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Knowledge Codification, Exploitation, and Innovation: The Moderating Influence of Organizational Controls in Chinese Firms

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ABSTRACT This study examines how firms use organizational controls in the knowledge exploitation process to enhance endogenous innovation. Some past studies have shown that controls restrict the flexibility needed in innovation, whereas others have shown that controls enhanced innovation by directing the efforts of research and development professionals. Thus, we extend the theoretical development of organizational control theory to examine how different types of organizational controls (clan, behaviour, and output controls) play different roles at different points in the innovation process. First, we propose that codifying knowledge enhances its level of exploitation, with clan control serving as a moderator. Next, we propose that knowledge exploitation enhances endogenous innovation with behaviour and output controls serving as moderators. Our results from a sample of 607 Chinese manufacturing firms show that clan control moderated the knowledge codification–exploitation relationship positively. Behaviour control moderated the knowledge exploitation–innovation relationship positively, but output control had an inverse U-shaped moderating influence in this relationship. The results indicate that examining different types of organizational controls at different points in the knowledge management process provides a more comprehensive understanding for the role of controls in innovation.

KEYWORDS endogenous innovation, knowledge codification, knowledge exploitation, organizational control

INTRODUCTION

Extant research suggests that firms can innovate either through knowledge exploitation, which is designed to meet the needs of current markets by leveraging internally existing knowledge (Benner & Tushman, 2003), or through knowledge exploration, which is designed to meet the needs of new markets by pursuing new knowledge externally (Jansen, Van Den Bosch, & Volberda, 2006). The resources and risks involved in exploitative innovations, which use a firm's

existing knowledge to improve existing technologies, tend to be fewer compared with exploratory innovations, which require new knowledge (Abernathy & Clark, 1985). As Un (2007: 6) noted, following the work of March (1991), knowledge 'exploration and exploitation compete for scarce organizational resources . . . and the organizational routines needed for exploration are markedly different from those needed for exploitation'; thus, firms tend to focus on one of these domains.

Exploiting and integrating a firm's existing knowledge is easier, more efficient, and less likely to conflict with the firm's established innovation models (Kogut & Zander, 1992). According to the knowledge-based view of the firm, endogenous innovations that are generated from a firm's internal knowledge are expected to have greater value because they use unique, path-dependent knowledge that is difficult for competitors to imitate compared with those obtained from external sources (Barney, 1991; Kogut & Zander, 1992). But precisely how do firms generate endogenous innovations by exploiting their existing internal knowledge? There is no clear answer from the existing literature.

Additionally, how do internal organizational control mechanisms enhance the innovation process? Specifically, controls establish standards and directions to help a firm accomplish its planned objectives (Eisenhardt, 1985; Ouchi, 1979; Ouchi & Maguire, 1975). However, the relationship between controls and innovation is complex. Some studies show that organizational controls stifle creativity and cause employee dissatisfaction (Adler & Borys, 1996), whereas others suggest that regulating employees' behaviours reduces ambiguity and directs projects in the right direction to ensure that organizational objectives are achieved efficiently (Das & Teng, 2001; Jaworski, Stathapopoulos, & Krishnan, 1993). Therefore, we examine the role of three different types of controls, namely, clan (socialization), behaviour (process), and output (outcome) controls, at different points in the innovation process.

Unlike research that has been conducted in market economies in the West, our study in China presents an opportunity to test the generalizability of existing management theories to an emerging economy (Li & Peng, 2008; Peng & Heath, 1996). We expect that Chinese firms will focus on exploiting internal knowledge to achieve endogenous innovations for three reasons. First, according to China's Ninth Five-Year Plan of Economic Development in 1996,[1] endogenous innovation was identified as key to China's economic growth. Second, Chinese firms lack the needed resources to acquire or engage in expensive, highly uncertain, and time-consuming external knowledge exploration processes (Atuahene-Gima & Murray, 2007). Instead, they can improve innovation efficiencies and play catch up to their developed-country counterparts by exploiting internal knowledge to respond quickly to market changes even though they are latecomers in innovation activities (Li & Kozhikode, 2008). Finally, we chose China as the context for our study because it was formerly a planned economy, where organizational controls

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are commonly used in the workplace. In summary, a sample of Chinese firms provides a good fit for our research question.

By theorizing and testing how various organizational controls facilitate knowledge exploitation to achieve endogenous innovation, we aim to make three research contributions. First, we extend the existing literature on knowledge management in emerging economies by focusing on endogenous innovations. Second, we combine knowledge management with organizational control theory to explore how control mechanisms serve as moderators in the relationships between knowledge codification, exploitation, and endogenous innovation. The findings will improve upon Jansen et al.'s (2006) study because they found no significant relationships between organizational mechanisms and endogenous innovations. Finally, the results will provide empirical evidence on how firms in emerging economies faced with limited resources leverage their internal knowledge and implement readily available organizational control mechanisms to achieve their innovation objectives.

THEORETICAL BACKGROUND AND HYPOTHESES

Knowledge Codification, Knowledge Exploitation, and Endogenous Innovation

To realize endogenous innovations, firms must use their internal knowledge resources effectively. A firm's internal knowledge may be explicit or tacit (Polanyi, 1967). Explicit knowledge is codified and stored in databases for easy access, transmission, and use by organizational members (Hansen, Nohria, & Tierney, 1999; Scarbrough, 2003). Conversely, tacit knowledge is personal knowledge that is embedded in individuals (Ambrosini & Bowman, 2001). These unique experiences are unavailable to competitors and, thus, provide a firm with a source of potential opportunities for unique discoveries and creativity (Nonaka & Takeuchi, 1995). Codification is the process that transforms unique personal knowledge into a format that makes it possible for this private knowledge to be stored or transmitted to others (Saviotti, 1998).

However, empirical evidence has not shown a clear link between knowledge codification and endogenous innovation. Specifically, De Luca and Atuahene-Gima (2007) did not find that firms had significantly better product innovations when they integrated their tacit knowledge. Brusoni, Marsili, and Salter (2005), likewise, did not find that the use of codified knowledge enhanced innovation. The lack of a relationship between knowledge codification and innovation suggests that intervening processes may be at work. Yli-Renko, Autio, and Sapienza (2001) suggested that knowledge has to be exploited to be useful in innovations. Thus, we examine the extent to which knowledge exploitation is an intervening variable between knowledge codification and innovation, with organizational controls

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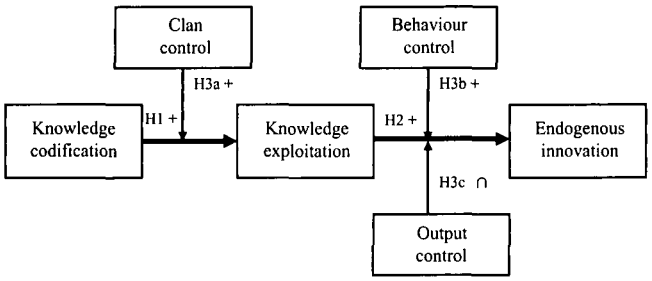
Figure 1. Conceptual model



pertaining to clan, behaviour, and output controls playing important moderator roles. Our research model is shown in Figure 1.

To establish the moderating hypotheses, which are the unique contributions of this study, as well as to provide empirical evidence for the relationships between knowledge codification, knowledge exploitation, and endogenous innovation, we first establish the baseline conditions from existing conceptual literature for our study, as summarized in Hypotheses 1 and 2. Specifically, to achieve successful knowledge exploitation, knowledge has to be codified or made explicit so that it can be transmitted to others for learning, absorption, or use (Saviotti, 1998). Tacit knowledge limits endogenous innovation because other organizational members may not be aware of its availability (Reed & DeFillippi, 1990). Thus, we expect the degree of codification to have a positive influence on endogenous innovation because it facilitates the transmission and exploitation of otherwise privately embedded know-how by other organizational members in new and creative ways (Zander & Kogut, 1995). Although the relationship between knowledge codification and exploitation has been assumed to exist, it has not been tested empirically (Schulz, 2001).

Hypothesis 1: Knowledge codification will relate positively to knowledge exploitation.

Further, in knowledge exploitation activities, a firm uses its existing internal knowledge to create value distinctive to the firm (Barney, 1991; March, 1991). Adenfelt and Lagerström (2006) found that firms that exploit their existing knowledge had better financial performance and competitive positions because of economies of scale in knowledge use and economies of scope in knowledge accumulation. Miller, Zhao, and Calantone (2006) also found improvements in organizational performance when employees accessed, exploited, and shared past learning and experiences, because the exchange and combination of underused, internal private knowledge across multiple functional areas enabled the firm to create new knowledge. Also, combining a firm's existing knowledge in new ways is less likely to conflict with its established models, reducing resistance to their application and

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adoption within the firm (Kogut & Zander, 1992). Hitt, Ahlstrom, Dacin, Levitas, and Svobodina (2004) argue that firms in transitional economies will cull their internal knowledge bases first to respond quickly to fleeting opportunities. As operational efficiencies arise from using internal knowledge, we expect a positive relationship between knowledge exploitation and endogenous innovation.

Hypothesis 2: Knowledge exploitation will relate positively to endogenous innovation.

Moderating Role of Clan, Behaviour, and Output Control

Studies that examine the use of organizational controls as means to facilitate innovations are few; and the results are mixed. Several studies indicate that establishing controls undermines innovation by reducing trust (Şengün & Wasti, 2007), slowing innovation (Lukas, Menon, & Bell, 2002), lowering employee morale (Adler & Borys, 1996), and hindering the degree of experimentation and flexibility needed (Bonner, Ruekert, & Walker, 2002). In contrast, others found that organizational controls have a positive effect on innovation by reducing ambiguity (Das & Teng, 2001; Jaworski et al., 1993) and facilitating knowledge flows (Schulz & Jobe, 2001). We aim to provide a more theoretical and comprehensive model to shed light on these contradicting results by examining the roles of different types of organizational controls, namely, clan, behaviour, and output controls (Eisenhardt, 1985; Ouchi, 1979; Ouchi & Maguire, 1975; Turner & Makhija, 2006) at different points in the innovation process. Briefly, clan controls are socialization mechanisms used to define appropriate employee attitudes based on organizational norms, shared values, and beliefs (Ouchi, 1979; Turner & Makhija, 2006). Behaviour controls are bureaucratic processes that impose specific procedures and methods to perform one's work responsibilities (Turner & Makhija, 2006). Output controls impose goals to be attained (Ouchi, 1979).

The mere availability of codified knowledge in the firm is insufficient for knowledge exploitation if organizational members do not completely understand its potential applications and uses (Szulanski, 1996). Here, clan control could be used. Clan control is different from societal controls or peer pressures that are external to and not necessarily sanctioned by the organization (Janowitz, 1975). Through clan control, the organization uses activities such as meetings, team-based activities, formal training, and indoctrination programs over time to make its internal knowledge regarding the organization's norms, values, and beliefs known and accessible to employees (Snell, 1992). Employees are socialized towards a shared understanding so that confusions over the meanings of the codified knowledge are minimized, and interpretations of the firm's knowledge are harmonized (Carlile & Rebentisch, 2003). With a common language, knowledge sharing and transfer among employees can be enhanced. Thus, we predict that clan control will facilitate knowledge exploitation by enabling a

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common understanding among individuals so that they can more effectively share, transfer, and use knowledge.

Hypothesis 3a: Clan control will positively moderate the relationship between knowledge codification and knowledge exploitation. The relationship will be stronger under a high level of clan control than under a low level of clan control.

When firms have difficulty determining specific innovation outcomes, having employees follow prescribed actions via behaviour or process control is preferred (Cardinal, 2001; Das & Teng, 2001). For example, risk-averse research and development (R&D) professionals may be encouraged to attempt what would otherwise be perceived as risky actions if such actions fall within the norm of acceptable behaviours (Eisenhardt, 1985). Also, when employees face inertia from a fear of failure, monitoring their behaviours may increase their work productivity from a 'Hawthorne effect' (Mayo, 1933: 55). Finally, those who lack abilities can improve their work performance by following established routines that have been proven to succeed (Ouchi & Maguire, 1975).

Given that employees in many emerging economies tend to have limited experiences innovating in cutting-edge technologies (Li & Atuahene-Gima, 2001), using standardized methods and procedures will improve their work efficiencies. Firms that emphasize close surveillance of employee behaviours through behaviour controls will enhance operational efficiencies in the innovation process by solving recurring problems quickly (Eisenhardt, 1985). As behaviour control ensures that employees adopt behaviours that have been proven to yield a positive return for their efforts (Cardinal, 2001), we expect that behaviour control will enhance a firm's innovation in its knowledge exploitation efforts.

Hypothesis 3b: Behaviour control will positively moderate the relationship between knowledge exploitation and endogenous innovation. The relationship will be stronger under a high level of behaviour control than under a low level of behaviour control.

In situations where the cause–effect relationships are weak, where there are no prescribed behaviours to follow, when individuals have no a priori knowledge, or when individuals cannot agree on specific procedures to execute an endeavour, giving R&D professionals explicit innovation targets or goals to reach via output control is preferred (Das & Teng, 2001; Snell, 1992). The use of output control provides participants with the flexibility and discretion to choose appropriate methods to pursue or adapt their behaviours accordingly to solve problems (Snell, 1992; Yu & Ming, 2008). As innovations are often unpredictable, idiosyncratic, and serendipitous, and the level of complexity and work interdependence in R&D activities are high, output control provides R&D professionals with autonomy but keeps them focused on attaining the desired goals (Cardinal, 2001; March, 1991).

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However, past research has not shown a consistent relationship between output control and innovation. Some evidence suggests a positive relationship between output control and performance, whereas others show negative or non-significant relationships (see Damanpour, 1991, for a review). We surmise that the moderating influence of output control on the relationship between knowledge exploitation and innovation may be curvilinear. This curvilinear moderating effect may be explained by drawing on goal-setting theory (Locke & Latham, 1990). Specifically, when goals are too easy or too hard, performance levels tend to be lower compared with moderately difficult but specific goals. Goals that are too easy create boredom; and employees do not strive to reach higher levels of performance once they reach their easy targets. However, goals that are too hard may exceed the individuals' abilities and create stress, causing them to focus their attention on the consequences of failure rather than to think creatively to achieve the hard goals. Singh (1998) found that stress had a curvilinear moderating influence on the relationship between job demands and performance levels, indicating that, as jobs become more difficult and complex, performance levels declined more steeply under conditions when individuals felt either low or high levels of stress.

Therefore, we predict that, if the level of output control is low, endogenous innovation will decrease more as employees have less motivation to exploit their knowledge because it is easy to reach low innovation targets. However, at high levels of output control, individuals tend to choose familiar projects to avoid the inherent uncertainties and risks in difficult, complex projects to ensure success (Sitkin & Pablo, 1992). Also, as the achievement of goals is often linked with incentives (Snell, 1992; Turner & Makhija, 2006), employees may inadvertently place greater emphasis on easier projects that they can confidently achieve in shorter time horizons to obtain these organizational rewards (Cardinal, 2001; Ouchi, 1979). Therefore, we predict that, when output controls are too low or too high, the effectiveness and efficiencies in the firm's knowledge exploitation efforts are lowered, leading to reduced innovations compared with situations where the output control is set at a moderate level.

Hypothesis 3c: Output control will moderate the relationship between knowledge exploitation and endogenous innovation in an inverse U-shaped relationship.

Behaviour and output controls are useful if a firm can specify procedures or has knowledge about the required outcomes, respectively (Das & Teng, 2001). As the process linking knowledge codification and knowledge exploitation is uncertain, and the outcome that knowledge will be exploited cannot be guaranteed, it stands to reason that behaviour and output controls would not be the most appropriate controls to use in the codification–exploitation link. Thus, we predict that only clan control would moderate the codification–exploitation linkage rather than behaviour and output controls as shown in the left side of Figure 1.

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Behaviour and output controls can only be implemented after organizational consensus to exploit knowledge has been established (Janowicz-Panjaitan & Noorderhaven, 2008). When behaviours or outcomes can be specified in the innovation process, extensive clan control is not an efficient use of organizational time and resources because of the lengthy socialization and communication processes involved (Das & Teng, 2001; Khazanchi, Lewis, & Boyer, 2007; Turner & Makhija, 2006). Thus, behaviour and output controls are more appropriate in enhancing the exploitation–innovation link after the decision to exploit knowledge is established.

METHOD

Sample and Data Collection

To test the hypotheses, we chose Chinese firms in our sampling frame for reasons mentioned earlier. A questionnaire survey was used to elicit responses from a sample of firms in the Shanghai, Shaanxi, Sichuan, Liaoning, Guangdong, Shandong, Henan, and Shanxi provinces of China. These locations were selected to represent the geographic, economic, and demographic diversities in China. We obtained a statistically random sample of 850 state-owned, collective-owned, limited, joint-venture, and private-owned manufacturing firms from the Economic Commerce Committee, an official government agency with administrative oversight of commercial enterprises in these regions.

We collected our data using face-to-face interviews to overcome the low participation rate typical of mail surveys in China. Personal trust between the interviewer and the interviewee is important to encourage candid responses. Our interview process enhanced personal trust in the following ways. First, our interviewers had an opportunity to show enthusiasm and interest during the interview, which enhanced the interviewees' feelings of significance and importance. Second, the interviewers had an opportunity to show empathy when the interviewees had questions, which enhanced the respondents' feelings of comfort and assurance. To reduce social desirability biases in the interview, we assured the respondents that there were no 'right' or 'wrong' answers to minimize any feelings of embarrassment they might feel regarding their responses. Also, the interviewers asked the questions according to the order in which the items were listed in the questionnaire to ensure neutrality by reducing any perceptions that some questions were more important than others. We also assured the interviewees that their responses were kept confidential and the names of their firms would not appear anywhere in our research paper to minimize any reason for or perceived benefit they might obtain from embellishing their answers.

We began the data collection in the summer of 2002 because the questionnaire assessed firms' practices from 1997 to 2001 when an increase in innovation

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activities occurred during China's Ninth Five-Year Plan. Among the 850 firms in our sampling frame, a total of 607 usable responses are used for data analyses. Our high response rate of 71.41 percent is particularly notable; and we attributed our success to advanced planning, a careful pilot study, and the effective execution of the field interviews. A profile of the respondents and responding firms can be found in Li, Guo, Liu, and Li (2008).

We checked for non-response bias by comparing the sales revenues between 171 non-responding and responding firms against those in the sample. Further, using χ^2 tests, we found no statistical differences in terms of firm size and ownership status between the non-responding and responding firms. We also verified the representativeness of the sample in terms of firm size and ownership status by comparing these data against the national population of firms from the *China Statistical Yearbook* (2002). The χ^2 tests on firm size and ownership status as well as the *t*-test result on sales showed no significant differences between the sample and the population of firms at $p > 0.10$.

Measurements

Special care was undertaken during the survey process to ensure reliability and validity in the following ways. First, the questionnaire items were drawn from existing scales when available or developed from the theoretical construct. For example, although there is currently no existing scale for knowledge exploitation, March (1991) defined it as refinement, implementation, and execution of a firm's existing technology, forms, routines, or practices. Based on this definition, we presented six survey items in terms of the application of the firm's: (i) processes; (ii) technologies; (iii) practices; (iv) human resources; (v) equipment; and (vi) know-how in R&D activities. Second, all 26 questionnaire items were translated into Chinese with the assistance of Chinese scholars in the knowledge management field, who resided in the USA. As these scholars were familiar with both languages and the theoretical constructs for these survey items, this ensured accuracy in the constructs and that meanings were not lost after the items were translated and back-translated. Third, after consulting extensively with several executives, we modified the instrument to best reflect the conditions that firms face in China. Fourth, we conducted a pilot test of the draft questionnaire with 15 firms from the Shaanxi, Henan, and Shandong provinces. From feedback obtained in the pilot study, the items were revised to make them more contextually valid (Tan, 1996). The responses from the 15 firms that participated in the pilot test were excluded from the final dataset. All the survey items were measured on seven-point Likert scales where '1' is 'strongly disagree' and '7' is 'strongly agree'.

Independent variables. Knowledge codification comprised three items adapted from Zander and Kogut (1995). We modified the wording of one item from 'using

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software to document a firm's manufacturing process' to 'documentation of a firm's work procedures, experiences, and regulations'. We measured *knowledge exploitation* with six items developed from March's (1991) theoretical construct mentioned earlier. *Clan control* comprised four items from Snell (1992), which focused on socialization, team building, training, and development-related activities. *Behaviour control* comprised four similar items from Cardinal (2001) and Snell (1992), which measured the degree to which standards and procedures were imposed top-down on subordinates' behaviours. *Output control* comprised five items adapted from Eisenhardt (1985), in which we modified the words 'rewards, compensation, and other financial outcomes' to 'salary increases, shareholders' equity, sales, financial targets, and firm growth' as goals that direct employees' efforts towards R&D achievements.

Dependent variable. We measured *endogenous innovation* with four items from Yli-Renko et al.'s (2001) measure of technological distinctiveness. We modified their wordings slightly from 'our competitive advantage is based on our technology' to emphasize the extent to which the firm's innovations were derived from internal resources.

Control variables. The effects from the following variables were controlled because of their potential impact on endogenous innovations in China. The data for these control variables were provided by the respondents in the questionnaire. First, *firm size* affects the availability of human resources for innovation and was coded as an ordinal scale in accordance to the classifications used by the National Bureau of Statistics of China, where 1 = less than 51 employees (very small firm), 2 = 51–200 employees (small firm), 3 = 201–500 employees (medium-sized firm), 4 = 501–1,000 employees (large firm), and 5 = more than 1,000 employees (very large firm). *Firm type* is associated with the relative levels of R&D intensity, innovation motives of the top management team, and the innovativeness of the firm (Hoskisson, Hitt, Johnson, & Grossman, 2002). It was coded on an ordinal scale in terms of its potential R&D activities, where 1 = state-owned enterprises, 2 = collective-owned enterprises, 3 = limited enterprises, 4 = joint ventures, and 5 = private-owned enterprises. Hansen (1992) found that a firm's age was inversely related to innovative output because older firms tend to have greater inertia towards making changes. Thus, the third control variable is *firm age*, which was measured as the number of years a firm has been in operation. The external environment also affects a firm's knowledge management and innovation activities. Thus, we controlled for four market variables using seven-point Likert scales, where '1' is 'strongly disagree' and '7' is 'strongly agree'. The first variable is *competitive intensity*, where the extent of external competition is expected to add pressure to a firm's need to achieve endogenous innovations. Next, the *industry's technological progress* affects the availability of technical knowledge for a firm's inno-

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vation efforts (Li & Atuahene-Gima, 2001; Tan, 1996). Also, *competitors' product quality* affects the firm's need to stay ahead of the technological curve through innovation (Gatignon & Xuereb, 1997). Finally, *new competitive orientation*, which is the new way of serving customers, provides firms with opportunities for innovation (Armstrong & Collopy, 1996; Gatignon & Xuereb, 1997).

Reliability and Construct Validity

We examined convergent validity (Fornell & Larcker, 1981) and discriminant validity (Bagozzi, 1980) of the six variables using confirmatory factor analysis. We performed a baseline model of six factors and a series of alternative models. The results indicate that the six-factor model had the best fit (goodness-of-fit index = 0.85, comparative fit index = 0.92, non-normed fit index = 0.90, root mean square error of approximation = 0.08, χ^2/degrees of freedom = 5.1), whereas other alternative models with fewer than six constructs had poorer fit compared with the six-factor model. The one-factor model had the worst fit to the data (goodness-of-fit index = 0.63, comparative fit index = 0.51, non-normed fit index = 0.46, root mean square error of approximation = 0.16, χ^2/degrees of freedom = 11.40), indicating that the threat to common method bias was minimal.

Although Nunnally (1978) recommended reliability coefficients of 0.70 or higher, he also stated that lower values were permissible ($\alpha > 0.60$) for newer scales. In this study, Cronbach's alphas range from 0.65 to 0.84. We also conducted a test–retest reliability check by comparing this dataset with data drawn from another survey we had conducted in Shaanxi, Henan, and Shanxi in the summer of 2001, where we had some similar questionnaire items. Among the 303 firms that participated in both survey studies, the correlation between the same measures over the two times were in the ranges of $r = 0.36$–0.79 ($p < 0.05$). Therefore, Cronbach's alphas and the test–retest reliabilities indicate that our measures are reliable.

A factor loading of 0.70 or greater indicates that about one-half of the item's variance (the squared loading) can be attributed to the construct, which is an indication of construct validity (Fornell & Larcker, 1981). As shown in Table 1, among the 26 item loadings, only four are below this threshold, but all are over 0.60, implying close relationships between the items and their respective constructs. In addition, an average variance extracted (AVE) of 0.50 or greater demonstrates that the construct as a whole shares more variance with its indicators compared with the error variance (Fornell & Larcker, 1981). As Table 1 demonstrates, all the AVEs surpassed the recommended 0.50 threshold for each construct.

In addition, we tested the construct validity for our dependent variable, *endogenous innovation*, by comparing it with R&D intensity (which is R&D expenditure/numbers of employees) and rates of new product sales (which is new product sales/total sales) in accordance with the two internal innovation measures from

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Table 1. Reliability and convergent validity

Variable	*Please indicate the extent to which:*	α	*CFA item loading*
Knowledge codification (AVE = 0.70)	1. Regulations and procedures can be specified for most work activities in the company.	0.77	0.88
	2. Work procedures can be established and documented in detail in the company.		0.85
	3. Successful work experiences can be extended and applied across different units quickly in the company.		0.76
Clan control (AVE = 0.50)	1. Managers facilitate employee learning by encouraging, directing, and training.	0.65	0.77
	2. Managers organize activities to motivate employees to understand and pursue company goals effectively.		0.73
	3. The company provides employees with more training and socialization compared with 5 years ago.		0.69
	4. The company provides team-building activities to develop cooperation among employees.		0.60
Knowledge exploitation (AVE = 0.56)	1. Extensive external advanced processes are applied in the firm's R&D activities.	0.84	0.81
	2. Extensive external advanced technologies are applied in the firm's R&D activities.		0.76
	3. Extensive internal management practices are applied in the firm's R&D activities.		0.76
	4. Extensive internal human resources are used in the firm's R&D activities.		0.74
	5. Extensive external advanced equipments are applied in the firm's R&D activities.		0.71
	6. Extensive know-how, patents, and new product designs are applied in the firm's R&D activities.		0.71
Behaviour control (AVE = 0.60)	1. The responsibilities of managers and employees are clearly defined.	0.78	0.81
	2. Formal procedures and methods for discussing problems and making decisions are established in the company.		0.80
	3. Managers are expected to supervise the operations and employees under their charge.		0.77
	4. Job descriptions for every category and type of employees are clearly documented.		0.72
Output control (AVE = 0.50)	1. High levels of sales are established for current markets.	0.73	0.78
	2. High levels of short-term firm growth are established.		0.76
	3. High levels of financial targets are established.		0.74
	4. Evaluation is strongly based on enhancing shareholders' equity.		0.64
	5. Employees' salary increases are based on high levels of short-term personal performance.		0.61
Endogenous innovation (AVE = 0.58)	1. The company always develops new products or services on its own.	0.79	0.79
	2. The company can innovate without cooperating with other firms.		0.74
	3. Company achievements are based on the capabilities of its own managers and R&D staff.		0.76
	4. The company applies and achieves many patents on its own.		0.75

Notes:

AVE, average variance extracted; CFA, confirmatory factor analysis; R&D, research and development.

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Hitt, Hoskisson, Johnson, and Moesel (1996). We obtained data for these two variables in a follow-up survey of 119 firms in our sample. The correlations between these two indicators and endogenous innovation were significantly positive [r (R&D intensity, endogenous innovation) = 0.32, $p < 0.01$; r (rates of new product sales, endogenous innovation) = 0.42, $p < 0.01$]. To check on the representativeness of the 119 firms, we conducted a t-test to compare the mean value for *endogenous innovation* for these 119 firms against those of the other 488 firms in our sample. The t-test results showed no statistically significant differences between these two groups at $t < 0.05$. Thus, we concluded that the data strongly supported the construct validity of *endogenous innovation*, indicating that the firm's innovations were derived from their internal efforts.

We further checked for discriminant validity by examining if the AVE for each construct (within-construct variance) is greater than the squared correlations between constructs (between-construct variance) (Fornell & Larcker, 1981). Specifically, discriminant validity exists if the items share more common variance with their respective construct than with the other constructs. An examination of the values in parentheses in Table 2, which are the square root of the AVE for each construct, reveals that they are significantly greater than the correlation coefficients, indicating that there is discriminant validity among the constructs. Overall, the preliminary data analyses suggest that the constructs exhibited acceptable psychometric properties.

RESULTS

Following Cohen and Cohen's (1983) recommendations, the variables were entered into the regression analyses in three steps: the control variables, followed by the predictors, and finally, the moderator variables. All the variables were mean-centred to minimize the threat of multicollinearity in equations that included the interaction terms. Moreover, the variance inflation factors of the variables in all the models were less than 2.0, which indicated no serious multicollinearity problems among the control and predictor variables.

As shown in Table 3, Model 1 provides the baseline results for the effects of the control variables on endogenous innovation. Model 2 shows that, when knowledge is codified, knowledge exploitation is enhanced ($\beta = 0.39$, $p < 0.001$), which supports Hypothesis 1. To show that only clan control moderates the relationship between knowledge codification and knowledge exploitation, we included behaviour control and output control as moderators as a robustness test in Model 3. The results show that only clan control significantly moderates the relationship between knowledge codification and knowledge exploitation ($\beta = 0.08$, $p < 0.01$). We plotted the moderating effect of clan control for low (−1 standard deviation from the mean) and high (+1 standard deviation from the mean) levels based on Cohen, Cohen, West, and Aiken's (2003) method. As shown in Figure 2, the steeper slope

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Table 2. Means, standard deviations, and correlations

Variable	*Mean*	*SD*	*1*	*2*	*3*	*4*	*5*	*6*	*7*	*8*	*9*	*10*	*11*	*12*	*13*
1. Firm size	3.34	1.46													
2. Competitive intensity	3.34	1.34	−0.06												
3. Technological progress	4.79	1.51	−0.08*	0.37**											
4. Competitors' product quality	3.96	1.39	−0.07	0.36**	0.35**										
5. New competitive orientation	4.16	1.25	0.07	0.08*	0.12**	0.11**									
6. Firm age	21.65	15.78	0.45**	−0.01	−0.03	0.01	0.09*								
7. Firm type	3.49	1.85	−0.30**	0.00	0.01	0.07	−0.04	−0.31**							
8. Knowledge codification	4.42	1.03	0.06	0.18**	0.28**	0.24**	0.26**	0.01	−0.06	(0.84)					
9. Clan control	4.95	0.92	0.01	0.18**	0.34**	0.20**	0.15**	−0.00	−0.02	0.58**	(0.71)				
10. Knowledge exploitation	3.78	1.11	0.11**	0.16**	0.20**	0.08*	0.03	0.03	0.08**	0.35**	0.39**	(0.75)			
11. Behaviour control	5.22	0.99	−0.02	0.10*	0.20**	0.16**	0.18**	0.02	−0.04	0.46**	0.65**	0.21**	(0.77)		
12. Output control	4.91	0.90	−0.03	0.19**	0.28**	0.23**	0.23**	−0.08	0.04	0.49**	0.49**	0.26**	0.41**	(0.71)	
13. Endogenous innovation	3.53	1.44	−0.03	0.17**	0.20**	0.11**	−0.08**	−0.08	0.08*	0.22**	0.27**	0.41**	0.13**	0.14**	(0.76)

Notes:

* $p < 0.05$ (two-tailed test); ** $p < 0.01$ (two-tailed test).

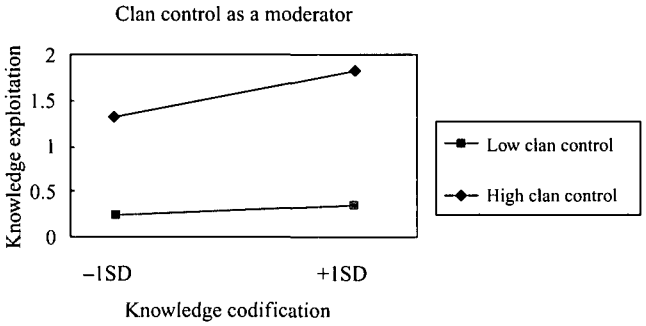
Values in parentheses are the square root of the average variance extracted for the construct in question.

Table 3. Regression analyses on knowledge exploitation and endogenous innovation

Variables	*Endogenous innovation*	*Knowledge exploitation*		*Endogenous innovation*	
	Model 1	*Model 2*	*Model 3*	*Model 4*	*Model 5*
	β	β	β	β	β
Controls					
Firm size	0.10*	0.19***	0.11***	0.13***	−0.04
Competitive intensity	0.11***	0.19***	0.16***	0.17**	0.13***
Technological progress	0.21***	0.16***	0.01***	0.09**	0.10***
Competitors' product quality	0.13***	−0.08**	−0.12***	−0.12***	−0.12**
New competitive orientation	−0.11**	−0.05	−0.05	−0.04	−0.10***
Firm age	−0.13***	−0.11**	0.01	−0.08**	−0.05
Firm type	0.05	0.08**	0.08**	0.10***	0.05
Predictors					
Knowledge Codification (KC)		0.39***	0.26***		
Knowledge Exploitation (KE)				0.42***	0.40***
Clan Control (CC)			0.35***		0.04
Behaviour Control (BC)			−0.14***		0.12***
Output Control (OC)			0.09***		0.11**
KC*CC			0.08**		
KC*BC			0.02		
KC*OC			0.03		
KE*CC					−0.06
KE*BC					0.12***
KE*OC					0.05
OC*OC					0.05
KE*OC*OC					−0.08*
F value	4.64***	8.42***	8.02***	8.90***	5.73***
R^2	0.14	0.29	0.36	0.28	0.31
Adjusted R^2	0.11	0.26	0.32	0.25	0.25

Notes:
$n = 607$.
* $p < 0.05$; ** $p < 0.01$; *** $p < 0.001$.

Figure 2. Moderating influence of clan control



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from high clan control indicates that clan control has a stronger positive influence on knowledge exploitation when knowledge codification is high. Thus, Hypothesis 3a is supported.

Model 4 of Table 3 shows that knowledge exploitation enhances endogenous innovation, giving support to Hypothesis 2 ($\beta = 0.42$, $p < 0.001$). To show that clan control does not moderate the relationship between knowledge exploitation and endogenous innovation, we included it in Model 5 as a robustness test. The results in Model 5 show that clan control is not a significant moderator in this relationship. Instead, the results show that behaviour control moderates the relationship between knowledge exploitation and endogenous innovation positively ($\beta = 0.12$, $p < 0.001$), which supports Hypothesis 3b. Correspondingly, Figure 3 shows that when behaviour control is high, the slope depicting the relationship between knowledge exploitation and endogenous innovation is steeper compared with the situation where behaviour control is low. However, output control moderates the relationship between knowledge exploitation and endogenous innovation in a negative curvilinear relationship, suggesting an inverse U-shaped relationship ($\beta = -0.08$, $p < 0.05$), which supports Hypothesis 3c. Figure 4 shows that, in the

Figure 3. Moderating influence of behaviour control

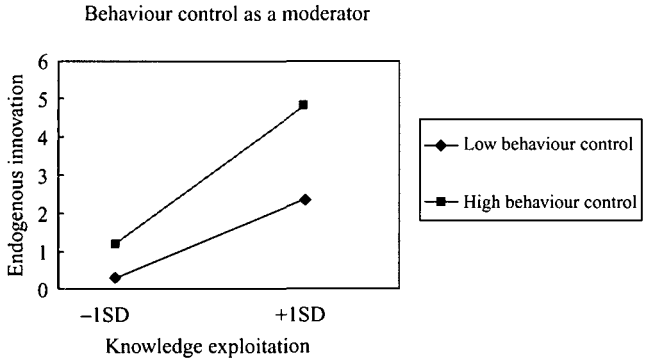
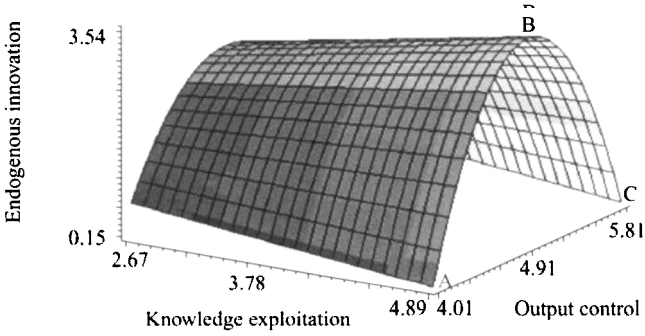


Figure 4. Moderating influence of output control



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relationship between knowledge exploitation and endogenous innovation, endogenous innovation is highest when output control is at moderate levels. For example, at point A where output control is low (output control = 4.01), the correlation coefficient for knowledge exploitation and endogenous innovation is 0.58, whereas at point B where output control is at a moderate level (output control = 4.91), the correlation coefficient is 0.82. However, at point C where the output control is high (output control = 5.81), the correlation coefficient for knowledge exploitation and endogenous innovation falls to 0.69.

DISCUSSION

This study provides strong support for the conceptual model in Figure 1. Specifically, the results indicate that codification of knowledge enhances the exploitation of knowledge, and this relationship is moderated positively by clan control. The results also show that the degree of knowledge exploitation is positively related to endogenous innovation. In turn, this relationship is moderated positively by behaviour control and moderated by output control in an inverse curvilinear relationship.

This study makes two major contributions to the literature. First, a major aim of this study was to combine knowledge management with organizational control theories to explore how control mechanisms can be implemented in the knowledge codification and knowledge exploitation processes to enhance endogenous innovations. The results show that clan control significantly moderates the relationship between knowledge codification and knowledge exploitation but plays no role in the knowledge exploitation and endogenous innovation process. This finding indicates that socialization processes that facilitate employees' understanding of the firm's codified knowledge enhance knowledge exploitation. However, as the process linking knowledge codification and knowledge exploitation is uncertain and the outcome that knowledge will be exploited cannot be guaranteed, it stands to reason that behaviour and output controls would not be the most appropriate controls to be used in the codification–exploitation link. Instead, behaviour control has a positive moderating influence on the relationship between knowledge exploitation and endogenous innovation, indicating that formalization of work procedures and routines that have worked well in the past enhances the knowledge exploitation and endogenous innovation relationship. The inverse U-shaped moderating influence of output control on the knowledge exploitation and endogenous innovation relationship suggests that moderate levels of output control provide the most challenging targets to motivate employees towards exploiting knowledge for the greatest level of endogenous innovation. Thus, behaviour and output controls are more appropriate in enhancing the exploitation–innovation link after the decision to exploit knowledge is established. These findings show that organizational controls, involving clan, behaviour, and output control, play different moderating roles in the knowledge codification, knowledge exploitation, and

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endogenous innovation relationships. By understanding the situations under which different organizational controls enhance the innovation process, our study provides a process view to knowledge management and is an improvement over current studies that have failed to demarcate fine-grained relationships among different types of organizational controls (e.g., Jansen et al., 2006).

Another contribution of this study relates to the positive effects from knowledge codification and knowledge exploitation on endogenous innovation in emerging economies. The results provide empirical evidence on how firms in emerging economies, faced with highly uncertain competitive markets and limited resources, can leverage their internal knowledge and implement readily available organizational control mechanisms to achieve innovation objectives. Thus, our findings empirically support the claims by Dröge, Claycomb, and Germain (2003) and Grant (1996) that the competitive advantage of firms depends not only on knowledge creation, but also, more importantly, on knowledge exploitation processes.

Limitations and Future Research

This study has several limitations, which also suggest directions for further research. First, we tested two different regression models pertaining to the knowledge management processes as two separate outcomes but did not test knowledge exploitation as a mediator between knowledge codification and endogenous innovation because of our focus on the moderators in our model. This mediating relationship should be examined in future research. Second, this study examined the codified dimension of knowledge but not specific knowledge types. Future research may explore specific kinds of knowledge for innovation, such as technological knowledge and market knowledge (Wiklund & Shepherd, 2003).

Third, the results of this study are clearly context-dependent. Although this is not inherently a weakness, it may limit the generalizability of the results. A natural extension of our study would be to compare the roles of knowledge codification, knowledge exploitation, endogenous innovation, and organizational controls within market economies, such as the USA, and between emerging economies and market economies. Also, we suggest that subsequent research should focus on firms in the same industry as the nature of knowledge is likely to differ considerably across industrial contexts, making comparisons difficult. It would be fruitful to observe if the relationships between knowledge and organizational controls will hold up in contrasting settings and to identify ways in which they might differ in different types of industries.

A fourth limitation is the cross-sectional nature of the data, which does not allow for definitive statements to be made about causality. Although we tried to minimize this limitation by requesting that firms supply data on their internal mechanisms during the five-year period before 2002, future research requires a longitudinal study involving panel data. Finally, we used one informant for each company,

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which may compromise the reliability of the responses even though we tried to ensure reliability with additional objective data and with test–retesting of a subsample. Future research should use multiple informants.

Managerial Implications

The model presented here provides important managerial implications in two areas. First, the results suggest that managers in China (and possibly other transitional or emerging economies) should leverage on processes related to internal knowledge exploitation to play catch up to their developed-country counterparts in innovation activities. When firms simply rely on their developed-country counterparts for advanced technologies, they often fail to create a distinct competitive advantage because of their inability to internalize the external knowledge for exploitation (Li & Kozhikode, 2008). More importantly, managers should attempt to codify tacit knowledge that is embedded in experienced employees so that such valuable knowledge can be maximally leveraged through knowledge exploitation activities.

The results also suggest that resource-poor firms should use less expensive and easier-to-implement organizational mechanisms, such as organizational controls, to leverage their internal knowledge to achieve endogenous innovation. It is important to consider the characteristics of each type of control and its impact in the knowledge management process as each type of control influences different points of the knowledge management processes.

CONCLUSION

This study fills a theoretical gap by linking knowledge management with organizational control theory and provides empirical results for these relationships. The results provide strong support for our research model. We offer evidence that different types of organizational controls play different roles at different points in the innovation process. By conducting a finer-grained examination of the different roles of controls, our results clarify why past studies may have had contradictory results because they failed to explore the application of different controls at different points in the innovation process. Hence, we extend the theoretical development and application of organizational control theory in the knowledge management process to suggest ways in which firms can reap positive returns on their innovation efforts.

NOTES

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[1] China's Ninth Five-Year Plan of Economic Development is available from the following URLs: http://www.gov.cn/english/2006-04/05/content_245690.htm and http://www.china.org.cn/95e/95-english3/3.htm

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