maintain better performance in the long run.

(2) Technological turbulence. Slater and Mohr (2006) define technology as the process of transforming inputs to outputs and the delivery of those outputs to the customer. Kumar et al. (2011) show that the characteristics of products and services can be largely determined by innovation when technological turbulence is high.

(3) Competitive intensity. Song and Parry (1997) define competitive intensity as the nature of inter-firm rivalry within the firm's target market. A hostile environment is characterized by competitors who attack each other aggressively on numerous strategic dimensions. Narver and Slater (1990) point out that competitive intensity reduces new product performance. Gatignon, Hubert and Xuereb (1997) argue that in a highly competitive market, firms are forced to predict the reactions of

competitors and analyze the strengths and weakness of competitors to develop competitive advantages. Thus, innovation performance should be affected by the level of competition intensity as well.

The business environment's volatility plays an increasingly important role in the relationship between marketing knowledge management and innovation performance. Since the volatility of the business environment varies depending on the companies' situations, the companies establish and adopt differentiated strategies that are most optimal in their operating circumstances.

The corporate strategy closely mirrors changes in the market environment. The intensifying competition in the market changes forces corporations to strategize. The corporate strategy varies by companies to address its idiosyncratic characteristics for optimal function. Two strategic trends especially stand out: (1) competitiveness through innovative technologies and services, and (2) management that pursues a stable performance. The firm's strategic choice depends largely on the individual firm's position in the market, its market share, and the acquisition of high technical skills.

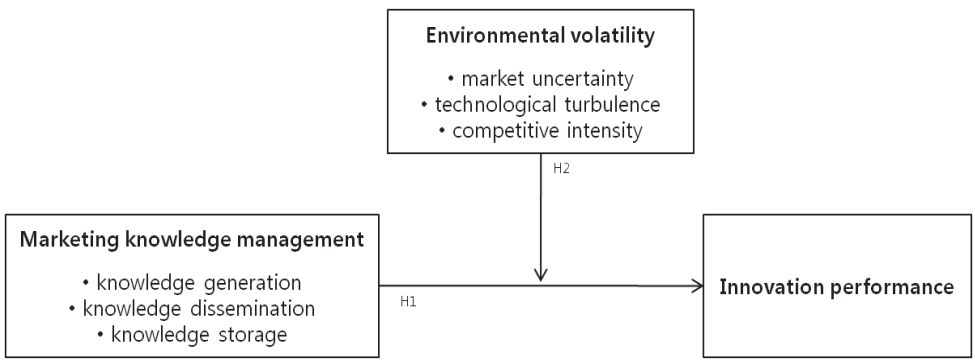
Consequently, the above three features weaken the effects of marketing knowledge management on innovation performance. Accordingly, we develop hypothesis 2 as follows:

Hypothesis 2: Environmental volatility, including (a) market uncertainty, (b) technological turbulence and (c) competitive intensity, negatively moderates the relationship between marketing knowledge management and innovation performance.

Ⅲ. Research model

In Figure 1, we specify the research model that shows (1) the relationship between marketing knowledge management and innovation

〈Fig. 1〉 The hypothesized framework



performance and (2) the moderating role of environmental volatility between marketing knowledge management and innovation performance. In the following sections, we discuss our sample, variables, and their measurement.

Ⅳ. Methods

4.1 Sampling and data collection

The sample includes 185 firms in industrial, construction and service industries in the city of Hangzhou in Zhejiang Province, China. Firms in Zhejiang Province are known to be well conscious of innovation and have a better foundation for innovation, especially in the Province capital city Hangzhou whose average index of innovation such as electronic commerce and the high-tech industry surpasses the average level in China. Hangzhou held the G20 summit in September 2016 with the theme "to foster an innovative, invigorated, interconnected and inclusive world economy." This reflects how important the role of innovation is perceived in that region, and in the current market environment. For these reasons, we chose Hangzhou as our target area to conduct this study. Through confirmation by on-line or telephone communication, 156 companies agreed to participate in the survey. We asked the participants to take part in the survey by sending an online survey link with the questionnaire. To investigate marketing knowledge management and innovation performance, we surveyed company executives, with a presumption that they represent their companies' characteristics.

Between May 9th and August 21th, 2017, we received a total of 468 responses. From the questionnaire responses, we selected respondents who actively participated in responding to the questionnaire, and whose responses to the questionnaire were considered reliable. Hence, we discarded 29 invalid questionnaires responses. Eventually, 439 valid questionnaires were used for data analysis. The 156 firms in our sample include 41 firms in the trade industry (including online trade, 26.3%), 32 firms in the wholesale and retail sale industry (20.5%), 22 firms in the accommodation and catering industry (14.1%), 21 firms in the industrial energy industry (13.5%), 19 firms in the construction and real estate industry (12.2%), 17 firms in the finance industry (10.9%), and 4 firms in the transportation and post industry (2.6%). Table 1 lists the characteristics of 439 participants in the sample.

4.2 Measures

Questionnaires used in this study were originally constructed in English. Following the method used by Reynolds et al. (1993) who introduced the translation back-translation process, we used English-version and Chinese-version questionnaires

〈Table 1〉 Sample statistics by category

Construct		Frequency	%
Gender	male	235	53.6
	female	204	46.4
Age	20-29	148	33.6
	30-39	144	32.8
	40-49	88	20.0
	50-59	39	8.8
	〉60	21	4.8
Education	high school graduated	28	6.3
	college graduated	96	21.8
	bachelor	248	56.6
	master	54	12.4
	doctoral	13	2.9
Department	sales	104	23.6
	marketing	124	28.2
	administration	81	18.5
	planning	93	21.2
	technical	37	8.5
Position	CEO	24	5.4
	director	49	11.2
	team leader	58	13.1
	head of department	95	21.6
	general staff	213	48.6
Years of employed	under 3 years	68	15.6
	4-10 years	143	32.6
	11-15 years	131	29.9
	16-20 years	78	17.7
	over 20 years	18	4.2
Total		439	100.0

simultaneously. We used five-point Likert scales anchored by 1 ("strongly disagree") and 5 ("strongly agree").

The independent variable is marketing knowledge management, which consists of knowledge generation, knowledge dissemination, and knowledge storage. We measure the variable by four aspects of 15 items developed by Morgan, Katsikeas and Vorhies (2012), and Jaworski and Kohli (1993).

We divided the marketing knowledge management into two types: (1) internally

accumulated knowledge management attained from knowledge generation and dissemination and (2) knowledge storage that can be used to share and develop internally accumulated management capabilities with business partners.

The dependent variable is innovation performance. Innovation performance refers to a firm's ability to apply new ideas flexibly to pursue profits from products/services. This study uses subjective evaluation of innovation performance because performance data on corporate operations are rarely disclosed, and managers are unwilling to provide financial data on innovation performance. We used the six-item scale as developed by De Luca and Athahene-Gima (2007), Naidoo (2010) and Paladino (2007).

The moderating variable is environmental volatility, which refers to the volatility of the environment including market uncertainty, technological turbulence and competitive intensity. We measure it by 3 aspects of 20 items based on Han, Kim and Srivastava (1998), Narver, Slater and MacLachlan (2004), and Joshi and Sharma (2004).

V. Analysis and results

5.1 Scale validation

As a validity check on the conceptual nature of the instruments, exploratory factor analysis (EFA) was performed and the results are presented in Table 2. We checked the Cronbach alphas to find that most of the final scales are very close to or over the 0.70 threshold (Nunnally 1994). We also conducted a confirmatory factor analysis (CFA) to assess the convergent and discriminant validity of the measures using SPSS AMOS 19.0. The results show that the measurement model has an acceptable model fit (χ^2=1042.526, $p < 0.01$, df=323, RMR=0.049, GFI=0.890, AGFI=0.862, PGFI=0.796, NFI=0.902, RFI=0.875, IFI=0.847, TLI=0.933, CFI=0.946, PCFI==0.882, RMSEA=0.046). All factor loadings are significant, and no cross-loadings are identified, which indicates the unidimensionality of the measures. The composite reliability (CR) values for each of the factors are exceeding the 0.70 criterion, which suggests that all factors have good internal consistency. Average variances extracted (AVE) of all constructs exceed or are proximate to the 0.50 threshold (Hair et al. 2006). Altogether, results of these tests demonstrated acceptable convergent validity and reliability of the measures. Table 3 presents the descriptive statistics and correlation coefficient matrix for the main variables used for Pearson's correlation analysis. We tested the CFA and showed positive results. Discriminant validity results show that the AVE value is higher than the square of the correlation coefficient. Therefore, the discriminatory validity and the validity of distinction are established to be appropriate.

〈Table 2〉 Measurement scales for all variables

Variable	Subordinate variables (questionnaire items)	Factor loading	Cronbach's α	CR	AVE
Marketing knowledge management: (Morgan Katsikeas and Vorhies 2012; Jaworski and Kohli 1993)					
Knowledge generation	find out what products or services customers will need in the future.	0.758	0.804	0.828	0.563
	poll end users to assess the quality of products and services.	0.786			
	department interact directly to learn how to serve customers better.	0.786			
	do a lot of in-house market research.	0.754			
	review the likely effect of changes in business environment to customers.	0.905			
Knowledge dissemination	have interdepartmental meetings to discuss market trends and developments.	0.663	0.802	0.790	0.503
	marketing personnel in business unit spend time discussing customers' future needs with other functional departments.	0.743			
	business unit periodically circulates documents that provide information on customers.	0.851			
	when something important happens to a major customer or market, the whole business unit knows about it in a short period.	0.787			
	data on customer satisfaction are disseminated at all levels in this business unit on a regular basis.	0.912			
Knowledge storage	planning and management of partnering activities	0.739	0.798	0.835	0.565
	initiating and implementing cooperative programs with suppliers	0.744			
	working with supplier to develop products	0.712			
	working with suppliers on quality management	0.696			
	enhancing suppliers' production capabilities and capacities	0.860			
Innovation performance: (De Luca and Athahene-Gima 2007; Naidoo 2010; Paladino 2007)					
Innovation performance	management actively seeks innovative marketing ideas.	0.777	0.820	0.890	0.574
	improvements in 4p are readily accepted.	0.789			
	new products or services are minor improvements in a current technology.	0.800			
	new products/ services incorporate a large new body of technological knowledge.	0.724			
	our new products/services are similar to our main competitors' products/services.	0.779			
	our new products or services are totally different from the applications of our main competitors' products or services.	0.719			
Environmental volatility: (Han, Kim and Srivastava 1998; Narver, Slater and MacLachlan 2004; Joshi and Sharma 2004)					
Market uncertainty	frequent changes in customer preferences	0.770	0.792	0.929	0.621
	ability to reduce market uncertainty	0.802			
	ability to respond to market opportunities	0.807			
	uncertainty of customers demand for products and services	0.839			
	uncertainty of customers loyalty	0.768			
	accuracy of assessing customer	0.727			
	easiness of forecasting customer demand	0.779			
	difficulty of predicting the evolution of customer	0.793			
Technological turbulence	extent of technological turbulence in the environment	0.714	0.798	0.907	0.623
	leadership in product/process innovation	0.653			
	impact of new technology on operations	0.849			
	allocating resources to research and planning	0.819			
	the technology in our industry is cutthroat	0.850			
	new product ideas made through technological breakthroughs	0.829			
Competitive intensity	competition in our industry is cutthroat	0.760	0.800	0.874	0.540
	promotion wars within the industry	0.793			
	strong competitors within the market	0.750			
	existence of a strong/dominant competitor with a large market share	0.721			
	loyalty of potential customers to competitors' products	0.762			
	frequent new product introductions by competitors	0.764			

〈Table 3〉 Descriptive statistics and correlation coefficients

	Variables	Mean	SD	1	2	3	4	5	6	7
1	Knowledge generation	3.833	0.623	1 (0.563)						
2	Knowledge dissemination	3.459	0.697	0.601** (0.361)	1 (0.503)					
3	Knowledge storage	3.788	0.610	0.688** (0.473)	0.619** (0.383)	1 (0.565)				
4	Innovation performance	3.662	0.663	0.437** (0.190)	0.445** (0.198)	0.525** (0.275)	1 (0.574)			
5	Market uncertainty	3.758	0.700	0.254** (0.064)	0.293** (0.085)	0.277** (0.076)	0.216** (0.046)	1 (0.621)		
6	Technological turbulence	3.801	0.680	0.212** (0.044)	0.251** (0.063)	0.241** (0.058)	0.191** (0.036)	0.721** (0.519)	1 (0.623)	
7	Competitive intensity	3.652	0.679	0.228** (0.051)	0.259** (0.067)	0.217** (0.047)	0.216** (0.046)	0.709** (0.502)	0.703** (0.494)	1 (0.540)

Notes: SD=standard deviation.

〈Table 4〉 Results of the regression analysis

	Dependent variable	Independent variables	Non-standard coefficient		Standard coefficient	t	p	Collinearity statistics	
			B	standard error	ß			Tolerance	VIF
H1	Innovation Performance	(Constant)	1.265	0.181		6.973	0.000		
		generation	0.094	0.062	0.088	1.517	0.130	0.477	2.098
		dissemination	0.162	0.051	0.170**	3.183	0.002	0.559	1.789
		storage	0.390	0.064	0.359***	6.080	0.000	0.460	2.173
R^2=0.303; F=62.952; sig.=0.000									

Notes: ***p < 0.001, **p < 0.01, *p < 0.05.

5.2 Hypotheses testing

Hypothesis testing is carried out by multiple regression analysis which is conducted to determine the factors that influence the dependent variable using SPSS 22.0. The results are listed in Table 4.

We estimate the first model (Hypothesis 1) about first-order marketing knowledge management including (a) knowledge generation, (b) knowledge dissemination, and (c) knowledge storage. The fit of the model is statistically good with R^2=0.303, F=62.952, sig.=0.000. Knowledge dissemination (β=0.170**, t=3.183, p < 0.01) and Knowledge storage (β=0.359***, t=6.080, p < 0.001) are positively related to innovation

performance. This finding supports H1b, and H1c. Accordingly, we can confirm that knowledge storage has a stronger fit than knowledge dissemination with innovation performance. However, the estimated coefficient of the knowledge generation variable ($\beta = 0.088$, $t = 1.517$, $p > 0.1$) was found to be statistically insignificant, implying that it does not have a direct implication on innovation performance. Therefore, H1a is rejected.

To diagnose potential multicollinearity among the variables, we calculate the variance inflation factor (VIF). Given that 10 is considered as the lower-bound cut-off point for no concern about multicollinearity and that our sample shows VIF values ranging between 1.789 and 2.173, multicollinearity does not pose a problem in this study. In the measurement of hypothesis 1, we only considered the direct effect of the independent variable on the dependent variable. However, uncontrolled indirect effects bias may occur.

To test Hypothesis 2, we utilize a hierarchical regression analysis to verify the moderating effects of environmental volatility on the relation between marketing knowledge management and innovation performance. The difference of R^2 of regression results under different moderating variables indicates statistical significance. Table 5 shows that the relation between marketing knowledge management and innovation performance with the moderating effect of environmental volatility is $\Delta R^2 = 0.042$, $\beta = -1.952$, $t = -5.225$, $p < 0.001$, which indicates that environmental volatility has a statistically significant negative moderating effect.

Regarding the hierarchical regression analysis, we supplemented the statistics of R^2, F, ΔR^2, ΔF, ß, and t. The regression coefficients of interaction terms, the R^2 variation, and the F variation are found to be statistically significant. We did not use the mean-centered variable in the analysis process because the mean-centered variable is used to reduce multicollinearity, but there is no multicollinearity in the empirical analysis of this paper.

The results for three subordinate factors of environmental volatility are market uncertainty ($\Delta R^2 = 0.033$, $\beta = -1.627$, $t = -4.645$, $p < 0.001$), technological turbulence ($\Delta R^2 = 0.047$, $\beta = -2.107$, $t = -5.581$, $p < 0.001$), and competitive intensity ($\Delta R^2 = 0.031$, $\beta = -1.664$, $t = -4.436$, $p < 0.001$). These results show that their negative moderating effects on the relation between marketing knowledge management and innovation performance are statistically significant. All in all, the results indicate that the effect of marketing knowledge management on innovation performance declines as the environmental volatility (including market uncertainty, technological turbulence and competitive intensity) increases. The results also indicate that the power of the effects of three subordinate factors rank as follows: technological turbulence > market uncertainty > competitive intensity. Furthermore, the result for the test of multicollinearity shows a VIF

〈Table 5〉 Results of the regression analysis about the moderating role

	Dependent variable	Independent variables	R^2	F	ΔR^2	ΔF	ß	t	p	Collinearity statistics	
										Tolerance	VIF
H2	Innovation Performance	MKM	0.303	62.952			0.233	4.324	0.000	0.902	1.109
		MKM EV	0.293	90.416			0.242	3.211	0.000		
		MKM, EV, MKM×EV	0.335	73.016	0.042	17.400	-1.952	-5.225	0.000		
		MKM	0.303	62.952			0.233	4.324	0.000	0.900	1.111
		MKM MU	0.292	89.817			0.312	3.132	0.000		
		MKM, MU, MKM×MU	0.325	69.896	0.033	19.921	-1.627	-4.645	0.000		
		MKM	0.303	62.952			0.233	4.324	0.000	0.927	1.079
		MKM TT	0.292	89.807			0.212	2.565	0.000		
		MKM, TT, MKM×TT	0.339	74.393	0.047	15.414	-2.107	-5.581	0.000		
		MKM	0.303	62.952			0.233	4.324	0.000	0.927	1.079
		MKM CI	0.295	91.168			0.174	2.104	0.021		
		MKM, CI, MKM×CI	0.325	69.941	0.031	21.227	-1.664	-4.436	0.000		

Notes: ***p〈0.001, **p〈0.01, *p〈0.05. MKM=marketing knowledge management; EV=environmental volatility; MU=market uncertainty; TT=technological turbulence; CI=competitive intensity

value of 1.079~1.111, which indicates that there is no multicollinearity in our test.

Ⅵ. Discussion

This paper analyzes the innovation performance of firms by focusing on marketing knowledge management. The findings are summarized as follows. First, marketing knowledge management has a positive effect on innovation performance. Furthermore, subordinate factors of marketing knowledge management, knowledge dissemination and knowledge storage, show different levels of influence on innovation performance. However, knowledge generation does not show a statistically significant effect on innovation performance. This result may imply that the sample firms in our study have a relatively deficient system construction of marketing information, imperfect marketing knowledge system and weak crisis

consciousness.

Thus, we suggest that 1) firms should improve the knowledge management of individuals and promote their integration and conversion with organizations to maximize its effect; 2) firms should constantly absorb knowledge from the external environment to enhance the effectiveness of knowledge integration and knowledge management, in order to develop specific resources and strengthen competitive advantages; 3) firms should exert more efforts to develop marketing knowledge management that is more adaptive to the ever-changing business environments; and 4) firms with relative weak advantages can learn the knowledge and skills from successfully performing enterprises through knowledge strategic alliance. An effective external communication network promotes the knowledge management.

Secondly, we test the moderating effect of environmental volatility on the relationship between marketing knowledge management and innovation performance. Nowadays, with the trend of political and economic globalization, domestic markets are increasingly influenced by external factors. The interaction effects of domestic and international factors have intensified the uncertainty of the market environment. When studying the effect of marketing knowledge management on innovation performance, we should adopt a multidimensional approach. Under the intensified development of technologies, it is crucial for firms to focus on innovation in order to be more adaptive to the uncertain environment.

This research investigates two aspects of the impact of business environmental variabilities on the relationship between marketing knowledge management and innovation performance. Between marketing knowledge management and innovation performance, the moderating effect can theoretically be both positive and negative. The negative moderating role of environmental variability has two characteristics.

First, the sample and associated results in this paper may differ from general marketing knowledge management research findings. We emphasize the negative moderating effects arising from specific characteristics of members, firms, and organizations. Due to internal inertia and rigid structure, some firms and organizations may not adapt nimbly to business environmental changes. As a result, innovation performance can slow down.

Second, as many Chinses firms compete fiercely in the market, the uncertainties arising from the repeated changes in small and large business environmental cycles can lead those Chinese firms to be passive and conservative. As a result, firms can be risk-averse with slower innovation performance. In this context, further research is needed that uses variables controlling for the cyclicality of business environment changes and their magnitude.

6.1 Theoretical implications

For theoretical implications, this paper empirically studies the relationship between marketing knowledge management and innovation performance, using a unique data set for Chinese firms. The findings of this research verify the theoretical validity of previous studies. We suggest that firms possessing internal innovation capability should make the most use of effective strategic approaches to achieve external market innovation capability in order to stay more flexible. We believe that the sustainability of the interaction of internal capability and external capability is of great importance to Chinese firms.

In addition, we consider the moderating effects of environmental volatility, with its three subordinate factors of market uncertainty, technological turbulence and competitive intensity, on the relationship between marketing knowledge management and innovation performance. Through effective analysis and planning, firms will be able to implement business strategies to stay competitive in multifaceted market environments. This study complements the extant research by conforming to the basic theory of marketing knowledge management and innovation performance and the role of moderating variables on business environmental variability.

In addition, due to the recent worldwide COVID-19 pandemic, firms have been exposed to extreme external environmental changes. As a result, the existing industry is declining, and the online sector is surging. Firms should actively utilize marketing knowledge management to respond to environmental changes. In this context, this study provides theoretical implications.

6.2 Practical implications

The increasing dynamic innovation capabilities of Chinese firms have led to a variety of innovative activities that encourage Chinese firms to pay more attention and invest more on innovation development. This market condition not only enhances the competitiveness of firms, but also has a positive impact on the overall trend of innovation. Faced with challenging economic environments and global recession, Chinese firms show remarkable features in two areas: Firstly, Chinese enterprises face fierce competition in domestic market environment. The dynamic nature of the large Chinese market has been promoting this fierce competition, driven by currently rising consumption expenditures and the consumption propensity of Chinese customers. Secondly, the extent of competition of Chinese firms is expanding gradually and the proportion of high value-added innovative industries increases year by year. It is important to possess sharp and sensitive perception to the market to develop the high value-added competitive advantage. The international environment is experiencing tremendous changes for both consumers and businesses. Against

this background, the rise of Chinese firms and their implementation of innovation strategies have been drawing much attention. Thus, this research focusing on the city of Hangzhou, a representative area of innovation in China, is of practical significance.

The recent growth of tech companies is maintaining its momentum. This ascent in tech companies, predominantly in online and finance markets, is relatively competitive. These firms gain competitive edge to respond quickly and easily adapt to changing market conditions through the proper management of marketing knowledge, in particular about the specific market and its consumers. This study looked at the variability in these market environments. And this volatility in the environment is represented by a very substantial change in the environment in the recent global pandemic. This study can provide practical implications for the management of marketing knowledge of firms.

6.3 Limitations and future research directions

Our sample has limitations in terms of firm size, industry and region. To ensure the diversity of sample firms, we advise future studies to utilize both on-line and off-line models, and traditional-market orientation/modern-market orientation as a division method to make a detailed division of sample firms. In the current environment, in which communication regarding global market information becomes increasingly and closely connected, the effect of variables such as the marketing knowledge level of customers can be an interesting research topic for future studies.

We believe that marketing knowledge management responds more flexibly to business environmental changes compared to resource-based management. In particular, this study focuses on both negative and positive consequences, such as negative instability and positive dynamics stemming from the changes in business environmental changes. We aim to develop a research agenda that distinguishes negative and positive moderating effects on marketing knowledge management and innovation performance.

We admit that improvements in research methods are needed to distinguish the representative characteristic of the companies from their executives. We aim to conduct future research on the analysis at the firm level. Further research is required to differentiate the various dimensions of knowledge management and streamline them into a pattern or a group, because knowledge management may take different forms depending on the general and specific business environment. This may be especially prevalent during the current turbulence of the COVID-19 pandemic where companies may implement knowledge management strategies differently with differing areas of focus.

Ⅶ. Conclusion

This study empirically examines the link between marketing knowledge management and innovation performance focusing on the moderating role of business environmental volatility. Following previous studies, we redefine marketing knowledge management as having three parts and study its effect on innovation performance. Furthermore, we study the moderating effects of environmental volatility, which consists of market uncertainty, technological turbulence and competitive intensity, on the relationship between marketing knowledge management and innovation performance. The results suggest that firms should strengthen their marketing knowledge management levels to improve innovation performance with the emphasis on marketing capabilities. In the meantime, firms should be aware of the importance of environmental volatility and take it into consideration in the process of achieving innovative goals.

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