MANAGING EMPLOYEES AND KNOWLEDGE FOR INNOVATION: THE LONGITUDINAL ANALYSIS OF INTERMEDIATE LINKAGES

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ABSTRACT

In this paper, I examine how managing employees and their knowledge is related to firms' innovation with enriching the literature of strategic human resource management. Since special knowledge for innovation resides in employees, it is important to hire, retain and nurture them through proper HR management. Analysis of three wave time-lagged data from 359 show that knowledge-based employment is related with knowledge sharing, and hence promotes firms to explore innovative solution. In addition, the influence of knowledge-based employment on knowledge sharing and innovation are contingent on knowledge loss.

Keywords: Knowledge-based employment; Exploratory innovation; Knowledge sharing; Strategic HR management; Turnover.

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Human resource (HR) management influence on firms' innovation through hiring, retaining and nurturing employees who possess knowledge needed for innovation (Grant, 1996). Various employment modes are introduced, for example, job-based employment, contractual work arrangements, knowledge-based employment, or partnership (Lepak & Snell, 2002). Among them, knowledge-based employment is related to exploratory innovation, since firms committed to employees' knowledge are likely to focus on internal development of new knowledge rather than the execution of programmed tasks and job routines (Lepak & Snell, 1999, 2002).

One stream of research has stressed that knowledge enables firms to innovate (e.g., Nonaka & Takeuchi, 1995; Grant, 1996). On the other hand, other studies highlighted that HR management practices such as commitment-based HR management (Ceylan, 2013; Collins & Smith, 2006), high involvement practices (Arthur, 1992), or high performance work practices (Huselid, 1995) promote innovation. However, integrated studies were rare, even though the most important knowledge for innovation resides in employees. Extending on these literatures, I argue HR management hiring and nurturing employees and their knowledge facilitate firms to explore innovation.

I establish the arguments based on the knowledge-based view of firms which concerns knowledge as a valuable resource of the firm (Nonaka & Takeuchi, 1995; Kogut and Zander 1992, Grant 1996). The knowledge embedded in human capital enables firms to enhance distinctive

competencies and discover innovation opportunities (Grant, 1996; Wright, Dunford, & Snell, 2001). Since employees represent the knowledge pool of a firm, HR management employing and retaining them affect firms' innovation.

In this paper, I first conceptually analyze exploratory innovation. Next, I theoretically connect knowledge-based employment, knowledge sharing and knowledge loss with firm innovation. Finally, I test the arguments using longitudinal dataset from year 359 firms. Figure 1 contains the theoretical model.

Insert Figure 1 about here

THEORY AND HYPOTHESES

Internal firm resources are base of firm's growth (Penrose, 1959) and competitive advantage (Barney, 1981). Specifically, the studies focusing on knowledge resource underscore that knowledge is the key for firms' growth (Kogut and Zander 1992) and the important knowledge is created by employees (Grant 1996). Since firms attempt to search the landscape for high value solutions by combining knowledge resources (Macher & Boerner, 2012), the firms' innovation depends on knowledge and management of employees who possess the knowledge.

In particular, innovation requires knowledge management practices to encourage employees to create and share their special knowledge (Grant, 1996; Nickerson & Zenger, 2004; Macher, 2006). Innovation is ill-structured problem, since it has limited information on how the exiting

knowledge integrated (Macher & Boerner, 2012). While the problem-solving processes of well-structured problems such as daily operation have already been formalized (Nickerson & Zenger, 2004), ill-structured problems such as innovation have more ambiguous problem-solving approaches through diverse knowledge.

Knowledge, employees who possess the knowledge, and HR management the employees interactively influence on firms' innovation. The knowledge, which resides in employees, enables firm to enhance distinctive competencies and discover innovation opportunities (Grant, 1996; Wright et al., 2001). Since people possess knowledge that provide economic value to firms, the firms need to invest to increase employee knowledge (Youndt, Snell & Lepak, 1996). Knowledge-based employment hires knowledge workers and promote them to constantly to develop and create knowledge.

Firms have to implement proper HR management to motivate employees to commit to their employer and to retain the knowledge within firm. In addition, since the knowledge is inherently mobile (Liebeskind, 1996), tacit and ambiguous over the ownership, it is difficult for firm to manage knowledge. In specific, for firms to explore new knowledge, firms have to share employees' knowledge and prevent knowledge losses through employees' turnover. When firms commit to the value of special knowledge of employees, they will have more incentives to innovate (Liebeskind, 1996).

Knowledge-Based Employment and Exploratory Innovation

I determine innovation as a dimension of exploratory learning: pursuing new domain or

exploratory organizational learning (Miles, Snow, Meyer, and Coleman, 1978; March, 1991, Danneels, 2002). March (1991: 1) articulated “exploration includes search, variation, risk taking, experimentation, play, flexibility, discovery and innovation”. Exploration means the introduction of novel ideas and technology with taking risk rather than exploiting the existing knowledge and domain (Daft, 1982). In particular, I focused on two focal characteristics of exploration: R&D investment and innovative resource orientation. R&D investment itself is risk taking practice because of invisible output in the future and also the organizational efforts for searching new discovery. Since exploratory innovation needs diverse ideas and new knowledge, it is prerequisite that employees who have skills and knowledge are recruited and retained (Macduffie, 1995; Song, Almeida, & Wu, 2003).

Knowledge-based employment indicates organizational goal to hire and nurture employees based on their knowledge (Lepak & Snell, 2002). Knowledge-based employment provides internal career development, extensive training and long-term growth opportunities (Delery & Doty, 1996; Lepak & Snell, 1999). In particular, knowledge-based employment mode was argued to fit with commitment-based HR management (Lepak & Snell, 2002) which promote innovation (Collins & Smith, 2006). The exposure to diverse training programs of knowledge-based employment could foster employees to learn new knowledge, broaden their insight, and equip them with innovative minds and skills (Nonaka & Takeuchi, 1995; Weisberg, 2006). In addition, the organizations commit to employees’ knowledge promote employee’s orientation to innovative performance (Toh, Morgeson & Campion, 2008).

Hypothesis 1. Knowledge-based employment is positively related to exploratory innovation.

Mediating Effects of Knowledge Sharing

Knowledge sharing at work is the exchange of explicit or tacit knowledge, ideas, experiences, skills, or technology among employees (Cabrera & Cabrera, 2002; Wang, Ahmed, & Rafiq, 2008). Knowledge sharing promote shared understanding, internal cooperation, and interdependence among employees through interactions between employees and employer. Through knowledge sharing mechanism, employees receive timely information in organization and interpret the meaning of information. In specific, while face-to-face meetings or bulletin board are common methods of traditional knowledge sharing, IT technology such as intranet, e-mail, and online communities have created additional channels (Godara, Isenhour & Kavanaugh, 2009).

To implement innovation in a dynamic and uncertain economy, organizations should more depend on ideas and knowledge from employees (Morrison, 2011). Knowledge has been found as "one of the principle inputs into the innovation process" (Miller, Fern, & Cardinal, 2007: 309). Knowledge sharing promotes internal integration of innovation capability through knowledge spillover within the organization. For example, communal knowledge management such as intranet may function as linking individuals and organizational units, and enabling collaboration on new projects (Donnellon, 1996).

Knowledge sharing is the fundamental process to intensify the organizational influence of individual knowledge. Knowledge sharing will make employees are less likely to be afraid of

speaking up their ideas to top managers. Decision makers need employees to express voice and speak up with suggestions for improvement (Grant & Ashford, 2008; Parker, Bindl, & Strauss, 2010). Meanwhile, employees are afraid of speaking up because they fear the undesirable responses from their leaders. Thus, knowledge sharing allow the employees' ideas be heard by the decision makers (Lee, Olson, & Trimi, 2012), and hence explore innovation overcoming status quo.

Hypothesis 2. Knowledge sharing is positively related to exploratory innovation.

Knowledge-based employment promotes knowledge sharing and collaboration among employee through team based appraisals and job security. Knowledge-based employment signals the employee role behaviors expected by the organization. Knowledge-based employment induces employee effort and commitment to the organization (Arthur, 1992). Employee's commitment to the organization is an important part of a knowledge sharing culture (Smith & McKeen, 2002). Through long term investments in employees, knowledge-based employment is a concrete signal that firms commit to their employees and hence promotes knowledge sharing. Knowledge sharing and knowledge creation with taking risk are facilitated by knowledge-based employment, and hence allow firm to allocate more resource on exploring the ill-structured problem, which will lead to exploratory innovation. In sum, when the knowledge-based employment is to induce employees' commitment, they are more likely to share knowledge (Dewitte & de Cremer, 2001). Therefore, I contend that the mediating role of knowledge sharing on the relationship between them.

Hypothesis 3. Knowledge sharing mediate the relationship between knowledge-based

employment and exploratory innovation.

Contingent Effects of Knowledge Loss

Employees are the key source of firm competitive advantage (Barney & Wright, 1998). If employees leave their employer, they take away their special tacit knowledge they have cumulated and learned. The loss of knowledge is a potential threat to the firms' competitiveness, especially if the employee with special knowledge departures to competitive firms. Stovel and Bontis (2002) empirically found that that voluntary turnover significantly impacts the firms' knowledge loss.

In addition, the loss of employees, especially when accompanied by the loss of other key network members, can severely damage an organization's social fabric and perhaps eradicate its social capital altogether (Leana & Van Buren, 1999). More specifically, knowledge loss resulted from turnover makes the disengaged relationship with his/her colleagues within the organization. This significantly affects the flow of knowledge inside the organization. Furthermore, even knowledge sharing may be weakened when knowledge loss provides a comprehensive picture of employer's low commitment.

Even though knowledge-based employment assures long-term employment, knowledge loss can make employees to doubt about regarding employer's policy and their safety, and hence prevent knowledge sharing in the organization with undermining the positive influence of knowledge-based employment. The positive relationship between the commitment-based HR practices, fitted with knowledge based employment (Lepak & Snell, 2002), and employee turnover was empirically found. In addition, the company based on a short-term outlook increases turnover

rate (Ceylan, 2013; Collins & Smith, 2006). Urbancová and Linhartová (2011) also found that employee turnover as knowledge loss interacts with the uncertainty in knowledge sharing.

Hypothesis 4a. The positive relationship between knowledge-based employment and knowledge sharing are contingent on knowledge loss: the positive influences are stronger (weaker) when knowledge loss is lower (higher).

Extending on the contingent effects discussed above, I predict moderated mediation model: knowledge-based employment decreasingly increases knowledge sharing when knowledge loss is high. The influences of knowledge-based employment on knowledge sharing subsequently affect exploratory innovation with weaken the influences when knowledge loss is high. The relationship between knowledge-based employment and exploratory innovation mediated by knowledge sharing and moderated by knowledge loss. Knowledge-based employment has a decreasingly positive indirect effect on exploratory innovation for high knowledge loss.

Hypothesis 4b. The indirect effects of knowledge-based employment on exploratory innovation through knowledge sharing are contingent on knowledge loss: the positive indirect influences are stronger (weaker) when knowledge loss is lower (higher).

METHODS

Data and Sample

To test these hypotheses, I analyzed a multi-wave, multi-source quantitative data from Workplace Panel Survey conducted by the Korea Labor Institute (KLI), a government-funded policy research body. The survey which are conducted in separate years cover the years 2007,

2009 and 2011. The survey data were collected through face-to-face interviews with multiple organizational members such as top managements, HR and industrial relations managers, employee representative for labor relations. Specific questionnaires were designed for each type of interviewees such that HR managers responded to questions about HR programs and policies, and employee representatives for labor union policies. KLI used a variety of methods including web-based surveys, paper-and-pencil questionnaires, and computer-assisted personal interviews. The response rate was approximately 50 percent.

I selected consecutively surveyed samples that cover from year 2007 to year 2011 (i.e., 75% retention rate). In particular, to avoid covariance obtained from the same-time responses and to gain a higher level of confidence on the causal relationships, I used 2011(Time 3) observations for dependent variables, 2009 (Time 2) for mediator, and 2007 (Time 1) for all other variables. I dropped observations from firms with less than 100 employees because firms of this size can be assumed to have systematic HR programs (Datta, Guthrie, & Wright, 2005). After deleting observations with missing data, final sample consists of 359 firm-level observations, with 175 firms in manufacturing sector, 105 in service sector, and others.

Measures

Exploratory innovation. Exploratory innovation was measured in year 2011 using a question describing different strategic orientation through organizational learning (March, 1991). In particular, the question includes the constant level of R&D investment and internal innovation capability (March, 1991; He & Wong, 2004). Firms choosing the answers with smaller numbers

are more likely to pursue exploratory innovation based on innovation and R&D investment. Since I reverse coded the answers, higher numbers indicate higher adopting exploratory innovation. Respondents of this question indicated their positions as top managers.

Knowledge-based employment. Employment policy was measured by four items with 5-point scale (e.g., 1 = HRM focuses on the short-term performance of workers; 5 = the long-term growth of workers) in year 2007. HR managers rated the how closely they adopted the commitment-based policies which includes job design, recruitment and selection, training and development and performance appraisal (Ceylan, 2013; Lepak & Snell, 2002). Using exploratory factor analysis (EFA), I validated with one factor of knowledge-based employment scale (displayed in Table 1). The factor indicates the organization's high commitment to stable employment, employee's long-term growth rather than maximizing the short-term performance of workers. High score of the index means a high use of knowledge-based employment (Ceylan, 2013; Collins & Smith, 2006). Internal scale reliability (Cronbach's alpha) is extremely strong (.91). In addition, I found the strong consistency of knowledge-based employment at time 1 and that of time 2 ($r = 8.90$, $p < .00$), which indicates that knowledge-based employment is embedded as organizational routine. To assess the discriminate validity of the measures, a confirmatory factor analysis (CFA) was performed using Lisrel version 8.7. Model fit was assessed using the Comparative Fit Index (CFI, Bentler, 1990), the Root Mean Square Error of Approximation (RMSEA), and the Standardized Root Mean Residual (SRMR, Hu & Bentler, 1999). The items loaded significantly on their intended latent variables and the overall fit of the model was

acceptable (X2(2) = 6.70; CFI = 0.97, RMSEA = 0.08, SRMR = 0.03).

Insert Table 1 about here

Knowledge loss. To measure the construct of knowledge loss, I used turnover rate as a proxy. Using financial information, I measured turnover rate as the number of employees who had voluntarily left divided in 2007 by total number of employees in that year. Previous studies found strong relationship between turnover rate and knowledge lost (Stovel, & Bontis, 2002). High score of the index means a high loss of internal knowledge.

Knowledge sharing. HR managers choose all items for information and knowledge sharing by using nine items (0 = yes, 1 = no, reverse coded) at T1. Sample items include "Email is regularly sent for information-sharing purposes", "Information is disclosed through the intranet which is accessible by all employees. Although dichotomous items can be factor-analyzed using standard techniques, the result may be biased (Frank & Keith, 1995). Adequate analytic solutions to these problems of bias can be dealt with parceling, a simple sum of several items assessing the same construct (Kishon & Widman 1994). I adopted parceling method to measure knowledge sharing. Aggregation was well supported by the strong internal scale reliability (.91). To further verify the measurement, I compared the index with a factor derived from EFA and got the same regression result predicting dependent variable of exploratory innovation. High score indicates high adoption of Knowledge sharing.

Control variables. Based on previous theoretical and empirical studies, I controlled a few variables in analyses. First, I controlled exploratory innovation because the innovation tends to be stable over time, $r = .20$, $p < .05$ (Nelson & Winter, 1982). Second, I controlled firm size because size impacts both HR practices and innovation (Mohr, 1969; Youndt, Snell, Dean, & Lepak, 1996). Firm size was measured as the natural logarithmic transformation of the total number of full time equivalent employees (Collins & Clark, 2003). Third, I controlled firm age for similar reasons (Sorensen & Stuart, 2000). I calculated firm age from the KLI data as the difference between year 2007 and each firm's founding year. Fourth, I controlled firm profitability because firms with a high performance are more likely to invest in innovation (Justin, 2005). I used the financial indicator of return on equity (ROE). The financial information was archived by the Korean Investors Service, government-funded organization that supplied key ID to be able to merge with KLI dataset. Fifth, I controlled firm R&D intensity because it indicates firms' investments in knowledge creation (Griliches, 1990) and contribute to its ability to absorb external knowledge (Cohen & Levinthal, 1990). The variable was calculated by R&D cost divided by total sales. Last, I controlled industry classification because the level of innovation and working practices could be different among industries (Chow, 2012). Industry classification includes manufacturing, construction, retail, transportation, finance, and business services (Kim & Kang, 2013). Industry dummy variables were created to control for inter-industry differences. All control variables are measured at Time 1.

RESULTS

Table 2 reports descriptive statistics and a bivariate correlation matrix. In general, the results show the positive correlation between exploratory innovation and knowledge-based employment, and Knowledge sharing. To test causal predictions, all hypotheses were tested using time lagged longitudinal data. I used OLS regression and reconfirmed argument by testing the potential reverse causality relationships in supplement section.

Insert Table 2 about here

Direct Effects of Knowledge-Based Employment on Exploratory Innovation

Hypothesis 1 proposes that the higher a firm adopt knowledge-based employment, the more the firm is likely to use exploratory innovation. As shown in model 2 of Table 3, this hypothesis was supported ($\beta = .12$, $p < .01$). The results strongly support the key argument that knowledge-based employment positively influence on exploratory innovation in the future.

Insert Table 3 about here

Indirect Effects through Knowledge sharing

Hypothesis 2 predicts the positive influence of knowledge sharing on exploratory innovation. The results of model 3 in table 3 significantly support this hypothesis ($\beta = .06$, $p < .05$). I found that the better a firm support knowledge-sharing within organization, the firm's innovation will be more explorative.

Hypothesis 3 predicts that the indirect influence of knowledge-based employment on exploratory innovation through knowledge sharing. To test the hypotheses, I used Preacher and Hayes' (2008) bootstrapping procedure to test for the significant indirect effect. The bootstrapping procedure was chosen to test for the significance of mediation and moderated mediation model in lieu of the Baron and Kenny (1986) procedure or the Sobel (1982). Five thousand bootstrap resamples were performed. The results of analysis revealed evidence of a significant indirect effect of knowledge-based employment on firms' choice of exploratory innovation via knowledge sharing (β = .02, SE = .01, 95% CI [.00, .05]). In addition, the results in Table 3 and 4 confirm the mediation effects based on the procedure by Barron and Kenny (1986).

Contingent Effects of Knowledge Loss

I predict knowledge loss as boundary condition that weakens the influence of knowledge-based employment on knowledge sharing and exploratory innovation. Specifically, Hypothesis 4a proposes that moderating effects of knowledge loss on the relationship between knowledge-based employment and knowledge sharing. Following Aiken and West (1991), knowledge loss, knowledge-based employment and exploratory innovation were standardized, and the interaction terms were calculated on the basis of these standardized scores. This Hypothesis was supported (β = -.26, $p < .05$), as shown in the model 4 of Table 4.

Insert Table 4 about here

Simple slope analysis was conducted to illustrate the nature of the interaction (Aiken & West, 1991). Figure 2 shows the knowledge sharing levels at different combinations of the two variables. The results further support prediction that knowledge-based employment cannot facilitate knowledge sharing enough when knowledge loss is high in the organization because the negative impact of knowledge loss will dominantly change the interactive effects to become negative.

Insert Figure 2 about here

Hypothesis 4b predicts that indirect effect of knowledge-based employment on exploratory innovation is contingent on knowledge loss (i.e., moderated mediation effects). To test the hypotheses, I used Preacher and Hayes' (2008) bootstrapping procedure and corresponding SPSS macro. The results revealed evidence of a significant moderated mediation effect of knowledge loss on the indirect linkage between Employment policy and exploratory innovation via knowledge sharing (β = -.09, SE = .05, 95% CI [-.24, -.01]). Thus hypothesis 4b was supported with suggesting the indirect influence of knowledge-based employment on exploratory innovation become low when knowledge loss is high.

Supplement Analysis

I conducted several robustness checks to test the possible reverse causality issue using OLS regression (supplement analysis results on request). First, I tested the routine characteristics of knowledge-based employment, knowledge sharing, and knowledge loss to confirm the assumption that these HR related constructs are embedded as organizational routine. The regression results confirmed the all three constructs at time 3 are tightly related to those of at time 1 respectively. Second, I tested whether exploration strategies can predict the knowledge-based employment. The regression results disproved that innovation cannot influence of the routinized employment policy: exploratory innovation at Time 1 was not related to knowledge-based employment at Time 3 (β = .07, p = .44), knowledge loss at Time 3 (β = -.01, p = .38), and knowledge sharing at Time 2 (β = .18, p = .17). These results confirm the model does not have the reverse causality.

DISCUSSION

Theoretical Implications

I contribute to the strategic HR management literature in three aspects. First, I empirically found that the mechanism to link employment mode with firm innovation. In this paper, I highlight mediating roles of knowledge sharing between knowledge-based employment and innovation. Second, I studied the boundary conditions of knowledge loss. The results suggest it is prerequisite to reduce employee turnover through commitment policy if firms plan to sustain their innovation through HR system. Third, I tested a rich and complex strategic HR model in a longitudinal dataset. To my best knowledge, very few longitudinal studies have addressed the

causal relationship between employment mode and innovation. The previous studies limit the confidence level of causal relationship between HR management and innovation due to the nature of using cross sectional data.

Practical Implications

Results from this study have two practical implications. First, knowledge-based employment is valuable for firm innovation. By using the knowledge-based employment, firms can inform employees that their knowledge is well appreciated. Therefore, employment policy and knowledge sharing have to be considered as antecedents of exploratory innovation. Second, firms need to establish their HR managers as a strategic partner of top leaders. The role of HR has long been neglected and many organizational decisions have given low priority on HR management (Lawler et al., 1992).

Limitation and Future Research

There are several limitations to this study that should be noted. First, the possibility of common method bias exists. Overall model fit of four constructs was not tested, although I checked the respective reliability test for each constructs. However, this possibility was minimized by various factors in the research design, including the use of longitudinal data, whereby knowledge-based employment was measured in 2007 and exploratory innovation in 2011. In addition, I controlled several variables of firm size, firm age, firm profitability, and firm R&D intensity which are based on objective financial information.

Second, the influence of HR management on organizational routine will be studied in the

future. Although firms could hope to initiate the new innovation, the dramatic change is difficult because the employment policy and HR practices are long been embedded as an organizational routine (Cyert & March, 1963; Nelson &Winter, 1982).

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TABLE 1
Exploratory Factory Analysis Results

	Survey Items	1
Knowledge-based employment	HR management focuses on the long-term growth and development of workers.	0.67
	Through long-term employment, we nurture qualified persons from among our own employees.	0.64
	The primary goal of HR management is to maximize employer loyalty and devotion to the firm.	0.45
	We utilize regular workers as much as possible.	0.32

TABLE 2
Descriptive Statistics and Correlations[a]

	Variables	**Mean**	**s.d.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**
1.	Exploratory innovation, time 1	3.38	0.88								
2.	Firm size, time 1	6.03	0.96	0.17*							
3.	Firm age, time 1	25.97	16.79	0.05	0.31*						
4.	Firm profitability, time 1	7.56	87.52	0.03	0.15*	-0.02					
5.	Firm R&D intensity, time 1	0.02	0.17	0.06	-0.03	-0.04	-0.01				
6.	Knowledge-based employment, time 1	7.89	1.23	0.11*	0.03	-0.01	0.00	0.04			
7.	Knowledge loss, time 1	0.13	0.15	-0.06	-0.15*	-0.20*	-0.03	0.04	-0.07		
8.	Knowledge sharing, time 2	4.03	2.31	0.19*	0.28*	0.03	0.02	0.00	0.19*	-0.13*	
9.	Exploratory innovation, time 3	3.18	1.04	0.23*	0.05	-0.01	-0.01	0.00	0.15*	0.07	0.15*

[a] n = 359 firms;
*p< .05.

TABLE 3
Effects of Knowledge-Based Employment on Exploratory Innovation [a]

Variables	Exploratory innovation: Time 3			
	Model 1	Model 2	Model 3	Model 4
Industry fixed effect [b]	Yes	Yes	Yes	Yes
Exploratory innovation, time 1	0.17**	0.15*	0.15*	0.13*
	(0.06)	(0.06)	(0.06)	(0.06)
Firm size, time 1	0.03	0.03	-0.00	-0.00
	(0.06)	(0.06)	(0.06)	(0.06)
Firm age, time 1	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Firm profitability, time 1	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Firm R&D intensity, time 1	-0.12	-0.15	-0.12	-0.14
	(0.30)	(0.29)	(0.30)	(0.29)
Knowledge-based employment, time 1		0.12**		0.10*
		(0.04)		(0.04)
Knowledge sharing, time 2			0.06*	0.05+
			(0.02)	(0.02)
R^2	0.13	0.15	0.15	0.16

[a] n = 359; standard errors are noted in parentheses;
[b] Industry dummy variables of six industry classification were included;
** p<0.01, * p<0.05, + p<0.1.

TABLE 4
Effects of Knowledge-Based Employment on Knowledge Sharing[a]

Variables	Knowledge Sharing System, Time 2			
	Model 1	Model 2	Model 3	Model 4
Industry fixed effect [b]	Yes	Yes	Yes	Yes
Exploratory innovation, time 1	0.37**	0.30*	0.34*	0.31*
	(0.14)	(0.14)	(0.14)	(0.14)
Firm size, time 1	0.59**	0.58**	0.57**	0.55**
	(0.13)	(0.13)	(0.13)	(0.13)
Firm age, time 1	-0.00	-0.00	-0.01	-0.01
	(0.01)	(0.01)	(0.01)	(0.01)
Firm profitability, time 1	-0.00	-0.00	-0.00	-0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Firm R&D intensity, time 1	0.06	-0.02	0.09	0.05
	(0.65)	(0.64)	(0.65)	(0.64)
Knowledge-based employment, time 1		0.41**		0.41**
		(0.11)		(0.11)
Knowledge loss, time 1			-0.26*	-0.25*
			(0.12)	(0.12)
Knowledge-based employment, time 1 x Knowledge loss, time 1				-0.26*
				(0.11)
R^2	0.16	0.19	0.17	0.21

[a] n = 359; standard errors are noted in parentheses;
[b] Industry dummy variables of six industry classification were included;
** p<0.01, * p<0.05, + p<0.1.

FIGURE 1
Theoretical Model: Knowledge-Based Employment, Knowledge sharing, and Exploratory Innovation

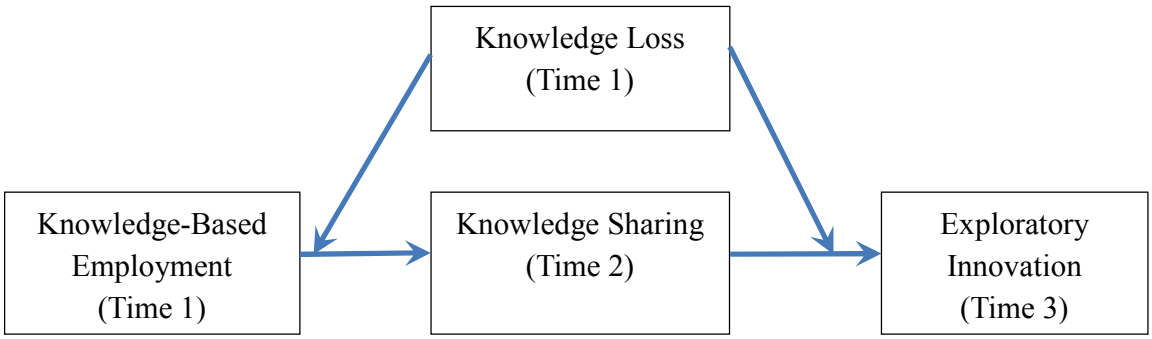

FIGURE 2
Moderating Effect of Knowledge Loss