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Building knowledge stock and facilitating knowledge flow through human resource management practices toward firm innovation

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The present study theoretically identifies the meaningful human resource management (HRM) practices that explain the emergence of two distinct dimensions of firm-level knowledge management, namely, firm knowledge stock and flow, which are critical drivers of firm innovation. We also propose that these knowledge dimensions interact synergistically and that their effects on firm innovation are accentuated in firms with strong innovation strategy. The proposed theoretical framework was tested using multisource, large-scale data collected from 203 manufacturing companies at three time points over a 5-year period. Analysis confirmed that stock-building and flow-facilitating HRM practices increase firm-level knowledge stock and flow, respectively. Firm knowledge flow (but not knowledge stock) exhibited a significant positive main effect on firm innovation. Firm knowledge stock was not related significantly to firm innovation, but it became a significant predictor of firm innovation when existing along a high level of firm knowledge flow, as well as in firms adopting innovation strategies. The present study provides significant insights for researchers and practitioners by offering comprehensive understanding of the nomological network of firm-level knowledge management enhanced by effective HRM practices.

KEYWORDS

HR and technology, innovation, knowledge management, strategic HR

"*Knowledge management* has become ubiquitous in organizational research and has served as a foundation for both theoretical and empirical advances in major management fields" (Minbaeva, Foss, & Snell, 2009, p. 477). Scholars taking the knowledge-based view (KBV) particularly emphasize the implications of knowledge on innovation, which enables firms to adapt flexibly to changing environmental demands by developing or frequently adopting new products, services, programs, or innovative ideas (Donate & Guadamillas, 2011; Mabey & Zhao, 2017; Özbağ, Esen, & Esen, 2013). This emphasis can be attributed to knowledge resources and effective knowledge utilization being fundamental sources of higher-order forms of thinking and creative solutions (C. J. Chen & Huang, 2009; Jiménez-Jiménez & Sanz-Valle, 2011; Mabey & Zhao, 2017). Drawing on the KBV of innovation (Grant, 1996; Lopez-Cabrales, Perez-Luno, & Cabrera, 2009), the present study extends the literature by specifying critical human resource management (HRM) practices that promote firm-level knowledge management, which in turn enhances firm innovation.

Various attempts have been made to understand the intersection and cross fertilization between HRM practices and knowledge management (Chang, Gong, Way, & Jia, 2013; Chen & Huang, 2009; Swart & Kinnie, 2013). This is not surprising, considering the prevailing emphasis on the role of *people* as core carrier and processor of knowledge (Felin & Hesterly, 2007; Mahoney & Kor, 2015; Wright, Dunford, & Snell, 2001). Nonetheless, due to the lack of consensus on the conceptualization and operationalization of the HRM practices as well as on knowledge management constructs, previous studies suffer from a fragmented and limited understanding of how HRM practices explain the emergence and development of firm-level knowledge-related processes.

The present study responds to the call for theoretically identifying HRM practices pertinent to knowledge management at the firm level (Mabey & Zhao, 2017). Such efforts should be driven by a systematic theory of knowledge management that informs core dimensions of knowledge management that need to be shaped by appropriate

bundles of HRM practices. To this end, we draw on the content and process, interactive perspectives of knowledge management to specify the core dimensions that need to be considered for a systematic identification of knowledge-related HRM practices (Gardner, Gino, & Staats, 2012). The content perspective focuses on the quantity and quality of *knowledge stock* or repositories in the overall pool of information, skills, and abilities of organizational members (Griffith & Sawyer, 2010). The process perspective focuses on *knowledge flow* or redeployment process that enables the transfer, application, and utilization of knowledge among members (Al-Tit, 2016; Basadur & Gelade, 2006; Mahoney & Kor, 2015). Thus, previous studies differentiate knowledge stock and flow and demonstrate their distinct functions toward team and organizational performance (Chang et al., 2013; Gardner et al., 2012; Mabey & Zhao, 2017). On the basis of this distinction, we propose two main bundles of HRM practices to promote firm knowledge management and ultimately firm innovation: (a) stock-building practices and (b) flow-facilitating practices. Stock-building practices (e.g., training, on the job [OJT], and external education) enable firms to develop and expand the pool of knowledge resource of their employees, which enlarges firm knowledge stock. In contrast, flow-facilitating practices (e.g., group-based incentive system and intranet knowledge sharing system) promote the efficient exchange, activation, and exploitation of information and knowledge, which encourages firm knowledge flow.

These two distinct bundles of HRM practices may affect firm innovation indirectly by shaping the stock and flow of firm-level knowledge. In predicting firm innovation, we further propose a synergistic interaction between knowledge stock and flow. Knowledge stock is the repository of resources required to generate innovation. However, merely possessing knowledge resource per se may "remain undiscovered, underleveraged, and trapped in the minds of individuals" (Minbaeva, 2013, p. 383); thus it may not be translated automatically into innovation unless it is applied and utilized effectively across members (Sung & Choi, 2012). Therefore, a critical step in advancing the literature is understanding the manner by which the knowledge stock and knowledge flow interact and complement each other and how the copresence of these two reinforces their positive effects on firm innovation beyond their independent main effects.

In addition to the interactive dynamics involving knowledge stock and flow, we also identify innovation strategy of the firm as a critical organizational contingency that strengthens the firm-level connection between knowledge management and innovation (Terziovski, 2010). The elaboration of the boundary condition is important because any organizational phenomenon is constrained or strengthened by their embedding context (Johns, 2006). HRM scholars suggest that combinations of HRM practices maximize organizational performance when the HRM system is designed appropriately in accordance with the organizational strategy (Delery & Doty, 1996; Zhang & Li, 2009). Firms with a strategy that actively encourages innovative approaches in response to task and environmental demands can amplify the innovation potential of firm knowledge stock and flow shaped by HRM practices.

In summary, the present study advances the HRM literature by developing a systematic framework that identifies two core bundles of HRM practices, which promote knowledge stock and flow, and ultimately firm innovation. Scholars pointed out that knowledge itself is not a main barrier for the successful implementation of knowledge management; the main problem occurs in knowledge transfer, especially when employees are not willing to share their information and knowledge with others (Cabrera & Cabrera, 2005). In explaining firm innovation, we elaborate further on the potential synergetic interactions between knowledge stock and flow as well as their further interactions with the firm's innovation strategy. These considerations are of significant practical importance in that these mechanisms reveal how firms can exploit knowledge that might otherwise remain untapped, thus benefiting the organization.

Apart from these theoretical and practical insights, the present study makes considerable empirical contributions through its rigorous research design and analysis. Our theoretical model was validated empirically using three-wave time-lagged data collected from 2,407 managers and 3,946 employees of 203 Korean firms that span over 5 years. This longitudinal research design addresses common methodological limitations, such as "postpredictive" (i.e., predicting past performance) or "retrospective" (i.e., asking respondents to recall HR practices that existed prior to the performance period) that cause severe causality issues in existing studies on HRM (Wright, Gardner, Moynihan, & Allen, 2005).

1 | THEORETICAL FRAMEWORK AND HYPOTHESES

Increasingly uncertain and competitive business environments have bestowed firm innovation a definite status related to value creation and sustainable competitive advantage (N. Anderson, Potočnik, & Zhou, 2014). KBV identified the knowledge embodied in organizational members as the main and inimitable resource responsible for innovation differences across firms (Donate & Guadamillas, 2011; Grant, 1996; Mabey & Zhao, 2017; Mahoney & Kor, 2015; Özbağ et al., 2013). HRM practices comprise the deliberate architecture of a firm used to channel the processes of knowledge acquisition and utilization (Kang, Morris, & Snell, 2007; Swart & Kinnie, 2013; Wright et al., 2001). With increasing appreciation for the inextricable connection between people and knowledge management in predicting innovation, studies linking HRM practices to innovation based on KBV have also increased. Nevertheless, the lack of consensus on the conceptualization and operationalization of HRM practices related to knowledge management toward firm innovation results in fragmented and limited understanding of the given phenomenon.

We draw on previous studies of knowledge and innovation at the individual, team, and organizational levels to develop a conceptual framework of HRM practices for knowledge management in the context of innovation. Research on individual creativity has emphasized domain-specific knowledge and creative processes for recombining knowledge toward creative solutions (Amabile, 1996). At the team level, studies on knowledge management (Gino, Todorova, Miron-Spektor, & Argote, 2009; Sung & Choi, 2012; Tallman & Chacar, 2011) identified two distinct dimensions of knowledge management, namely, knowledge stock and knowledge flow, to explain team performance and creativity. Similarly, organizational learning literature differentiated

between *learning stocks* possessed by individuals, groups, and organizations, from *learning flows* that involve feedforward (bottom-up) and feedback (top-down) sharing of those stocks (Bontis, Crossan, & Hulland, 2002).

These conceptual and empirical developments at multiple levels inform a systematic identification of bundles of HRM practices for knowledge management. Based on the distinction between the stock and flow of knowledge, we specify two bundles of HRM practices, each targeted at building knowledge stock and facilitating knowledge flow, that will ultimately generate firm innovation (see Figure 1). In an effort to integrate strategic HRM discipline and knowledge management, HRM researchers have appreciated the theoretical distinction between knowledge stock or intellectual capital embedded in people and knowledge flow, which enables knowledge transfer and application (Lepak & Snell, 2002; Wright et al., 2001). For example, Lopez-Cabrales et al. (2009) identified knowledge-based practices (e.g., job training) and collaborative practices (e.g., team-based task arrangement) that predict the value and uniqueness of employee knowledge. Recently, Chang et al. (2013) differentiated between practices for gaining resource flexibility (e.g., skill training and job rotation) and those for achieving coordination flexibility (e.g., suggestion system and team-based pay). Drawing on these studies, we propose specific practices included in the two HRM bundles for knowledge stock and flow.

1.1 | HRM practices and knowledge management

Given that people and their interactions form the foundation of knowledge-related processes in organizations, knowledge management can be shaped by the "people management practices" of an organization (Özbağ et al., 2013; Swart & Kinnie, 2013; Wright et al., 2001). Scholars have established knowledge stock and flow as the "linchpin" between people management practices and core competence of firms, such as innovation capability (Mäkela & Brewster, 2009; Tallman & Chacar, 2011). Responding to the call for research on HRM practices that shape knowledge stock and flow (Mabey & Zhao, 2017; Minbaeva et al., 2009) and addressing the need for a systematic approach to HRM practices related to knowledge management, the present study advances two distinct dimensions of HRM practices, namely, *stock-building practices* and *flow-facilitating practices*.

1.1.1 | Stock-building HRM practices

One of the foundational roles of HRM is to improve the skills and abilities of employees (Boxall, 1998; Swart & Kinnie, 2013; Tallman & Chacar, 2011), which expands and strengthens the unique knowledge repository of a firm (Griffith & Sawyer, 2010). Drawing on prior studies, we isolate HRM practices particularly relevant to knowledge-specific, resource-generating functions, which should affect the development of cognitive resources directly and enrich firm knowledge stock. These stock-building practices include corporate training, external education, OJT, and task rotation (Cabrera & Cabrera, 2005; Chang et al., 2013; Lepak & Snell, 2002; Zhang & Li, 2009). For example, firms can expose their employees to new information and skills that can expand their cognitive assets by providing in-house corporate training (Donate & Guadamillas, 2011; Pastor, Santana, & Sierra, 2010). Moreover, firms can diversify and broaden their knowledge reservoir by supporting external educational and degree programs (Sung & Choi, 2014). OJT effectively equips employees with task-specific knowledge catered to immediate task goals (Hatch & Dyer, 2004). Regular task rotations also encourage employees to assume

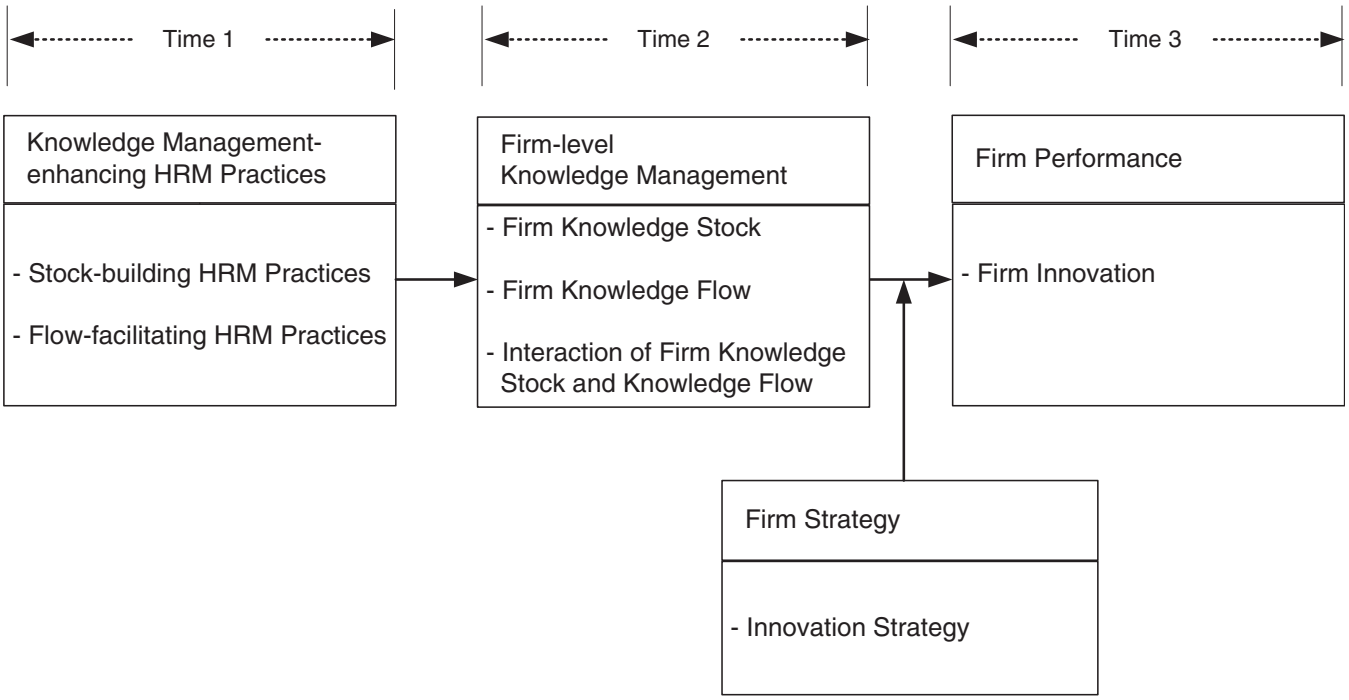

FIGURE 1 Theoretical framework predicting firm innovation

different roles and tasks, which diversify their knowledge base, thereby resulting in multiskilling (Beugelsdijk, 2008; Mäkela & Brewster, 2009). These stock-building practices help expand the knowledge reservoir collectively, which in turn increases firm knowledge stock.

Hypothesis 1: *Stock-building HRM practices are positively related to firm knowledge stock.*

1.1.2 | Flow-facilitating HRM practices

Another critical bundle of HRM practices is geared toward the promotion of knowledge flow through which knowledge distributed across individuals and work units exchanged, activated, and utilized effectively (Basadur & Gelade, 2006; Boxall, 1998; Chang et al., 2013). In activating and utilizing knowledge possessed by a firm, employees' willingness to solve collective problems and the sense of "we-ness" are crucial (Beugelsdijk, 2008). Social dilemma theory attends to the motivational dilemma or the mixed motivation situation involving knowledge sharing and provides an influential explanation regarding the challenges of knowledge exchange (Wang & Noe, 2010). Individuals contribute to public goods when they attribute great value to collective goals because such contribution incurs personal costs (Cabrera & Cabrera, 2005). Therefore, employees are likely to engage in knowledge sharing and utilization when rewards are contingent on collective performance instead of or in addition to individual performance. In this regard, group- and firm-based reward systems (i.e., incentives contingent on team and firm performance) are important in promoting horizontal and vertical flows of knowledge by aligning the personal or work unit interests with collective or organizational goals (Lopez-Cabrales et al., 2009).

In addition, considering that knowledge exchange and application occur in the context of social interactions (Kang et al., 2007; Mabey, Wong, & Hsieh, 2015; Pastor et al., 2010; Wei, Zheng, & Zhang, 2011), HRM practices involving social and technological infrastructure (i.e., suggestion system, quality circle, and intranet system for knowledge sharing) activate the flow of knowledge in organizations. Suggestion systems and quality circles cater to knowledge exchanges by encouraging and legitimizing inputs from employees and increasing the frequency and opportunity for institutional interactions that generate social ties or channels for contributing knowledge (Donate & Guadamillas, 2011; Griffith & Sawyer, 2010). An intranet facilitates the contribution, retrieval, and usage of knowledge among employees and reduces communication barriers (Mäkela & Brewster, 2009). These practices enhance the social expectation and legitimacy of knowledge flow and offer venues for employees to contribute to the knowledge pool. Flow-facilitating HRM practices may contribute to firm knowledge flow by increasing motivation toward knowledge exchange behavior and providing social and technical infrastructure for effective interactions among employees.

Hypothesis 2: *Flow-facilitating HRM practices are positively related to firm knowledge flow.*

1.2 | Firm-level knowledge management and firm innovation

1.2.1 | Firm knowledge stock

Innovative solutions are driven by new combinations of existing ideas and knowledge (Felin & Hesterly, 2007; Jiménez-Jiménez & Sanz-Valle, 2011; Özbağ et al., 2013). The presence of a greater knowledge stock is conducive to firm innovation because employees gain access to more and diverse experiences, skills, and information reservoir. These factors increase the likelihood of identifying creative breakthroughs by promoting opportunities to recombine and reconfigure existing knowledge (Griffith & Sawyer, 2010; Mahoney & Kor, 2015; Sung & Choi, 2012; Swart & Kinnie, 2013). Moreover, firms with a large reservoir of cognitive resources can recognize the value of new ideas and opportunities accurately and absorb the necessary information from external sources given that the absorptive capacity of a firm relies heavily on its possession of relevant prior knowledge (Tallman & Chacar, 2011; Zahra & George, 2002). Therefore, substantial knowledge repositories can be a conducive condition for firms to appreciate and respond properly to external challenges. Such a process enables them to introduce new and differentiated products or services (Damanpour, Walker, & Avellaneda, 2009; Donate & Guadamillas, 2011; Mabey & Zhao, 2017). Thus, we advance the following hypothesis.

Hypothesis 3: *Firm knowledge stock is positively related to firm innovation.*

1.2.2 | Firm knowledge flow

Activating the exchange and utilization of collective knowledge asset is another critical element of knowledge management. Innovation is driven by the effective exchange, redeployment, and application of existing knowledge and resources (Özbağ et al., 2013; C. L. Wang, Rodan, Fruin, & Xu, 2014). Knowledge flow reflects "the process by which knowledge held by an individual is converted into a form that can be understood, absorbed, and used by other individuals" (Ipe, 2003, p. 341). Knowledge flow activates the elaboration and refinement of knowledge among individuals and stimulates in-depth application to current problems (Mabey et al., 2015; Wei et al., 2011), which may result in product or service innovations. Therefore, unconstrained horizontal and vertical knowledge flows refine collective thinking and spur the application and utilization of knowledge, thereby enhancing the ability of a firm to develop innovative responses to environmental challenges.

Hypothesis 4: *Firm knowledge flow is positively related to firm innovation.*

1.2.3 | Synergistic interaction between knowledge stock and flow

Extending the previous investigations of the main effects of knowledge stock and flow on firm performance in separate studies (Beugelsdijk, 2008; Liao, Rice, & Martin, 2011; Shipton, West, Dawson, Birdi, & Patterson, 2006), we examine the effects of the two

components simultaneously and focus on their interaction. The availability of information and knowledge does not translate automatically to innovation unless employees share and utilize those cognitive resources effectively (Basadur & Gelade, 2006). Likewise, knowledge stock serves as a platform for innovation (Damanpour et al., 2009). However, unconstrained flows of knowledge across individuals and teams are essential for its value to be appropriated (Kang et al., 2007). Bontis et al. (2002) demonstrated that the alignment between learning stocks and flows is critical for business performance because the lack of an adequate flow causes accumulated learning stocks to create bottlenecks that impede rather than promote performance. Similarly, increased knowledge stock may not lead to firm innovation (if not hinder it) unless this knowledge is redistributed proficiently and flows across individuals and work units (Mabey & Zhao, 2017; Sung & Choi, 2012). Therefore, the two dimensions of firm-level knowledge management complement each other, and their copresence can strengthen (i.e., synergistic interaction) or is even required for (i.e., strong complementarity) their positive effects on firm innovation (Johns, 2006).

> **Hypothesis 5:** *The relationship between firm knowledge stock and firm innovation is moderated by firm knowledge flow in such a way that the relationship is more positive when firm knowledge flow is high than when it is low.*

1.3 | Innovation strategy as a moderator

In addition to the potential interaction between knowledge stock and flow, we identify further a boundary condition of the knowledge-innovation relationship at the firm level to offer a more contextualized explanation of the phenomenon in question (Johns, 2006). HRM scholars underscore the importance of the fit between managerial systems and organizational strategy (Delery & Doty, 1996; Zhang & Li, 2009). This underscoring is because a firm's overall strategic position provides legitimacy and momentum to a series of managerial decisions and employee actions in support of the strategy. Strategy researchers also highlight that managerial actions and internal processes are affected considerably by the overall strategic direction of a firm (Terziovski, 2010). In the present study, we isolate firm innovation strategy as a core contingency that strengthens the effects of firm knowledge management on firm innovation.

Strategy literature often compares innovation strategy (also referred to as differentiation strategy) with cost leadership strategy. While the latter focuses on the provision of products and services at the most competitive prices, the former emphasizes the creation of customer value by offering novel and differentiated products (Santos-Vijande, López-Sánchez, & Trespalacios, 2012). Firms with innovation strategy require a significantly broader range of knowledge and skills to produce innovative ideas and are more likely to benefit from the expanded knowledge asset compared with those pursuing cost leadership strategies. Moreover, these firms encourage knowledge diffusion and transfer processes that help them generate innovation and differentiation in their products and services (Argote, McEvily, & Reagans, 2003). Thus, the roles of knowledge stock and flow toward innovation are likely to be more pronounced in firms with a strong innovation orientation, which shapes an organizational context that urges the exploitation of knowledge resources and utilization for developing innovation.

> **Hypothesis 6:** *The relationship between firm-level knowledge management (stock and flow) and firm innovation is moderated by innovation strategy in such a way that the relationship is more positive when innovation strategy is high than when it is low.*

2 | METHOD

2.1 | The dataset

Investigating the current research framework that proposes the effects of the two different dimensions of HRM practices on firm innovation through firm-level knowledge stock and flow imposes various empirical challenges. Specifically, it requires a decent firm-level sample with time-lagged, multisource data to avoid methodological confounding and enable causal explanations of the unfolding firm-level processes. To address these challenges, we employed the Human Capital Corporate Panel (HCCP) data archived by Korea Research Institute for Vocational Education and Training (KRIVET) in support of the Ministry of Labor of the Korean government. To provide primary statistics and information that support national policies on HR development, a stratified random sample was drawn from companies listed in the database of the Korea Investors Service. Specifically, KRIVET created a $3 \times 4 \times 2$ matrix based on the industry (i.e., manufacturing, banking, and service), four categories of firm size (i.e., 100–299, 300–999, and 1,000–2,999 and more than 3,000 employees), and two ownership types (i.e., publicly vs. privately owned). The initial sample of 1,851 organizations was classified into each cell depending on the above-mentioned organizational characteristics. Approximately 25% of the companies were selected randomly from each cell of the matrix to avoid the potential problems of over- or under-sampling of specific cells.

Before the corporate survey, considerable efforts were exerted to ensure content validity by establishing relevance with existing HRM practices and eliminating wording problems (such as biased, ambiguous, inappropriate, or double-barreled items). Most scales employed in HCCP were adopted from discussions with academics and directors of the companies and from in-depth case studies during the 1-year pretesting phase of questionnaire development. Before the first wave of data collection, the research instrument of HCCP was pretested in three companies, and the scale items were modified further to increase their clarity. In this pretest phase, the most appropriate and qualified key respondents for different items were also confirmed.

2.2 | Analysis sample for the present study

In the present study, we used firm-level data collected at the following three time points: 2007 ($T1$, N = 467), 2009 ($T2$, N = 473), and 2011 ($T3$, N = 500). In the HCCP dataset, different scales were used across

manufacturing, banking, and service industry companies in assessing their knowledge stock and innovation. Thus, analyzing the companies in different industrial categories together was not possible. Given that HRM practices have strong implications for functional operations and performance particularly for manufacturing companies (Combs, Liu, Hall, & Kitchen, 2006) and manufacturing companies comprise more than half of the current sample, we focused on the manufacturing industry and excluded companies in the banking and service industries. Consequently, the sample size was reduced to 314, 336, and 369 companies at *T*1, *T*2, and *T*3, respectively. Among this initial sample, 203 companies participated in all three waves of data collection and provided usable data for the present analysis. These companies constitute 10 manufacturing industries, such as food, fiber, chemical products, plastic, metal, machinery, computer, electronics, electric appliance, and automobile. This study used the complete survey data from these firms and identified matching firm-level archival data, such as patent registration.

The three-wave research design corresponded with the causal flow of the present conceptual framework: (a) Two dimensions of knowledge management–enhancing HRM practices were reported by HRM directors at *T*1. (b) Firm-level knowledge stock and flow were rated by HRM directors, production managers, and employees at *T*2. (c) Firm innovation was reported by department managers and indicated by patent registration data, as archived by the Korean Intellectual Property Office (KIPO) at *T*3. The 2-year time-lagged design is consistent with existing innovation literature, which usually puts a 1- to 2-year temporal gap between predictors and firm innovation because organizational innovation process unfolds over a long period, and it takes a minimum of 1 year before positive organizational practices or employee behaviors lead to organizational innovation (Ahuja, 2000; Hagedoorn & Cloodt, 2003).

Different groups of organizational members participated in corporate surveys during the three waves of data collection. The HRM and the strategy directors of the 203 companies completed the survey for *T*1 data. The *T*2 sample was composed of 1,082 production managers and 3,946 employees, which included managers, engineers, office workers, and factory workers. Thus, the *T*2 sample included an average of 30.79 members (*SD* = 11.16) from each company. Males constituted 85.1% of the sample. The mean age was 43.6 years (*SD* = 8.20), and average organizational tenure was 16.1 years (*SD* = 7.85). For the *T*3 data, 919 department managers participated in the survey, including on average 4.53 (*SD* = 2.39) managers per company. Males constituted 97.4% of the *T*3 sample. The average age was 46.6 years (*SD* = 5.66), and the average tenure was 18.1 years (*SD* = 7.07).

2.3 | Measures

All study variables were assessed using multi-item measures with a 5-point Likert-type scale ranging from 1 (*strongly disagree*) to 5 (*strongly agree*). Individual responses were aggregated to the organization level for analysis. All aggregated scales exhibited acceptable within-organization agreement ($r_{wg(j)}$) and intraclass correlations (ICC [1] and ICC[2]), which suggests that employees and managers of the same organization held shared perceptions of the present constructs (Chen, Mathieu, & Bliese, 2004).

2.3.1 | Knowledge management-enhancing HRM practices (HRM director, *T*1)

The development of the measures of knowledge management-enhancing HRM practices is generally lacking because the integrative work between HRM practices and knowledge management is in its initial stage. Given the lack of existing measures, we reviewed extant studies on HRM practices thoroughly to identify the pool of HRM practices relevant conceptually to the domain of knowledge management (Beugelsdijk, 2008; Chang et al., 2013; Chen & Huang, 2009; Liao et al., 2011; Lopez-Cabrales et al., 2009; Shipton et al., 2006). Our review identified 18 potential items, such as internal training, external training/tuition assistance, OJT, flexible work hours, job security, participation in decision-making/empowerment, performance appraisal, pay/incentive for performance, group/organization-based reward/pay, employee suggestion system, job design, quality circles, information technology/intranet knowledge sharing system, quality circles, performance assessment-based on collaboration, selection/recruitment, task rotation, and cross-functional teams. Among the 18 items, 5 items (job security, job design, performance assessment based on collaboration, selection/recruitment, and cross-functional teams) were excluded because they were not available or measured inadequately for the current purpose in the HCCP data (e.g., selection/recruitment: HRM directors of each company marked the three most important practices that their companies administer for hiring). The remaining 13 items were subjected to an assessment of content validity.

We employed the Q-sort procedure, which is used widely in various behavioral fields of science by offering a powerful quantitative tool for examining opinions and assessments (Brown, 1986). To this end, 10 experts, including 5 professors and 5 doctoral students of strategic management and HR disciplines, participated in Q-sort using those 13 items. Based on the descriptions of the stock-building and flow-facilitating practices, these experts were asked to classify the 13 items into two practices or the category of "NA" (not applicable). Among the 13 items, only 8 achieved unanimity from all members of the expert group (4 items each for stock-building and flow-facilitating HRM practices).

Stock-building HRM practices were assessed by examining both formal and informal approaches. The formal approach in building knowledge stock is measured by assessing corporate resource investment, which is devoted mostly to the collective formal training for employee skills development (Lopez-Cabrales et al., 2009; Sung & Choi, 2014). Each HRM director reported the total expenditure on employee training based on the company's financial record. The total amount of training-related expenses was divided by the size of the firm to obtain per capita spending on training and development. The informal aspect of stock-building practices was assessed using the following three items rated by HRM directors (α = .85). "Our company actively utilizes the following practices: (a) tuition assistance for external education (e.g., private education programs, colleges, and graduate schools), (b) OJT, and (c) task rotation" (1 = *not at all*, 5 = *a great deal*; Beugelsdijk, 2008; Chang et al., 2013; Liao et al., 2011). The HRM directors' ratings of the three items were averaged to create an index of informal practices of stock building. The overall score for stock-

building practices was computed by averaging the formal and informal aspects of stock-building practices. Considering the different metrics of these indicators, we transformed them into z-scores prior to averaging them.

Flow-facilitating HRM practices were indicated by motivation- and system-related practices drawn from previous studies (Cabrera & Cabrera, 2005; Chang et al., 2013; Donate & Guadamillas, 2011; Lepak & Snell, 2002). For motivation-related practices, we used the proportion of collective incentives or bonuses paid in the total amount of incentive compensation. Collective incentive compensation includes all forms of team- and firm-level bonuses and extra remuneration disbursed to employees. HRM directors reported the proportion of the amount of collective incentive in the total employee incentive based on the financial records of their firm. For system-related practice that involves social and technical infrastructure for knowledge flow, HRM directors rated three items (α = .73). "Our company actively utilizes the following practices: (a) suggestion system, (b) quality circle, and (c) intranet knowledge-sharing system" (1 = *not at all*, 5 = *a great deal*; Beugelsdijk, 2008; Chang et al., 2013). The three items were averaged to create a system-related measure of flow-facilitating practices. The score for flow-facilitating practices of each company was calculated by averaging the z-scores of motivation- and system-related practices.

2.3.2 | Firm knowledge stock (HRM director and production managers, *T2*)

In accordance with previous studies (Boxall, 1998; Sung & Choi, 2012), firm knowledge stock was operationalized as the knowledge and skills possessed by employees. Firm knowledge stock was measured by combining two aspects of knowledge stock: (a) the task-related skills and abilities of employees in general and (b) the task-specific knowledge and skills of production workers. The HRM directors reported the level of overall ability of employees by rating six items (α = .85): "The employees of our company possess adequate levels of skills and abilities in (a) task coordination, (b) problem solving, (c) learning, (d) resource utilization, (e) interpersonal relationship, and (f) information processing." Given that the core competence of manufacturing companies lies in production procedures and technology (Sung & Choi, 2014), production managers were asked to report the level of their production workers' task-specific knowledge and skills (1 = *conducting simple labor and routine tasks*, 5 = *performing multiple tasks proficiently*). The ratings of production managers were aggregated to organization level (ICC [1] = .31, ICC[2] = .74, F = 3.87, p < .001). Firm knowledge stock was calculated by averaging the ratings from the HRM director and those from production managers.

2.3.3 | Firm knowledge flow (Employees, *T2*)

Consistent with existing measures (Cabrera & Cabrera, 2005), a three-item scale (α = .72) was used to assess firm-level knowledge flow: "In our company, (a) employees actively share their ideas and knowledge with one another; (b) employees freely communicate their ideas and opinions to their supervisors; and (c) employees actively share their ideas and know-how with members of other departments." This scale exhibited acceptable inter-rater agreement ($r_{wg(3)}$= .92) and acceptable intraclass correlations (ICC [1] = .09, ICC[2] = .73, F = 3.69, p < .001) for firm-level aggregation.

2.3.4 | Innovation strategy (Strategy director, *T2*)

Based on existing innovation strategy items that underscore innovative activities in organizations (Li & Atuahene-Gima, 2001), firm innovation strategy was assessed using two items (α = .69): (a) "The market strategy of our company is oriented toward leading the changes in the customer and the market by developing new products and services ahead of competitors." (b) "In our company, developing new products and services is the first priority."

2.3.5 | Firm innovation (Department managers and KIPO, *T3*)

Complementing prior studies that rely solely on either a subjective measure of innovative performance or an objective one, the present study assessed multiple dimensions of innovation, such as new product development (NPD), product and service differentiation, and patent registration. The department managers rated two items (α = .70, $r_{wg(2)}$ = .83, ICC [1] = .28, ICC[2] = .68, F = 3.17, p < .001). "Our company holds a competitive advantage over other companies in terms of (a) developing and introducing new products and (b) introducing differentiation in the products and/or services offered" (1 = *not at all*, 5 = *a great deal*; Beugelsdijk, 2008; Shipton et al., 2006). The ratings of the department managers on the two items were averaged to create a subjective measure of innovation. The number of patents registered by the company, as archived by KIPO, was also used as an objective measure of innovation given the significance of patents that provide strong protection for proprietary knowledge of firms and the direct relationship of patents with inventiveness and technological novelty (Ahuja, 2000; Cohen, Goto, Nagta, Nelson, & Walsh, 2002; Kwan & Chiu, 2015). Consistent with a recent study (Sung & Choi, 2014), the overall innovation score for each firm was calculated by averaging the subjective (i.e., NPD and product and service differentiation) and objective measures (i.e., number of patents) using their z-scores.

2.3.6 | Control variables (Strategy director and HRM director, *T1*)

The present analysis included industry type and firm size as controls. Industry type has often been considered a critical determinant of firm innovation (Jiménez-Jiménez & Sanz-Valle, 2011). Thus, the effect of industry type was controlled using nine dummies created for 10 industry categories. Firm size is another critical firm-specific determinant of various firm outcomes (Zhang & Li, 2009). Firm size was indicated by the number of employees. Firm size was transformed using the logarithm function to reduce the undue effects of very large firms.

3 | RESULTS

Before testing the hypotheses, we examined the empirical validity of the scales using confirmative factor analysis (CFA; Anderson & Gerbing, 1988) and conducted CFA on the 11 items that comprise five study variables. This measurement model included covariances among

all study variables. The five-factor model exhibited good fit with the data, χ^2 (df = 32)= 39.74, p = .16; comparative fit index, CFI = .98; root-mean-square error of approximation, RMSEA = .03, and performed better than any of the alternative factor models (all p < .001). All indicators loaded significantly on the corresponding latent factors (p < .01) and the covariances remained low to moderate (all below .25), indicating the convergent and discriminant validity of the measures used. The descriptive statistics and correlations among variables are presented in Table 1.

3.1 | Hypothesized model and alternative models

After confirming the empirical validity of the measures with CFA, we tested structural relations among constructs by conducting a structural path analysis using statistical software AMOS. The present model included 11 indicators of five study variables aside from 10 control variables (i.e., nine dummies for 10 industries and firm sizes) that resulted in 210 parameters to be estimated [21(21−1)/2 = 210], which were larger than the size of the present sample of 203 firms. The sample size is not sufficient to attain reliable estimates of the parameters. Thus, we used a structural path analysis that employs the scale means of each variable instead of item-level indicators (Bandalos & Finney, 2001). The results of the structural models based on all item-level indicators were identical with the results based on the scale means reported below, although the former was characterized by lower levels of model fit.

We fit the hypothesized structural model as shown in Figure 1, which produced good fit to the data (Hu & Bentler, 1999): χ^2 (df = 56) = 66.05, p = .17; CFI = .97; RMSEA = .03; Akaike information criterion, AIC = 194.05. The possibility that theoretically plausible alternative models could offer a better explanation of observed patterns in the data was verified (Anderson & Gerbing, 1988). First, we examined the possibility of cross effects of the two knowledge management–enhancing HRM practices, that is, stock-building and flow-facilitating practices predicting both firm knowledge stock and flow. This model exhibited a good fit as reported in Table 2, but failed to improve the model fit, $\Delta\chi^2$ (df = 2) = 4.76, p > .05, significantly, and the two added paths were statistically insignificant. Second, the mediating roles of knowledge stock and flow were only partial rather than full, although the present model suggested full mediation. Thus, we tested the possibility of partial mediation by adding the direct paths from knowledge management–enhancing HRM practices to firm innovation. This partial mediation model produced excellent model fit, χ^2 (df = 54) = 57.68, p = .34; CFI = .99; RMSEA = .02; AIC = 189.68, which was better than that of the hypothesized model, $\Delta\chi^2$ (Δdf = 2) = 8.37, p < .05. In the third alternative model, we tested the possibility that HRM practices and firm-level knowledge management have parallel or independent effects on firm innovation instead of having a mediated relationship. The fit of this model was worse than that of

TABLE 1 Means, standard deviations, and correlations among study variables (N = 203)

Variables	*M*	*SD*	1	2	3	4	5	6	7	8
1. Firm size	6.01	1.05	—							
2. Food industry	.09	.30	.29**							
3. Fiber industry	.04	.20	.28**	—						
4. Chemical industry	.13	.34	.35**	−.08	—					
5. Plastic industry	.05	.22	.26**	−.05	−.09	—				
6. Metal industry	.19	.39	.29**	−.10	−.19**	−.11	—			
7. Machinery industry	.09	.28	.28**	−.07	−.12	−.07	−.15*	—		
8. Computer industry	.02	.14	.35**	−.03	−.05	−.03	−.07	−.04	—	
9. Electronics industry	.08	.27	.26**	−.06	−.11	−.06	−.14*	−.09	−.04	—
10. Electric appliance industry	.16	.37	.15*	−.09	−.17*	−.10	−.21**	−.14	−.06	−.13
11. Stock-building HRM practices	−.12	.64	.29**	−.09	.09	−.15*	−.02	.02	.06	.03
12. Flow-facilitating HRM practices	−.03	.69	.28**	−.01	−.02	−.05	.05	.04	.05	−.16*
13. Firm knowledge stock	−.02	.79	.35**	−.02	.15*	.06	.01	−.02	.10	−.10
14. Firm knowledge flow	3.70	.26	.26**	−.12	.16*	−.02	.04	−.15*	.02	−.02
15. Innovation strategy	1.98	.62	.15*	−.03	−.01	−.14*	.02	.02	−.03	.02
16. Firm innovation	.05	.70	.28**	−.01	−.06	−.08	.07	−.02	.11	.08

Variables	*M*	*SD*	9	10	11	12	13	14	15	16
9. Electronics industry	.08	.27	—							
10. Electric appliance industry	.16	.37	−.01	—						
11. Stock-building HRM practices	−.12	.64	.01	.29**	—					
12. Flow-facilitating HRM practices	−.03	.69	.04	.28**	.31**	—				
13. Firm knowledge stock	−.02	.79	−.03	.35**	.25**	.16*	—			
14. Firm knowledge flow	3.70	.26	−.04	.26**	.16*	.19**	.29**	—		
15. Innovation strategy	1.98	.62	.01	.15*	.20**	.16*	.11	.13	—	
16. Firm innovation	.05	.70	−.07	.28**	.19**	.27**	.20**	.26**	.34**	—

Note: Unit of analysis is firm (N = 203). *p < .05; **p < .01.

TABLE 2 Comparison of model fit of alternative models

Model	χ^2 (*df*)	*p*	CFI	RMSEA	AIC
Hypothesized model	66.05 (56)	.17	.97	.03	194.05
Alternative models:					
1. Stock-building and flow-facilitating HRM practices predicting both firm knowledge stock and firm knowledge flow	61.29 (54)	.23	.98	.03	193.29
2. Direct effects of stock-building and flow-facilitating HRM practices on firm innovation (partial mediation model)	57.68 (54)	.34	.99	.02	189.68
3. Parallel effects of stock-building and flow-facilitating HRM practices and firm knowledge stock and firm knowledge flow on firm innovation	72.32 (56)	.07	.95	.04	200.23

CFI = comparative fit index; RMSEA = root-mean-square error of approximation; AIC = Akaike information criterion.

the hypothesized model (see Table 2). Thus, the partial mediation model was selected as the final best-fitting model, which also provided a plausible theoretical account of the observed pattern (see Figure 2).

3.2 | Hypothesis testing

3.2.1 | HRM practices and knowledge management

As reported in Figure 2, the present structural path analysis revealed that stock-building and flow-facilitating HRM practices were associated positively with firm knowledge stock and flow (β = .22, p < .001 and β = .15, p < .05, respectively). Therefore, Hypotheses 1 and 2 are confirmed. As part of the test of alternative structural relationships, the cross effects of the two HRM practices on knowledge stock and flow were insignificant, thereby demonstrating that stock-building and flow-facilitating practices have different effects on firm knowledge stock and flow.[1]

3.2.2 | Knowledge management and firm innovation

Structural path analysis (Figure 2) showed that firm knowledge stock is not related to firm innovation (β = .09, *ns.*), which disproves Hypothesis 3. However, the results supported Hypothesis 4 in that firm knowledge flow was a significant predictor of firm innovation (β = .14, p < .05). Thus, only firm knowledge flow was a meaningful predictor of firm innovation in the two components of knowledge management.

3.2.3 | Interaction between firm knowledge stock and flow

Hypothesis 5 posited a positive interaction between knowledge stock and flow in predicting firm innovation. The moderation hypothesis was tested by employing hierarchical regression analyses that included all control variables for firm innovation to avoid potentially biased estimates of interaction terms in the structural path analysis (Little, Card, Bovaird, Preacher, & Crandall, 2007). As expected, the interaction between knowledge stock and flow was positive for innovation (β =.17, p < .01). This significant interaction was examined further using a simple slope analysis (Aiken & West, 1991). Plot A of Figure 3 shows that knowledge stock is a positive predictor of firm innovation when knowledge flow is high or one *SD* above the mean (b = .77, p < .01), but not when it is low or one *SD* below the mean (b = −.08, *ns.*), which is a pattern that supports Hypothesis 5.

3.2.4 | Moderating effects of innovation strategy

In Hypothesis 6, we proposed that the relationships between firm knowledge management and innovation are moderated by innovation strategy. The results based on hierarchical regression equations revealed significant positive interaction between firm knowledge stock and innovation strategy (β = .18, p < .01) in predicting firm innovation. The two regression lines depicted in Plot B of Figure 3 confirm that knowledge stock contributes to innovation when firms have high innovation strategy (b = .92, p < .001), but not when they have low innovation strategy (b = −.07, *ns.*). However, the interaction between firm knowledge flow and innovation strategy was not significant. Therefore, the moderating effect of innovative strategy is confirmed only for knowledge stock, which provides partial support for Hypothesis 6.

4 | DISCUSSION

The role of *people* and *people management* has long occupied a central position in knowledge management (Al-Tit, 2016; Kang et al., 2007; Kwan & Chiu, 2015; Mabey & Zhao, 2017; Özbağ et al., 2013). In this regard, understanding how people management practices develop effective knowledge management is important because the accumulation and utilization of knowledge are crucial sources of innovation and competitive advantage of firms (Chang et al., 2013; Donate & Guadamillas, 2011; S. Wang & Noe, 2010). This study elaborated on the two dimensions of HRM practices that explain the emergence of firm-level knowledge stock and flow that contribute to firm innovation through their interactive effects. The proposed framework was validated through a systematic empirical investigation using multisource firm-level data collected over a 5-year period. The implications of this study are highlighted in the following section along with the limitations and directions for future research.

4.1 | Implications for theory and research

Drawing on KBV literature, we identified two dimensions of HRM practices that exert disparate values toward firm-level knowledge management. On one hand, stock-building HRM practices develop and expand the firm-level knowledge reservoir by providing many opportunities to improve task-related skills and competence (Chang et al., 2013; Hatch & Dyer, 2004; Pastor et al., 2010). On the other hand, flow-facilitating HRM practices enable firms to apply and utilize effectively the knowledge resources they possess by legitimizing and

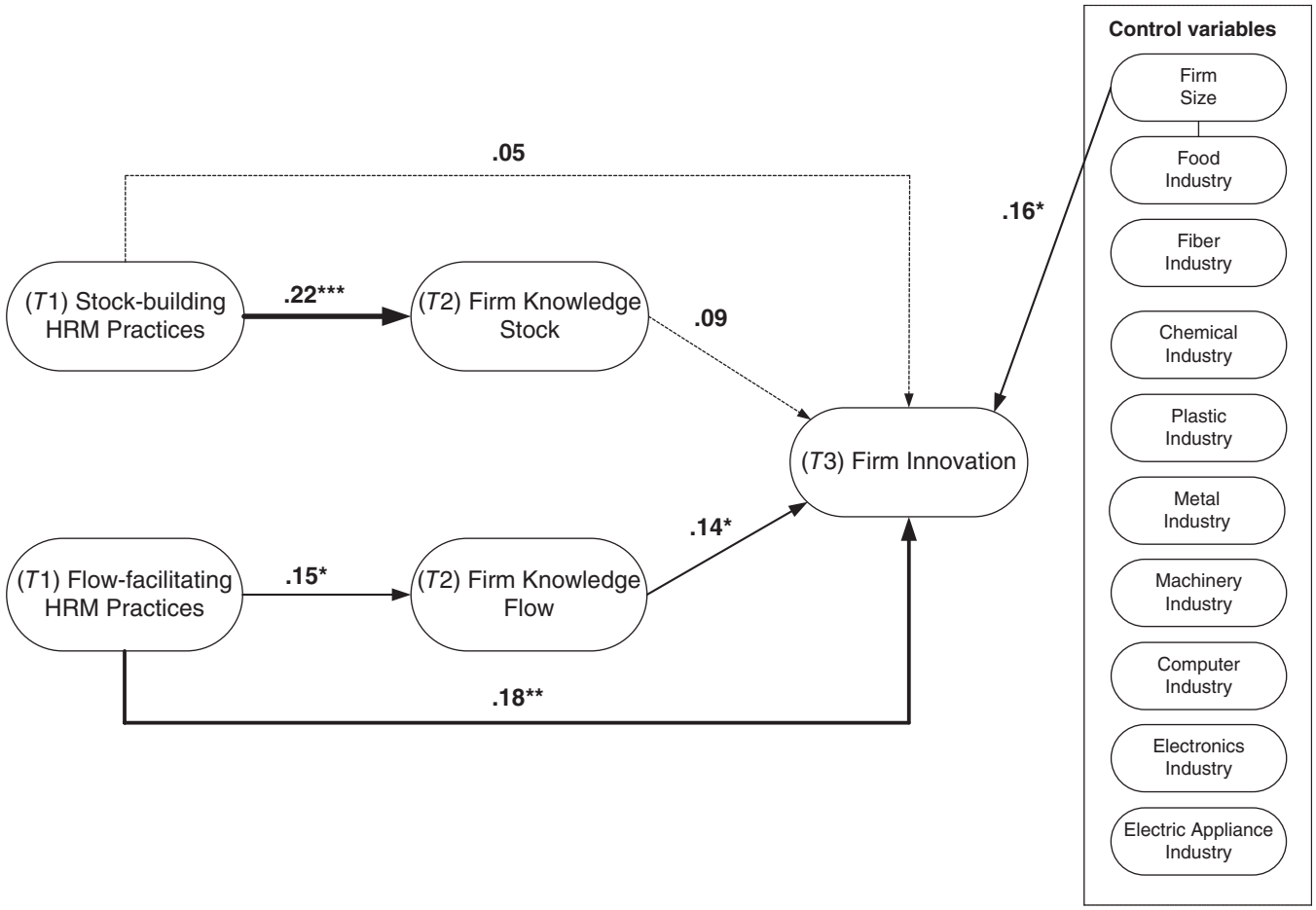

FIGURE 2 Final structural model predicting firm innovation

Note. Thicker lines represent statistically more significant results. Insignificant paths are depicted as dotted lines in the diagram. Insignificant paths from control variables are not presented in the diagram. $^{*}p < .05$; $^{**}p < .01$; $^{***}p < .001$

alleviating the cost incurred by knowledge exchange and activation among employees and motivating them to engage in such activities (Al-Tit, 2016; Mäkela & Brewster, 2009). Considering the distinct processes of firm-level knowledge management spurred by different dimensions of HRM practices, undifferentiated approaches to these processes appear to oversimplify the complex firm-level dynamics involving HRM, knowledge, and innovation.

The acquisition and exchange of knowledge are core processes of knowledge management (Sung & Choi, 2012). Nevertheless, organizations often face difficulties in encouraging their employees to involve themselves in these core knowledge processes, because knowledge management processes within organizations represent a particular case of a paradigmatic social situation known as a "social dilemma" (Cabrera & Cabrera, 2005). This phenomenon is a collective action

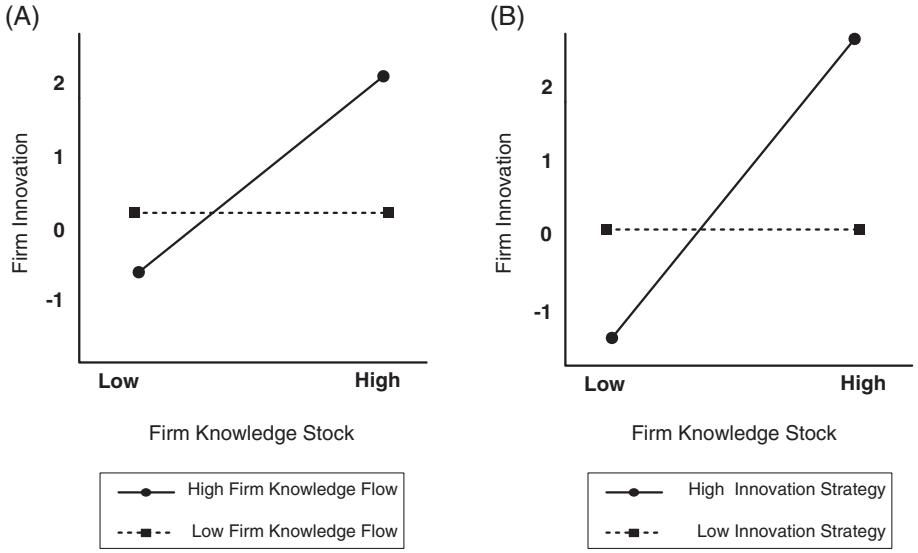

FIGURE 3 Interaction between firm knowledge stock and firm knowledge flow, and between firm knowledge stock and innovation strategy in predicting firm innovation

situation, in which there exists conflict between individual and collective interests; thus, when individuals try to maximize their pay off, this can lead to a collective disadvantage or damage. Under such a situation, organizations can mitigate this dilemma by increasing the employees' belief that their information can certainly increase shared good (information self-efficacy) by training and by convincing individual gains achieved through the increase of collective gain (Cabrera, 2002; Tallman & Chacar, 2011).

The present analysis also reveals directions to advance further the literature on KBV at the firm level. With regard to the two knowledge management dimensions investigated, knowledge flow increased firm innovation, but knowledge stock did not. Empirical studies that examine the effects of knowledge stock and flow simultaneously are rare, particularly at the firm level, and hence, accepting the present findings single-mindedly and judging that only knowledge flow is important for firm innovation would be premature. Nevertheless, the present empirical findings based on a multiyear longitudinal design suggest the potential "primacy" of knowledge transfer and integration over the presence of accumulated knowledge reservoir (Al-Tit, 2016; Mahoney & Kor, 2015). From the KBV of firms, the current findings suggest that knowledge creation through collective knowledge transfer and exchange (i.e., knowledge flow) may supersede knowledge creation based on individual knowledge retention (i.e., knowledge stock; Argote et al., 2003; Grant, 1996; Swart & Kinnie, 2013; Tallman & Chacar, 2011). A balanced consideration of both knowledge dimensions is still warranted because knowledge stock fuels the entire knowledge management process, and the flow and exploitation of a flimsy body of knowledge may stall in the middle. In this respect, further studies may explore at what level knowledge stock can operate as a "constraint" that causes the malfunction of knowledge flow (Bontis et al., 2002).

Knowledge stock exhibited a significant positive effect on innovation in firms characterized by the free flow of knowledge and innovation strategy despite its nonsignificant main effect. Unlike knowledge flow, which is dynamic and fluid, knowledge stock per se is static. The mere possession of knowledge is insufficient to produce innovative outcomes because unless it is exploited, such knowledge only represents potential (Kwan & Chiu, 2015; Mabey & Zhao, 2017; Sung & Choi, 2012). Potential remains a potential without application and exploitation. Knowledge stock can only benefit firms that have the appropriate tools and strategy to mobilize such potential resource effectively (Delery & Doty, 1996; Donate & Guadamillas, 2011; Zhang & Li, 2009). Moreover, increased knowledge stock can hamper innovation when such resource fails to flow freely to the parties who need it, which creates indigestion or stockpiling of knowledge that overloads or blocks the organizational system (cf. alignment between learning stock and flow; Bontis et al., 2002). The HRM literature highlights the synergetic effects that occur collectively in various HRM practices. However, implementing all HRM practices may not be the best way to enhance innovation. Some practices are likely to be more appropriate for building knowledge reservoir while others are likely to be more suitable for facilitating knowledge application and utilization, and vice versa. Future studies should consider the selective implementation of HRM practices instead of combining all possible HRM practices that a firm can provide.

Future studies may also consider multilevel issues of HRM practices. The present study maintained the theoretical focus on individuals and their interactions that drive firm-level processes. This orientation is in line with the emphasis on the microfoundation underlying macroprocesses and firm outcomes (Felin & Hesterly, 2007). Concerning HRM practices that lead to firm-level knowledge processes, researchers may investigate their multilevel implications for knowledge management by observing simultaneously intended practices at the firm level, implemented practices at the unit level, and perceived practices at the individual level (Minbaeva, 2013). Further work should address and overcome the conceptual and empirical challenges involving multilevel and micro- versus macrodynamics to help firms fully utilize accumulated knowledge resources and transform them into innovative outcomes.

4.2 | Implications for practice

The present analysis offers various practical implications for business leaders. Our results suggest that the free flow of knowledge across individuals and groups unleashes the potential value of knowledge repository for innovation (Kang et al., 2007; Mabey et al., 2015; Wei et al., 2011). Knowledge sharing elicits mixed motives among employees because of the social dilemma between personal and collective interests (Wang & Noe, 2010). Therefore, managers must resolve the motivational dilemma with regards to employees' knowledge sharing within organizations. Cabrera (2002) suggested restructuring the payoff function (e.g., reward based on the combined efforts of individual and bonus based on the success of the knowledge-sharing program) and reducing the time necessary to distribute individual ideas (e.g., making it easier for employees to share information) as important potential interventions for overcoming those dilemmas and effectively managing organizational knowledge. In support of these practical recommendations, the present study demonstrated the significant association between flow-facilitating practices (collective incentive and knowledge infrastructure) and knowledge flow.

Group- and firm-level collective incentives may promote knowledge sharing and utilization by aligning the employees' self-interest with the collective, organizational interest, thereby overcoming the motivational dilemma inherent in sharing one's own knowledge. As another important managerial intervention for knowledge sharing and utilization, managers may strengthen knowledge-facilitating organizational infrastructure and supportive systems, such as suggestion systems, quality circles, and intranet information systems, which effectively facilitate the flow of knowledge among employees and work units. These social and technical support for knowledge sharing may reduce the psychological burden and physical costs associated with offering knowledge, which in turn can increase employees' abilities and opportunities of knowledge exchanges and activation (cf. AMO framework, Kehoe & Wright, 2013). To overcome social dilemma and increase employee motivation toward knowledge sharing and utilization, managers could further nurture social capital among employees, such as strong social ties, shared language and narratives, and trust and group identification (Cabrera & Cabrera, 2005).

Our analysis also confirmed the importance of the fit between managerial systems and firm strategy by demonstrating the significant

interaction between firm knowledge stock and innovation strategy. Contemporary organizations exert considerable efforts in building greater knowledge reservoir, which enables them to achieve advantage through increased innovation. However, even though organizations implement diverse HRM practices to build knowledge stock, if such systems are not congruent with overall firm strategy, such efforts may not lead to the intended outcomes. In this regard, practitioners should draw a clear blueprint for their organization, set a strategic direction, and develop appropriate HRM practices in line with such strategy.

4.3 | Study limitations and future research directions

The present analysis is based on a longitudinal multisource research design and offers robust empirical support for most of the theoretical hypotheses proposed. Nonetheless, the current findings should be interpreted with caution in light of several limitations. First, because of the practical survey limitation, other practices that could bear distinct implications for knowledge management (e.g., selection/hiring, performance appraisal, and job design) were not included. Although the current HRM practice measures addressed the most representative practices identified in previous studies (Chang et al., 2013; Kehoe & Wright, 2013; Liao et al., 2011), future studies should employ a broader operationalization of HRM practices that capture various managerial policies, interventions, and activities.

Second, the present measures of HRM practices were not fine-grained to detect delicate and nuanced effects of organizational context on firm knowledge stock and flow. For example, this study focused on the corporate monetary expenditure on formal training of any kind. However, the effects of training are contingent on the content or type of training (Noe, Tews, & Dachner, 2010). A more elaborate understanding could be gained by exploring the specific characteristics of training (i.e., content, types, instructional designs, or delivery formats) with regard to their distinct contributions toward knowledge management. Some practices (e.g., OJT, job rotation) can also contribute to the building and flow of knowledge in organizations. Researchers should use finer-grained measures of HRM practices and consider their boundary conditions.

Third, firm knowledge stock and flow were operationalized by aggregating individual-level ratings offered by managers and employees. Such an aggregation is a common practice and justified by various statistics such as $r_{wg(j)}$, ICC[1], and ICC[2]. However, Coleman (1966) argued that aggregate-level outcomes are more than a mere sum of individual-level outcomes. By contrast, global, organization-level ratings offered by CEOs or executives suffer from another problem: "If one were able to assess some form of 'organizational human capital' through a measure at the organization level, then the measure ignores the emergence process and misses important individual level variance" (Wright & McMahan, 2011, p. 101). Likewise, Minbaeva (2013) called for deeper understanding of explanatory mechanisms that involve individual heterogeneity and interaction in explaining the relationship between HRM practices and knowledge management. The issue of emergence and the challenge of multilevel dynamics have been neglected in empirical literature on HRM and knowledge management, which must be addressed in a more elaborate manner in future studies.

Finally, although we used items pertinent to innovation strategy (i.e., strong tendency/orientation toward and emphasis on innovativeness) drawn from existing literature (Li & Atuahene-Gima, 2001), only two items were used, which could pose a problem in terms of assessing the firm-level context. Future research should replicate the current framework using a comprehensive scale that assesses broader aspects of innovation strategy, such as the pursuit of novel products and services, exploration of various markets, and radical versus incremental product innovations (Zhang & Li, 2009).

Despite the limitations, the present study enriches literature on HRM and knowledge management by clarifying the often arbitrary conceptualization and operationalization of HRM practices and knowledge management and proposing two distinct dimensions of HRM practices, each predicting firm knowledge stock and flow. This systematic scheme offers firms valuable insights into effective implementation of HRM practices toward firm innovation. Thus, this study provides a foundation for the further development of a fine-grained theory of HRM practices and knowledge management at the firm level.

ENDNOTE

[1]Given that each componential HRM practice may have distinct implications that can differ from their combined effects as a system of practices (Combs et al., 2006; Wright et al., 2001), we performed a follow-up analysis to examine the individual effects of each constituting subdimension of the two practices. This post hoc analysis showed that the formal dimension of stock-building HRM practices (i.e., the total expenditure on corporate training) exerted a more significant effect on firm knowledge stock (β = .23, p < .01) than the informal dimension (i.e., external education, OJT, and task rotation; β = .13, p < .10). The results also revealed that motivation-related flow-facilitating practices (i.e., collective incentives) had a more significant effect on firm knowledge flow (β = .18, p < .01) than infrastructure-related practices (i.e., suggestion system, quality circle, and intranet; β = .11, p < .10). Each constituting dimension of the two HRM practices exhibited different magnitudes of effects on their corresponding aspects of knowledge management. However, the overall patterns of individual effects were consistent with their combined effects.

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REFERENCES

Ahuja, G. (2000). Collaboration networks, structural holes, and innovation: A longitudinal study. *Administrative Science Quarterly*, *45*, 425–455.

Aiken, L. S., & West, S. G. (1991). *Multiple regression: Testing and interpreting interactions*. Newbury Park, CA: Sage.

Al-Tit, A. A. (2016). The mediating role of knowledge management and the moderating part of organizational culture between HRM practices and organizational performance. *International Business Research*, *9*, 43–54.

Amabile, T. M. (1996). *Creativity in context*. Boulder, CO: Westview Press.

Anderson, J. C., & Gerbing, D. W. (1988). Structural equation modeling in practice: A review and recommended two-step approach. *Psychological Bulletin*, *103*, 411–423.

Anderson, N., Potočnik, K., & Zhou, J. (2014). Innovation and creativity in organizations: A state–of–the–science review, prospective commentary, and guiding framework. *Journal of Management*, *40*, 1297–1333.

Argote, L., McEvily, B., & Reagans, R. (2003). Managing knowledge in organizations: An integrative framework and review of emerging themes. *Management Science*, *49*, 571–582.

Bandalos, D. L., & Finney, S. J. (2001). Item parceling issues in structural equation modeling. In G. A. Marcoulides & R. E. Schumacker (Eds.), *Advanced structural equation modeling: New developments and techniques* (pp. 269–296). Mahwah, NJ: Lawrence Erlbaum Associates, Inc.

Basadur, M., & Gelade, G. A. (2006). The role of knowledge management in the innovation process. *Creativity and Innovation Management*, *15*, 45–62.

Beugelsdijk, S. (2008). Strategic human resource practices and product innovation. *Organization Studies*, *29*, 821–847.

Bontis, N., Crossan, M. M., & Hulland, J. (2002). Managing organizational learning system by aligning stocks and flows. *Journal of Management Studies*, *39*, 437–469.

Boxall, P. F. (1998). Human resource strategy and industry–based competition: A conceptual framework and agenda for theoretical development. In P. M. Wright, L. D. Dyer, J. W. Boudreau, & G. T. Milkovich (Eds.), *Research in personnel and human resources management* (pp. 1–29). Madison, WI: IRRA.

Brown, S. R. (1986). Q technique and method: Principles and procedures. In W. E. Berry & M. S. Lewis-Beck (Eds.), *New tools for social scientists* (pp. 57–76). Beverly Hills, CA: Sage.

Cabrera, E. F. (2002). Knowledge-sharing dilemmas. *Organization Studies*, *23*, 687–710.

Cabrera, E. F., & Cabrera, A. (2005). Fostering knowledge sharing through people management practices. *International Journal of Human Resource Management*, *16*, 720–735.

Chang, S., Gong, Y., Way, S. A., & Jia, L. (2013). Flexibility–oriented HRM systems, absorptive capacity, and market responsiveness and firm innovativeness. *Journal of Management*, *39*, 1924–1951.

Chen, C. J., & Huang, J. W. (2009). Strategic human resource practices and innovation performance: The mediating role of knowledge management capacity. *Journal of Business Research*, *62*, 104–114.

Chen, G., Mathieu, J. E., & Bliese, P. D. (2004). A framework for conducting multi-level construct validation. In F. J. Yammarino & F. Dansereau (Eds.), *Multi-level issues in organizational behavior and processes* (pp. 273–303). Elsevier, England: Emerald Group.

Cohen, W. M., Goto, A., Nagta, A., Nelson, R. R., & Walsh, J. P. (2002). R&D spillovers, patents, and the incentives to innovative in Japan and the United States. *Research Policy*, *31*, 1349–1367.

Coleman, J. S. (1966). Foundations for a theory of collective decisions. *American Journal of Sociology*, *71*, 615–627.

Combs, J., Liu, Y., Hall, S., & Kitchen, D. (2006). How much do high–performance work practices matter? A meta–analysis of their effects on organizational performance. *Personnel Psychology*, *59*, 501–528.

Damanpour, F., Walker, R. M., & Avellaneda, C. N. (2009). Combinative effects of innovation types and organizational performance: A longitudinal study of service organizations. *Journal of Management Studies*, *46*, 650–675.

Delery, J. E., & Doty, D. H. (1996). Modes of theorizing in strategic human resource management: Test of universalistic, contingency, and configurational performance predictions. *Academy of Management Journal*, *39*, 802–835.

Donate, M., & Guadamillas, F. (2011). Organizational factors to support knowledge management and innovation. *Journal of Knowledge Management*, *15*, 890–914.

Felin, T., & Hesterly, W. S. (2007). The knowledge-based view, nested heterogeneity and new value creation: Philosophical considerations of the locus of knowledge. *Academy of Management Review*, *32*, 195–218.

Gardner, H., Gino, F., & Staats, B. (2012). Dynamically integrating knowledge in teams: Transforming resources into performance. *Academy of Management Journal*, *55*, 998–1022.

Gino, F., Todorova, G., Miron-Spektor, E., & Argote, L. (2009). When and why prior task experience foster team creativity. In *Research on managing groups and teams: Creativity in groups* (pp. 87–110). Bingley, UK: Emerald Group Publishing.

Grant, R. M. (1996). Towards a knowledge-based theory of the firm. *Strategic Management Journal*, *17*, 109–122.

Griffith, T. L., & Sawyer, J. E. (2010). Multilevel knowledge and team performance. *Journal of Organizational Behavior*, *31*, 1003–1031.

Hagedoorn, J., & Cloodt, M. (2003). Measuring innovative performance: Is there an advantage in using multiple indicators? *Research Policy*, *32*, 1365–1379.

Hatch, N. W., & Dyer, J. (2004). Human capital and learning as a source of sustainable competitive advantage. *Strategic Management Journal*, *25*, 1155–1178.

Hu, L. T., & Bentler, P. M. (1999). Cutoff criteria for fit indexes in covariance structure analysis: Conventional criteria versus new alternatives. *Structural Equation Modeling*, *6*, 1–55.

Ipe, M. (2003). Knowledge sharing in organizations: A conceptual framework. *Human Resource Development Review*, *2*, 337–359.

Jiménez-Jiménez, D., & Sanz-Valle, R. (2011). Innovation, organizational learning, and performance. *Journal of Business Research*, *64*, 408–417.

Johns, G. (2006). The essential impact of context on organizational behavior. *Academy of Management Review*, *31*, 386–408.

Kang, S. C., Morris, S. S., & Snell, S. A. (2007). Relational archetypes, organizational learning, and value creation: Extending the human resource architecture. *Academy of Management Review*, *22*, 236–256.

Kehoe, R. R., & Wright, P. M. (2013). The impact of high performance human resource practices on employees' attitudes and behaviors. *Journal of Management*, *39*, 366–391.

Kwan, L. Y.-Y., & Chiu, C.-Y. (2015). Country variations in different innovation outputs: The interactive effect of institutional support and human capital. *Journal of Organizational Behavior*, *36*, 1050–1070.

Lepak, D. P., & Snell, S. A. (2002). Examining the human resource architecture: The relationship among human capital, employment, and human resource configurations. *Journal of Management*, *28*, 517–543.

Li, H., & Atuahene-Gima, K. (2001). Product innovation strategy and the performance of new technology ventures in China. *Academy of Management Journal*, *44*, 1123–1134.

Liao, T. S., Rice, J., & Martin, N. (2011). The role of market in transforming training and knowledge to superior performance: Evidence from the Australian manufacturing sector. *International Journal of Human Resource Management*, *22*, 376–394.

Little, T. D., Card, N. A., Bovaird, J. A., Preacher, K. J., & Crandall, C. S. (2007). Structural equation modeling of mediation and moderation with contextual factors. In T. D. Little, J. A. Bovaird, & N. A. Card (Eds.), *Modeling contextual effects in longitudinal studies* (pp. 207–230). Mahwah, NJ: Lawrence Erlbaum.

Lopez-Cabrales, A., Perez-Luno, A., & Cabrera, R. V. (2009). Knowledge as a mediator between HRM practices and innovative activity. *Human Resource Management*, *48*, 485–503.

Mabey, C., Wong, A., & Hsieh, L. (2015). Knowledge exchange in networked organizations: Does proximity matter? *R&D Management Journal*, *45*, 487–500.

Mabey, C., & Zhao, S. (2017). Managing five paradoxes of knowledge exchange in networked organizations: New priorities for HRM? *Human Resource Management Review*, *27*, 39–57.

Mahoney, J. T., & Kor, Y. Y. (2015). Advancing the human capital perspective on value creation by joining capabilities and governance approaches. *Academy of Management Perspectives*, *29*, 296–308.

Mäkela, K., & Brewster, C. (2009). Interunit interaction contexts, interpersonal social capital, and the differing levels of knowledge sharing. *Human Resource Management*, *48*, 591–613.

Minbaeva, D. B. (2013). Strategic HRM in building micro–foundations of organizational knowledge–based performance. *Human Resource Management Review*, *23*, 378–390.

Minbaeva, D. B., Foss, N., & Snell, S. (2009). Gest editors' introduction: Brining the knowledge perspective into HRM. *Human Resource Management*, *43*, 477–483.

Noe, R. A., Tews, M. J., & Dachner, A. M. (2010). Learner engagement: A new perspective for enhancing our understanding of learner motivation and workplace learning. *Academy of Management Annals*, *4*, 279–315.

Özbağ, G. K., Esen, M., & Esen, D. (2013). The impact of HRM capabilities on innovation mediated by knowledge management capability. *Social and Behavioral Sciences*, *99*, 784–793.

Pastor, I., Santana, P., & Sierra, C. (2010). Managing knowledge through human resource practices: Empirical examination of the Spanish automotive industry. *International Journal of Human Resource Management*, *21*, 2452–2467.

Santos-Vijande, M. L., López-Sánchez, J. Á., & Trespalacios, J. A. (2012). How organizational learning affects a firm's flexibility, competitive strategy, and performance. *Journal of Business Research*, *65*, 1079–1089.

Shipton, H., West, M., Dawson, J., Birdi, K., & Patterson, M. (2006). HRM as a predictor of innovation. *Human Resource Management Journal*, *16*, 3–27.

Sung, S. Y., & Choi, J. N. (2012). Effects of team knowledge management on the creativity and financial performance of organizational teams. *Organizational Behavior and Human Decision Processes*, *118*, 4–13.

Sung, S. Y., & Choi, J. N. (2014). Do organizations spend wisely on employees? Effects of training and development investments on learning and innovation in organizations. *Journal of Organizational Behavior*, *35*, 393–412.

Swart, J., & Kinnie, N. (2013). Managing multidimensional knowledge assets: HR configurations in professional services firms. *Human Resource Management Journal*, *23*, 160–179.

Tallman, S., & Chacar, A. (2011). Knowledge accumulation and dissemination in MNEs: A practice-based framework. *Journal of Management Studies*, *48*, 278–304.

Terziovski, M. (2010). Innovation practice and its performance implications in small and medium enterprises SMEs in the manufacturing sector: A resource–based view. *Strategic Management Journal*, *31*, 892–902.

Wang, C. L., Rodan, S., Fruin, M., & Xu, X. Y. (2014). Knowledge networks, collaboration networks and exploratory innovation. *Academy of Management Journal*, *57*, 484–514.

Wang, S., & Noe, R. A. (2010). Knowledge sharing: A review and directions for future research. *Human Resource Management Review*, *20*, 115–131.

Wei, J., Zheng, W., & Zhang, M. (2011). Social capital and knowledge transfer: A multi-level analysis. *Human Relations*, *64*, 1401–1423.

Wright, P. M., Dunford, B. B., & Snell, S. A. (2001). Human resources and the resource based view of the firm. *Journal of Management*, *27*, 701–721.

Wright, P. M., Gardner, T. M., Moynihan, L. M., & Allen, M. R. (2005). The relationship between HR practices and firm performance: Examining causal order. *Personnel Psychology*, *58*, 409–446.

Wright, P. M., & McMahan, G. (2011). Exploring human capital: Putting human back into strategic human resource management. *Human Resource Management Journal*, *21*, 93–104.

Zahra, S. A., & George, G. (2002). Absorptive capacity: A review, reconceptualization, and extension. *Academy of Management Review*, *27*, 185–203.

Zhang, Y. C., & Li, S. L. (2009). High performance work practices and firm performance: Evidence from the pharmaceutical industry in China. *International Journal of Human Resource Management*, *20*, 2331–2348.

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