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Collective turnover and firm innovation: Knowledge-sharing system as a contingency

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Abstract

Is high employee turnover harmful to innovation? To answer this question, we draw on the knowledge-based view of innovation. Specifically, we theorize that the collective turnover of a firm engenders complex changes in knowledge insourcing needed for generating innovation, which may lead to the attenuating negative effect of turnover on innovation. This study also aims to investigate a contingency that modifies the detrimental effect of collective turnover on innovation. Specifically, we identify knowledge-sharing system (KSS) as a positive knowledge-related contingency that engenders a U-shaped curvilinear relationship between collective turnover and firm innovation. In addition, replenishing human capital by hiring new employees improves knowledge insourcing quality and diversity, thereby constituting the mechanism through which collective turnover affects firm innovation. An analysis of large-scale firm-level data collected from 2259 Korean firms over a 6-year period supports most hypotheses and confirms the positive effect of high turnover on firm innovation through replacement hiring and under favorable firm contingencies, such as a high KSS. This study provides a balanced perspective by revealing the costs and benefits of collective turnover and explains when and how turnover can facilitate firm innovation.

KEYWORDS

hiring, innovation, knowledge sharing, knowledge-based view, turnover

1 | INTRODUCTION

Innovation refers to the introduction of new or improved products (services), processes (solutions), marketing strategies, and organizational practices that significantly differ from what firms have adopted before (Jiang et al., 2019; OECD/Eurostat, 2018). As firms have begun to recognize its importance in surviving and thriving in contemporary business environments, innovation has become a foremost managerial challenge (Chen et al., 2021). In explaining innovation emergence, researchers have identified knowledge as a primary driver because innovation originates from the recombination and reconfiguration of existing knowledge (Danneels & Vestal, 2020). This appreciation of knowledge, as the core of innovation, is aligned with the knowledge-based view (KBV) that characterizes firms as institutions for integrating and creating knowledge that resides in individuals to gain competitive advantages (Grant, 1996; Teece et al., 1997). This study builds on the fundamental assumptions of KBV, that is, "Knowledge assets remain resident with individual employees... the primary role of the firm as integrating the specialist knowledge resident in individuals into goods and services" (Grant, 1996, p. 119).

Despite the prevailing endorsement of KBV underpinning innovation processes (Stephan et al., 2019), previous

studies offer limited insights into those people who actually carry knowledge in and out of organizations. This neglect is mostly due to the extant focus on knowledge management processes, such as sharing, accumulating, applying, and integrating knowledge, which are often based on the distinction between knowledge stock and flow (Cohen & Levinthal, 1990; Sung & Choi, 2018). Therefore, previous studies treat knowledge as the focal entity or locus of action. However, employees ultimately hold knowledge for their organizations and carry out knowledge-related processes (Chen et al., 2021; Grant, 1996; Li et al., 2022). In this respect, individual employees should be at the core of KBV in relation to innovation management. Although innovation studies from the organizational perspective have investigated the role of employees, unlike what is often assumed, the human capital available for firms to innovate is not fixed but constantly changing because of globalization, demographic shifts, and emerging career norms, all of which increase workforce mobility (Minbaeva & Collings, 2013). The increasing fluctuation of human capital directly affects the knowledge stock and flow in organizations, hence underscoring its significant role in understanding firm innovation.

Our study aims to expand the innovation literature by exploring the functions of employee turnover and hiring in firm innovation. Collective turnover is a major driver of organizational membership changes in that it not only causes the outflow of employee knowledge, skills, and abilities (KSAs) but also instigates the inflow of new hires to match the losses. Such membership changes affect firm innovation by reshaping *knowledge sourcing*, which refers to the effort of an organization to obtain, upgrade, combine, and exploit knowledge to extract its value (Cohen & Levinthal, 1990; Grant, 1996). KBV suggests that new knowledge for innovation can be obtained and assimilated from within and outside firm boundaries (i.e., insourcing and outsourcing; Li et al., 2022). Accordingly, changing organizational membership is an integral part of knowledge creation and shapes the ability of an organization to improve its processes and introduce new products and services (Chen et al., 2021; Sung & Choi, 2018). However, our review reveals that this issue has been mostly neglected in the innovation literature. Moreover, the underlying mechanism and contingency of the turnover–innovation relationship remain unknown. Drawing on KBV, we challenge the existing argument of a simple linear negative effect of turnover on innovation to develop a finer-grained explanation by theorizing how and when turnover affects innovation.

Although limited, empirical evidence suggests a negative relationship between collective turnover and innovation (Hancock et al., 2017). We advance a nuanced view on this relatively simple notion of turnover as a threat to innovation by claiming that the negative effect of turnover may attenuate as it increases. Increasing levels of collective turnover may stimulate the reconfiguration of internal knowledge reservoirs and force the development of new routines, which reveal new connections among knowledge (Shaw et al., 2013). Accordingly, although collective turnover deteriorates operational effectiveness and firm productivity (Pissaris et al., 2017; Revilla et al., 2020), such detriment may be less salient for innovation and may weaken after a certain threshold is reached by improving knowledge sourcing (Grant, 1996).

We draw on KBV to elaborate on the possibility that the high turnover rates above a certain threshold may have a positive effect on innovation under certain knowledge-related contingencies, which turn the attenuating negative curve to a positive direction. In this light, Staw (1980) speculated the potential positive consequences of turnover, such as resolving conflicts and enhancing organizational adaptation and innovation. Nonetheless, Hausknecht and Trevor (2011, p. 370) stated that "the very existence of positive effects of collective turnover remains an open question." To answer this question, we isolate knowledge-sharing system (KSS), which refers to an organizational system and infrastructure that is designed to promote knowledge sharing in an organization (Huang et al., 2010; Mahr et al., 2014; Wang & Noe, 2010), as a facilitating contingency. KSS weakens the negative effects of collective turnover while strengthening its positive effects, thereby changing the net turnover effect on firm innovation from negative to positive. From the vantage point of KBV, KSS operates as a firm-level practice to upgrade knowledge insourcing quality resulting from collective turnover (Huang

Practitioner points

- High employee turnover does not necessarily harm firm innovation which can be even facilitated by informational externalities or knowledge outsourcing.
- Employee turnover contributes to firm innovation partly by promoting replacement hiring, which replenishes the human capital losses.
- The turnover cost can be mitigated by systematic organizational support and knowledge management practices that facilitate knowledge sharing and diminish knowledge loss.
- Firms with high turnover rates should promote the knowledge flow accompanying human resource inflow and revitalize their knowledge stock.

et al., 2010). KBV assumes that distinct knowledge is resident in individual employees such that firms need to integrate their knowledge (Grant, 1996). This assumption suggests that the loss of employees induces a deficit or a leak of knowledge source for innovation; therefore, firms need to mitigate such negative impact by promoting the transfer and storage of knowledge across employees, hence underscoring the significance of KSS.

This study also reveals a potential way for collective turnover to benefit firm innovation in view of KBV. Previous studies claiming the potential positive sides of turnover have often resorted to the rationale that turnover leads to the introduction of new human resources and knowledge inflow that avoids stagnant human capital and promotes knowledge transfer across firm boundaries (Raffiee & Byun, 2019). Workforce mobility is a vehicle for knowledge spillover that stimulates innovation (Mawdsley & Somaya, 2016; Singh & Agrawal, 2011). Therefore, collective turnover can benefit firm innovation to the extent that the knowledge outflow from exiting employees is counteracted by knowledge inflow from new employees joining the firm (Brymer & Sirmon, 2018). This balanced consideration of human resource outflow and inflow is underscored by context-emergent turnover (CET) theory for a comprehensive understanding of the effect of turnover on performance (Call et al., 2015; Nyberg & Ployhart, 2013). Drawing on these arguments, we propose that if the knowledge loss from turnover is followed by knowledge inflow through hiring new employees who compensate the loss, then firm innovation can be promoted (Shaw et al., 2013).

This study contributes to innovation management literature in several ways. First, we challenge the preliminary finding of a linear negative relationship between turnover and innovation and elaborate on a potential curvilinear relationship by focusing on the complex knowledge-sourcing implications of turnover instead of proposing a simple resource-loss account. This proposition drawn from KBV should offer a compelling and realistic explanation. Second, further drawing on knowledge insourcing quality from KBV (Grant, 1996), we also specify when and how collective turnover can become a positive predictor of firm innovation. Specifically, we isolate KSS as a knowledge context and replacement hiring for knowledge inflow as an indicator of when and how the turnover–innovation relationship can take a positive form. Our theoretical framework addresses the recent call for further research to bridge the fields of innovation management and organizational behavior (Weiss et al., 2022). Third, filling the relative lack of empirical investigations into turnover in relation to innovation, we verify the current theoretical propositions using large-scale firm-level data involving a panel of 3966 firm-year observations collected from 2259 firms over a 6-year period.

2 | THEORY AND HYPOTHESIS DEVELOPMENT

Recent technological and societal changes (e.g., LinkedIn and Facebook) have enabled and encouraged people to develop their careers beyond traditional organizational boundaries. People also feel marketable and mobile in their careers by building and demonstrating their employers' reputation (Makarius et al., 2017). Given that employees are becoming increasingly mobile and certain firms flexibly utilize workforce mobility to boost innovation, the prevailing negative perspective on collective turnover may need to be reconsidered (Mawdsley & Somaya, 2016). Contemporary firms pursuing innovation should adopt a holistic perspective and consider adopting strategies to leverage turnover beyond the conventional *War for Talent* mentality, which views turnover as a win–lose game, to prevent talents from being stolen (Minbaeva & Collings, 2013). Given the increasing significance of turnover, the relative value of retaining current employees with accumulated human capital versus losing them but acquiring new hires with potentially diverse viewpoints toward innovation should be reconsidered.

Our work revisits the innovation implications of turnover by integrating the different views proposed in human resource management (HRM) and strategic management literature. These two streams of literature analyze the seemingly same phenomenon but endorse contrasting organizational consequences. On the one hand, the HRM literature focuses on the downsides of turnover (Hancock et al., 2013; Park & Shaw, 2013). On the other hand, the strategic management literature emphasizes the positive function of employee mobility toward innovation (Mawdsley & Somaya, 2016; Müller & Peters, 2010). We aim to integrate these views by considering outward (i.e., turnover) and inward mobility (i.e., hiring) and examine the possibility that "performance peaks at very high turnover rates" (Park & Shaw, 2013, p. 270) and at low turnover rates. To move this line of research forward, we adopt KBV based on a balanced consideration of the functions of human resource outflow and inflow and the resulting changes in knowledge insourcing that contribute to firm innovation (Call et al., 2015; Grant, 1996).

2.1 | Collective turnover and firm innovation

A stable workforce can promote firm performance, such as sales, customer service, labor productivity, and financial performance (Pissaris et al., 2017; Revilla et al., 2020). Employees perceive the achievement of their firms as their

own when the turnover rate is low, thereby generating cohesion and trust among members (Somers, 1995). In this situation, employees are willing to contribute their knowledge to innovate and improve the products and processes of their organizations instead of hoarding knowledge (Wang & Noe, 2010). Thus, the stable and cohesive workforce built on low turnover rates facilitates knowledge accumulation and transfer among employees with intensive work experiences and high KSAs (Horwitz & Horwitz, 2007). Highlighting the significance of the transferability of knowledge, KBV ascertains that organizational capability results from "integrating specialized knowledge of multiple individuals" (Grant, 1996, p. 114). From this view, stable and high-quality knowledge insourcing may bolster the capacity of firms to innovate by promoting knowledge integration among their employees (Li et al., 2022). By contrast, collective turnover may decrease firm innovation by damaging this stable knowledge insourcing among employees (Pissaris et al., 2017; Revilla et al., 2020).

However, such impairments can attenuate along with increasing turnover rates because the marginal cost of losing employees tends to diminish and organizations learn and develop mechanisms to deal with such losses and operational disruptions (Shaw et al., 2013). On the one hand, the costs of collective turnover increase at a declining rate and eventually level off. In other words, the negative mechanisms of collective turnover, such as knowledge outflow from human capital loss, are likely to exhibit diminishing marginal impacts on firm innovation. On the other hand, some benefits related to collective turnover can emerge, such as escalated knowledge inflow from new hires and organizational flexibility obtained through nimble restructuring and new routines to evade the losses resulting from leaving employees. These adaptive mechanisms start to contain the diminishing negative impacts of high turnover rates from a certain point. Subtracting these emerging benefits from the decreasing costs (Haans et al., 2016) may lead to a decreasingly negative relationship between collective turnover and firm innovation.

We expect that the negative effect of collective turnover on firm innovation becomes neutral with increasing turnover levels for several reasons. Offsetting the detriments of turnover, high turnover rates may stimulate firms to improve their existing practices and overcome unconventional workloads and disconnected social networks, all of which tend to generate new knowledge and expand their internal knowledge reservoir (Li et al., 2022). According to Hale et al. (2016), "employees that remain will now be required to develop different collective states and processes (e.g., coordination, routines) to effectively accommodate expanded responsibilities and workloads" (p. 911). High turnover also leads to reduced commitment to path-dependent knowledge development practices observed in a stable workforce with habitual routines (Jiang et al., 2018). This situation may attenuate the harm incurred by turnover by stimulating the reconfiguration and recombination of the specialized knowledge held by employees, thereby improving knowledge insourcing toward innovation (Grant, 1996).

In addition, firms with high turnover rates may neutralize the negative effects of turnover by promoting structural adaptability, which allows them to address future losses through flexible structures. High turnover results in position and personnel shifts, which shrink outmoded units and redirect limited resources to new, promising units (Staw, 1980). Moreover, high turnover rates dismantle the extant organizational structure or inertia by disrupting established work processes and network patterns (Tzabbar & Kehoe, 2014). Accordingly, firms with high turnover rates tend to adapt to dynamic changes in their workforce by increasing their structural flexibility, rearranging their work processes, and broadening their environmental scanning (Cho, 2006). Such internal structural and procedural changes stimulated by high turnover can also improve firm innovation by enriching knowledge insourcing (Teece et al., 1997). On the basis of these arguments, we propose the following hypothesis.

> **Hypothesis 1.** Collective turnover has a curvilinear relationship with firm innovation, such that this relationship is generally negative but attenuates as turnover rates increase.

2.2 | KSS as a contingency

Theoretical analysis highlights the importance of considering various contingencies that may buffer or accentuate turnover effects (e.g., firm size, labor cost, knowledge-intensive work, and collaborative culture). However, empirical investigations are still rare (Brymer & Sirmon, 2018; Hom et al., 2017). The present theoretical framework is based on KBV, which identifies the firm as "an institution for integrating knowledge" (Grant, 1996, p. 109). From this view, knowledge may be the key in explaining the effect of turnover on firm innovation, which relies on acquiring and integrating new knowledge (Zhou & Li, 2012). The effects of employee KSAs moving in and out of organizations may depend on the system that manages knowledge loss, acquisition, and dissemination (Soto-Acosta et al., 2014). Accordingly, we isolate KSS as a contingency that moderates the effects of collective turnover on innovation.

KSS refers to an organizational system designed to promote the flow and integration of knowledge in an organization; KSS is often based on various IT systems, which include company intranets, online/offline bulletin boards, and online communication channels that are available for employees to share their knowledge (Huang et al., 2010; Mahr et al., 2014; Wang & Noe, 2010). KSS may facilitate the transfer and aggregation of specialized individual knowledge into organizational knowledge by boosting the motivation of knowledge holders and the absorptive capacity of knowledge recipients, both of which effectively alleviate the internal stickiness of knowledge transfer (Szulanski, 1996). Given that knowledge is partially tacit and certain KSAs are deeply embedded in individuals, building explicit practices of sharing and codifying knowledge is essential for learning and innovation (Grant, 1996; Leiponen, 2006). By contrast, the low usage of KSS hinders firms from codifying, collecting, and storing individual tacit knowledge and promoting organizational flexibility through organizational knowledge.

We propose that KSS positively moderates the attenuating negative relationship between collective turnover and firm innovation, that is, KSS weakens the detriment of knowledge loss while augmenting the innovation benefit derived from developing new routines and flexible structures stimulated by high turnover. This moderating role of KSS changes the attenuating negative effect to a U-shaped curvilinear effect, which is categorized as "additive flattening/steepening" (Haans et al., 2016).

First, the negative downward slope at low-to-moderate turnover rates is buffered by KSS, which maintains the knowledge reservoir shared among employees and compensates for operational disruptions, thereby diminishing turnover cost (cf. buffering perspective, Ton & Huckman, 2008). The negative effects of collective turnover on performance tend to be diffused by storing knowledge in organizational routines, rather than in people, which can be achieved by implementing a knowledge management system (Hausknecht & Trevor, 2011; Wang & Wang, 2012). In effect, KSS enables firms to effectively use their accumulated knowledge stock to quickly fill in the knowledge gap caused by human capital loss (Eckardt et al., 2014; Hancock et al., 2013). For a firm with strong KSS, its knowledge insourcing for innovation may remain intact even with a certain degree of collective turnover, which attenuates the negative turnover effect on firm innovation.

Second, KSS diminishes the negative effect of collective turnover and further activates its positive potential, thereby turning the flattened effect to a positive direction to increase firm innovation. High collective turnover disturbs routine practices, urging firms to rearrange their operations and search for alternative procedures (Cho, 2006; Tzabbar & Kehoe, 2014). When firms encounter high collective turnover, a strong KSS may facilitate prompt structural and process rearrangements (Wang & Wang, 2012; Zhou & Li, 2012), which ignite creative solutions that are overlooked or undetected by existing routines. KSS helps materialize the benefits of lost and reshuffled human capital resulting from high turnover. Therefore, KSS may enrich the knowledge reservoir of a firm to diversify knowledge insourcing and reveal new knowledge hidden among employees with specialist knowledge (Grant, 1996; Li et al., 2022). On the basis of these arguments, we propose the following moderation hypothesis:

> **Hypothesis 2.** KSS moderates the attenuating negative relationship between collective turnover and firm innovation, such that the overall negative effects of collective turnover are weaker and become positive at high turnover rates when KSS is high rather than low.

2.3 | Replacement hiring as a mediator

The collective turnover effects on various firm outcomes cannot be fully understood without considering the extent to which the lost human capital is replenished through a hiring process, which uses a new workforce inflow to restock human resources (Hancock et al., 2013; Nyberg & Ployhart, 2013). Replacement hiring reflects a firm's capability to recover from losses and materialize the opportunities presented by turnover (Hom et al., 2017). Acquiring and reshuffling human capital are effective strategies for exchanging ideas and absorbing external knowledge (Cho, 2006; Müller & Peters, 2010). Employee mobility spreads ideas and knowledge across organizational boundaries through the learning-by-hiring mechanism, thereby facilitating innovation (Mawdsley & Somaya, 2016; Singh & Agrawal, 2011). In line with the innovation benefit of knowledge outsourcing (Li et al., 2022), we propose that replacement hiring directly affects firm innovation for several reasons.

First, given the basic tenet of KBV that "knowledge is viewed as residing within the individual" (Grant, 1996, p. 109), the inflow of new individuals reformulates the knowledge base of an organization. Replacement hires involve the inflows of distinct skills, heterogeneous experiences, and different viewpoints into an organization. In effect, new hires bring heterogeneous resources that promote knowledge cross-fertilization (Ostergaard et al., 2011). Second, replacement hiring should rewire communication networks and reshape the way people share

their ideas and coordinate task flows. Internal social asset restructuring can be further enriched by fresh social capital and external connections that new hires bring into an organization (Raffiee & Byun, 2019; Staw, 1980). Third, replacement hiring and accompanying workforce reshuffling can facilitate innovation by stimulating employees to change their extant routines. Although long-tenured employees can work efficiently, they feel complacent about their task routines and are hesitant to adapt to a changing work environment (Jiang et al., 2018). Routinized task behaviors can be rearranged by newcomers, which enrich and diversify knowledge insourcing for encouraging innovative efforts among employees. Accordingly, drawing on KBV, we hypothesize the following:

> **Hypothesis 3.** Replacement hiring has a positive relationship with firm innovation.

We also propose that replacement hiring may explain why collective turnover predicts innovation based on the previous claim that replacement hiring is a mechanism through which firm-level turnover can affect performance (Hausknecht & Holwerda, 2013; Morris et al., 2017). KBV suggests the possibility that the collective turnover effects on innovation can be explained by the extent to which firms replenish their knowledge outflow by generating knowledge inflow to maintain or even improve knowledge insourcing (Grant, 1996; Stephan et al., 2019). Specifically, we argue that the proposed mediation process develops in the following ways.

At low levels, the indirect effect of collective turnover on firm innovation via replacement hiring may be negative. As turnover rates initially increase, firms may not immediately respond and initiate hiring processes, thereby resulting in a time lag in hiring new employees owing to organizational inertia (Hom et al., 2017; Meier & Hicklin, 2008). Thus, at low levels of collective turnover, replacement hire rates may remain low if firms can tolerate and operate with a temporary understaffed situation. Accordingly, the initial hiring effort may not catch up with the speed of human capital loss, and firms cannot promptly cope with collective turnover (Call et al., 2015). From the CET perspective, this imbalance characterized by a greater outflow than inflow may trigger a human capital erosion, which may reduce the innovation capacity of a firm by degenerating its knowledge reservoir, thereby resulting in impaired or reduced knowledge insourcing (Nyberg & Ployhart, 2013).

However, as turnover rates increase to high levels, the indirect effect of turnover on innovation may attenuate and become neutral or flat. As turnover rates increase, firms are likely to suffer from human capital loss and operational challenges, which urge them to actively restore their human resources (Shaw et al., 2013). Restocking human resources may take place in a prompt manner when turnover rates are high, when firms are particularly concerned with losses, and when they exert intensive recovery efforts to generate a complementary human capital inflow (Nyberg & Ployhart, 2013). With increasing collective turnover, the speed and number of hiring employees may catch up with those of losing employees. In effect, high turnover rates may become inconsequential because "at high levels, continuous replacement of the workforce becomes routine and steps are taken to minimize its disruption" (Hausknecht & Trevor, 2011, p. 365). As firms replenish their workforce, they may develop an increased capacity to innovate. The increasing inflow of replacement hires helps firms recover from the damage of human capital loss on their innovation, thus neutralizing the harm (Call et al., 2015). In addition, new hires can offer a distinct benefit for innovation by facilitating knowledge outsourcing based on heterogeneous knowledge and their fresh perspectives (Cooper, 2001; Raffiee & Byun, 2019). Therefore, collective turnover may affect firm innovation to the extent that it leads to subsequent replacement hiring, which may vary across different turnover levels. The following hypothesis is then proposed:

> **Hypothesis 4.** Replacement hiring mediates the attenuating negative relationship between collective turnover and firm innovation.

3 | METHODS

We test the effects of employee and knowledge inflow and outflow on innovation using a large-scale survey of firms in South Korea (hereafter, Korea). The Korean labor market is traditionally rigid with a conservative culture and low workforce mobility but has rapidly become flexible since the 1997 financial crisis (Shaw et al., 2013). Turnover in Korea has been increasing as most companies move away from traditional lifetime employment (Bae & Rowley, 2001) and start to adopt open, irregular recruitment in addition to an annual recruitment system (Khanna et al., 2011). In addition, Korea is known for innovations in various industries and is among the top spenders on innovation and research and development (R&D) activities among OECD countries (OECD, 2020). Therefore, Korea may provide an appropriate setting for our research on turnover and innovation.

3.1 | Data and sample

To test our hypotheses, we analyzed multi-wave, multi-source data drawn from the workplace panel survey (WPS), which is administered every 2 years by the Korea Labor Institute (KLI), a government-funded policy research agency. WPS is conducted through computer-assisted personal interviews and includes web-based surveys, face-to-face interviews, and paper-and-pencil questionnaires (Kim & Kang, 2013). Specific questionnaires are designed for different informants. For example, industrial relations (IR) managers provide general firm information, such as the number of employees and new hires, whereas human resource (HR) managers respond to questions about HRM practices. KLI also provides the financial information of the surveyed firms, such as their sales, profits, and wage bills, by merging WPS with the financial data archived by the NICE Information Service Co. The validity of WPS data has been demonstrated in previous studies (Kim & Kang, 2013; Mitra & Shin, 2012).

KLI samples firms to adequately replicate the entire population of firms listed in the Korea National Statistical Office by building subgroups based on firm size (i.e., number of employees: 30–99, 100–299, 300–499, and 500 or more) and industry (e.g., utility, finance, construction, and transportation). Our final sample data covered 63 of the 99 industries listed in the Korean Standard Industrial Classification. Data from four waves of WPS, which were collected in 2013, 2015, 2017, and 2019, were used in this study because the items for firm innovation were only included in the questionnaire starting in 2013 and the latest survey year is 2019. For example, WPS 2013 covered 1775 firms, among which 1295 were consecutively surveyed in WPS 2015 (retention rate of approximately 73%).

To avoid causal ambiguity in testing predictive relationships, we constructed time-lagged data and used objective measures of main predictors (i.e., turnover rates and replacement hire rates). We measured the independent and control variables at year t and the dependent variable at year $t + 1$. Specifically, WPS 2013, 2015, and 2017 and the corresponding financial information from NICE were used for the independent variables, whereas the corresponding $t + 1$ dependent variable was identified at WPS 2015, 2017, and 2019. After excluding those observations with missing data, our final sample included 2259 firms and a panel of 3966 firm-year observations (1942 observations in manufacturing, 1547 in services, and the remaining 477 in finance). No significant differences in firm characteristics (e.g., firm age, firm profitability, and R&D intensity) were observed between the included and excluded samples. Using firm-year observations, the variables of interest were measured on firm i at year t and $t + 1$.

We assumed a two-year lag between the changes resulting from collective turnover and replacement and the subsequent firm performance, such as innovation, because of the temporally delayed effects of human capital changes. Previous studies often adopt a two-year lag between the predictors and innovation, such as integrating external knowledge with internal knowledge for developing new products (Caner & Tyler, 2015), implementing a firm's R&D strategy for increasing invention (Audretsch, 1995), and extending working hours for promoting innovation (Ko & Choi, 2019). Even when we tested the hypotheses using the dependent variable measured at the same year t, all analysis results remained the same.

3.2 | Measure

3.2.1 | Independent variables

Collective turnover

Collective turnover was operationalized by the turnover rate of firm i at year t based on the reports of IR managers. We computed turnover rate by dividing the total number of employees who had left firm i during the whole year t (from January 1 to December 31 in 2013, 2015, and 2017) by the average number of employees at year t (e.g., for year 2013, the sum of the total number of employees at the end of 2012 and 2013 was divided by 2) (Ton & Huckman, 2008). The median turnover rate for the current sample was 14.48%, whereas the mean turnover rate was 21.69%. The highest average turnover rate was 36.73% in the facility maintenance industry, whereas the lowest turnover rate was 7.97% in the utility industry (see Table 1).

Replacement hiring

Following Call et al. (2015), replacement quantity was operationalized by the number of new hires relative to the number of leavers in firm i at year t. Replacement hire rate was computed by dividing the number of employees who were hired during year t by the total number of employees who voluntarily left the firm during year t. Both of these numbers were reported by the IR manager. Even when we alternatively measured replacement hire rate at year $t + 1$, our results remained the same.

Knowledge-sharing system

Following previous studies (Huang et al., 2010; Wang & Wang, 2012), the HR managers evaluated whether their firms systematically promoted information and knowledge sharing among and across their employees,

TABLE 1 Distribution of firms and average turnover rates.

Industry	Number of firms	Average turnover rate
Facility maintenance and business support services	256	36.73%
Construction and engineering	325	31.33%
Recreational, cultural and sporting activities	56	29.34%
Hotels and restaurants	77	24.98%
Social welfare and health care	138	24.63%
Wholesale and retail trade	266	24.25%
Transportation	250	22.45%
Other community and other personal services	48	19.43%
Manufacturing	1942	19.13%
Real estate and renting and leasing	22	17.70%
Professional science and technology services	226	17.37%
Media & entertainment (publishing and broadcasting)	130	16.34%
Education	13	16.00%
Financial institutions and insurance	101	14.62%
Environment (sewage and waste disposal)	43	13.75%
Public administration, defense, and social security	12	10.67%
Utilities (electric, gas, and water)	61	7.97%
Total	3966	

management, and work units. Specifically, the HR manager of each firm rated whether his/her firm has information sharing channels, such as intranets, online bulletin boards, e-mails, and IT systems (Mahr et al., 2014; Song et al., 2007). The four items for measuring KSS showed acceptable reliability ($\alpha = 0.67$). By conducting principal component analysis (PCA) for the four items, we identified a single factor with an eigenvalue of greater than 1 (i.e., 2.04), which accounted for approximately 51% of the total variance of the scale. This single factor was calculated using the corresponding factor loadings of the four items (Table 2) for each firm i at year t and was labeled *KSS*. Although we alternatively assessed KSS at year $t + 1$ in consideration of the stability of organizational infrastructure, our analysis results remained the same. We further conducted confirmatory factor analysis

TABLE 2 Results of the exploratory factor analysis of knowledge-sharing system (KSS) measurement items.

Survey item	Factor loading
Business- and task-related knowledge are updated in the company intranet, such that all employees can access and share related knowledge.	0.73
Newsletters are regularly published on/offline to share information and knowledge with employees.	0.71
An internal on/offline bulletin board is set up to share relevant internal and external information.	0.71
E-mails are regularly used to share information and communicate with employees.	0.70

(CFA) to test the factorial validity of our measure of KSS. Results show a good fit for this measure ($\chi^2(2) = 13.02$; comparative fit index [CFI] = 0.99; root mean square error of approximation [RMSEA] = 0.03; standardized root mean square residual [SRMR] = 0.01), thereby supporting the use of the four items for a latent factor of KSS (Song & Chen, 2014).

3.2.2 | Dependent variable

Firm innovation

WPS followed the guidelines of the Oslo Manual (OECD/Eurostat, 2018) and employed four innovation types (i.e., product, process, marketing, and organizational). We measured firm innovation using these types to evaluate the overall innovation performance of firms. The top-level informants at each firm reported whether their firm introduced new or significantly improved outcomes in the four domains of product, process, marketing, and organizational innovation (0 = No, 1 = Yes). The four innovation items exhibited high scale reliability ($\alpha = 0.79$; Table 3). The single factor was calculated by adding each value of the four innovation types of firm i at year $t + 1$ and was labeled *firm innovation*. The additive scale indicates that a higher value of *firm innovation* corresponds to a greater innovative performance of a given firm.

We performed CFA to test the factorial validity of the firm innovation measure. The CFA results showed that the single-factor model of the four innovation items had a good fit ($\chi^2(2) = 78.89$; CFI = 0.98; RMSEA = 0.11; SRMR = 0.02). In addition, we alternatively measured firm innovation by conducting PCA for the four items,

TABLE 3 Firm innovation measurement items and an alternative exploratory factor analysis.

Survey item	Factor loading
Did the company implement *process innovation*—the implementation/adoption of new or significantly improved production or delivery methods—that includes changes in equipment, human resources, working methods, or a combination of these?	0.83
Did the company implement *marketing innovation*—the implementation of a new marketing method to address customer needs better—that includes a new knowledge embodied in distribution channels, customer expectations, preferences, and advertising or a significant improvement in product design or packaging, product placement, promotion, or pricing?	0.81
Did the company implement *organizational innovation*—the implementation of new organizational methods in business practices or workplace organizations—that includes the introduction of significantly changed organizational structures and the implementation of advanced management techniques or substantially changed corporate strategic orientations?	0.80
Did the company introduce *a new product* whose technological characteristics or intended uses significantly differ from those of previously produced products or *an improved product* whose performance has been significantly enhanced or upgraded?	0.70

which produced a single factor that had an eigenvalue of greater than 1 (2.45) and accounted for more than 62% of the total variance of the scale. When we employed the alternative PCA-based scale, rather than the additive scale, by using factor loadings to measure firm innovation, our results remained the same.

3.2.3 | Control variables

Our analysis included several controls following the literature. First, we included the firm-specific characteristics that are pertinent to firm innovation and knowledge-sharing tendencies. We controlled 16 dummies for the 17 *industries* represented in the current sample at year *t*. *Firm age* was measured as the year since each firm was founded. We controlled for the *proportions of employees* who are below 30 and above 50 years in their firms' workforce. The incentive to accumulate human capital and its expected return may be large for relatively young employees, thereby affecting knowledge-sharing and firm innovation (Møen, 2005).

Second, we also included firm-level factors that are related to a firm's innovation capability. *Employee productivity* was measured as annual revenues divided by total labor costs at year *t* (Stuebs & Sun, 2010). Firm-level *R&D intensity*, which represents a firm's internal innovative capacity, was calculated by dividing annual R&D investment by annual revenue at year *t* (Leiponen, 2006; Song & Chen, 2014). *Flextime practice*, which promotes employee proactivity and innovation process (Zhang & Parker, 2019), was controlled at year *t*. The HR managers in each firm answered whether their firm implemented flexible work time (0 = No, 1 = Yes).

Third, we controlled for workforce-related factors. The *number of hires* was measured by the absolute number of employees who were hired during year *t*. New employee inflow brings fresh human capital that promotes internal social asset restructuring (Raffiee & Byun, 2019) and knowledge cross-fertilization toward innovation (Ostergaard et al., 2011). *Changes in turnovers* were assessed by the change in the number of employee leavers between years *t* and $t + 1$. Those firms that are more used to high turnover rates may be better able to manage changes in their workforce composition. *Occupational category of major workforces* was controlled because turnover effects may vary depending on job characteristics (Hom et al., 2017). The HR managers reported the main occupation of their largest group of workers at their firms (International Labour Organization, 2012). We included seven dummies for the eight major occupations, namely, administrative workers, production workers, professionals and technicians, service workers, simple task laborers, and sales workers.

3.3 | Findings

Table 4 presents the descriptive statistics and pairwise Pearson correlations among the variables. The variance inflation factor (VIF) values of all explanatory variables were assessed. All VIF values were less than 2.31 (average VIF = 1.27; the highest VIF [turnover rate] = 2.31), which is far below the general rule of thumb (VIF = 10), indicating that multicollinearity is unlikely to bias our estimates (Chen et al., 2014).

Following Aiken and West (1991), the independent and moderating variables were mean-centered prior to the creation of the interaction term to reduce the potential multicollinearity. To facilitate the interpretation and comparison of the magnitude of effects, standardized coefficients (β) were reported. We conducted a series of hierarchical regression analyses to test the main and moderation effect hypotheses. Models 1 and 7 in Table 5

TABLE 4 Descriptive statistics and correlations.

	Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1	Firm age	–												
2	Proportion of employees under 30	−0.12*												
3	Proportion of employees over 50	0.04*	−0.15*											
4	Employee productivity	0.01	0.01	−0.04*										
5	R&D intensity	−0.06*	0.03*	−0.05*	−0.02									
6	Flextime practice	0.00	0.04*	−0.03	0.01	0.01								
7	Number of hires	0.01	0.06*	0.03	0.00	−0.02	0.04*							
8	ΔNumber of turnovers	0.00	0.00	0.03	0.00	0.00	−0.04*	−0.40*						
9	Occupational category dummies	−0.01	−0.11*	0.08*	−0.03*	−0.05*	−0.09*	−0.06*	0.00					
10	Turnover rate	−0.10*	0.03*	0.07*	−0.04*	0.03*	0.04*	0.28*	−0.24*	−0.04*				
11	Replacement hire rate	0.04*	0.04*	0.02	0.03	0.01	0.03*	−0.01	0.03*	0.00	−0.11*			
12	KSS	0.10*	0.07*	−0.18*	0.03*	0.02	0.13*	0.06*	0.00	−0.15*	−0.08*	0.04*		
13	Firm innovation	0.04*	0.07*	−0.14*	0.06*	0.04*	0.07*	0.06*	−0.03	−0.02	−0.05*	0.06*	0.21*	-
Mean		29.40	0.27	0.18	0.56	0.01	0.06	61.19	−2.03	4.48	0.22	1.35	0.74	0.91
SD		15.11	0.25	0.22	3.44	0.08	0.23	234.70	151.17	1.87	0.30	2.30	0.86	1.30

Note: $N = 3966$ firm-year observations.

Abbreviations: KSS, knowledge-sharing system; SD, standard deviation.

*$p < 0.05$.

TABLE 5 Panel regression predicting firm innovation.

	Firm innovation $t+1$						Replacement hire rate	
Variables	**Model 1**	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**
Firm age	0.04	0.03	0.04	0.03	0.01	0.01	0.03	0.02
Proportion of employees under 30	0.05**	0.05***	0.04**	0.05**	0.04**	0.05**	0.07***	0.08***
Proportion of employees over 50	−0.08***	−0.07***	−0.08***	−0.07***	−0.05***	−0.05***	0.03	0.04*
Employee productivity	0.03	0.02	0.02	0.02	0.02	0.02	0.02	0.01
R&D intensity	0.03*	0.03**	0.03*	0.03**	0.02	0.03*	0.01	0.02
Flextime practice	0.08***	0.07***	0.07***	0.07***	0.05**	0.05**	0.04	0.03
Number of hires	0.08*	0.10**	0.08*	0.09**	0.07*	0.08*	0.01	0.04
ΔNumber of turnovers	0.02	0.01	0.01	0.01	0.01	0.01	0.04*	0.01
Turnover rate		−0.12***		−0.11***		−0.09***		−0.21***
Turnover rate^2		0.08***		0.07***		0.07***		0.12***
Replacement hire rate			0.06*	0.05	0.05*	0.05		
KSS					0.18***	0.17***		
Turnover rate × KSS						−0.03		
Turnover rate^2 × KSS						0.07*		
Occupational category dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry category dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Number of firm year observations	3966	3966	3966	3966	3966	3966	3966	3966
Number of firms	2259	2259	2259	2259	2259	2259	2259	2259
R^2	0.06	0.09	0.08	0.09	0.11	0.12	0.02	0.05
ΔR^2		0.03***	0.03*	0.03**	0.05***	0.06***		0.03***
f^2	0.06	0.09	0.09	0.10	0.13	0.13	0.02	0.05

Note: $N = 3966$ firm-year observations. Standardized regression coefficients are reported.
Abbreviation: KSS, knowledge-sharing system.
*$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

present the baseline models that include the control variables. Models 2 and 8 test the direct effect of turnover rate. Model 6 examines the moderating effect of KSS. The average VIF statistic for each regression model ranged from 1.64 to 1.72. A mean VIF value that exceeds 4 indicates the presence of multicollinearity (Chen et al., 2014). In addition, we checked for bootstrapped confidence interval (CI) through resampling to test the unconditional and conditional indirect effects (Hayes & Preacher, 2010).

3.3.1 | Curvilinear effect of collective turnover

Hypothesis 1 proposes an attenuating negative relationship between collective turnover and firm innovation. To test the curvilinear relationship, we followed three steps as recommended in the literature (Fernhaber & Patel, 2012; Haans et al., 2016). First, we tested the linear and quadratic terms of turnover rate in Model 2 to determine the significance of the curvilinear effect. The quadratic term shows a significant positive effect ($\beta = 0.08$, $p < 0.001$) with a significant negative linear effect ($\beta = -0.12$, $p < 0.001$). Second, we tested the joint significance of the linear and squared terms of turnover rate following Sasabuchi's (1980) test for a U-shaped relationship (Fernhaber & Patel, 2012). The test result for turnover rate is significant ($p < 0.001$). Third, we estimated the extreme point of turnover rate and calculated CIs using the Delta method (Hirschberg & Lye, 2005). The estimated extreme point (0.80) and its 95% CI (from 0.64 to 0.95) are within the data limits. These results confirmed the significant curvilinear relationship. Specifically, the collective turnover effect is the lowest when turnover rate reaches the extreme point, after which such effect weakens. This pattern resonates the previous findings on the "diminishing damage" of high turnover rates

(Meier & Hicklin, 2008; Ton & Huckman, 2008). We also evaluated the f^2 effect size and the change in R-square (Heidenreich & Handrich, 2015). Including the curvilinear effect of turnover rate in Model 2 significantly improves the explained variance of firm innovation ($f^2 = 0.09$, $\Delta R^2 = 0.03$, $p < 0.001$), thereby supporting Hypothesis 1 and confirming that collective turnover has an attenuating negative effect on firm innovation.

3.3.2 | Moderating effect of KSS

We identified KSS as a boundary condition. Hypothesis 2 predicts that KSS positively moderates the attenuating negative relationship between collective turnover and firm innovation. We tested this hypothesis through the interaction term between KSS and the quadratic term of turnover rate using mean-centered variables. Such a quadratic-by-linear interaction model (cf. less constrained model; Van Der Vegt & Bunderson, 2005) assumes that the shape of a given curvilinear relationship changes by the moderator level (Sui et al., 2016). Specifically, we predicted that KSS steepens the curve instead of shifting the turning point. We initially found a positive and significant effect of KSS on firm innovation (Model 5: $\beta = 0.18$, $p < 0.001$). As predicted, the interaction between the quadratic term of turnover rate and KSS is significant (Model 6: $\beta = 0.07$, $p < 0.05$). The positive β coefficient concludes that a steepening occurs for the U-shaped relationship (Haans et al., 2016). Moreover, adding the moderating effect of KSS significantly increases the explained variance of firm innovation ($f^2 = 0.13$) in terms of change in R-square ($\Delta R^2 = 0.06$, $p < 0.001$). Therefore, Hypothesis 2 is supported.

To depict the pattern of this moderation effect, we further conducted a simple slope analysis (Aiken & West, 1991). We estimated the curves between turnover rate and firm innovation for firms with low (−1 standard deviation [SD]) and high (+1 SD) levels of KSS and plotted the relationship. Figure 1 illustrates that under the low KSS, turnover rate has a negative linear effect ($\beta = -0.06$, $p < 0.01$), but its quadratic term does not predict firm innovation ($\beta = -0.01$, *ns*). By contrast, when KSS is high, turnover rate is curvilinearly related to firm innovation with significant linear ($\beta = -0.12$, $p < 0.01$) and quadratic effects ($\beta = 0.14$, $p < 0.01$). In this condition, the initially negative turnover effect on innovation is flattened and changes to positive along with increasing turnover rates (beyond the point of 0.58), that is, an increasing KSS changes the turnover–innovation relationship from the overall attenuating negative pattern to a U-shaped pattern. Although we theoretically and empirically proposed a steepening type of moderation, "In practice, a flattening or steepening often goes hand in hand with a turning point shift" (Haans et al., 2016, p. 1185).

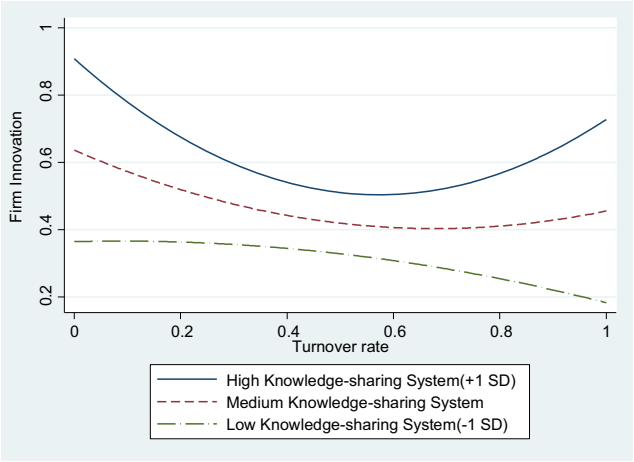

FIGURE 1 Turnover rate and firm innovation under high and low KSS.

3.3.3 | Mediating effect of replacement hiring

Hypothesis 3 predicts the direct effect of replacement hiring on firm innovation. Model 3 in Table 5 shows that replacement hire rate has a positive effect on firm innovation ($\beta = 0.06$, $p < 0.05$). When we alternatively used replacement hire rate measured at year $t + 1$, our results remained consistent. The f^2 effect size and change in R-square indicate that including the direct effect of replacement hire rate significantly increases the explained variance of firm innovation ($f^2 = 0.09$, $\Delta R^2 = 0.03$, $p < 0.05$). Therefore, Hypothesis 3 is supported.

Hypothesis 4 proposes that replacement hiring mediates the attenuating negative relationship between collective turnover and firm innovation. To test the proposed curvilinear indirect effect of collective turnover on firm innovation via replacement hiring, we conducted the bootstrapping procedure using PROCESS macro (Hayes & Preacher, 2010). We ran the macro with 1000 bootstrap resamples with all control variables included as covariates. We further computed the curvilinear indirect effects (cf. instantaneous indirect effects; Hayes & Preacher, 2010) of collective turnover on firm innovation via replacement hiring at different turnover rates. Table 6 reports the bias-corrected bootstrapped 95% CIs for the instantaneous indirect effects across varying turnover rates. Specifically, the instantaneous indirect effect coefficient is significant and decreasingly negative (from −0.044 to −0.034) when turnover rates increase (from 0.00 to 1.00).

We further investigated the mediating effect of replacement hire rate by following the rule of establishing the curvilinear mediation effect suggested by De Dreu (2006). First, collective turnover has a curvilinear effect on firm innovation (Hypothesis 1). Second, replacement hiring has a linear positive effect on firm innovation

TABLE 6 Instantaneous indirect effects via replacement hire rates across turnover rates.

	Turnover rate					
Indirect effect	**0.00**	**0.20**	**0.40**	**0.60**	**0.80**	**1.00**
Coefficient	−0.044	−0.042	−0.040	−0.038	−0.036	−0.034
95% Lower CI	−0.095	−0.089	−0.085	−0.082	−0.079	−0.076
95% Upper CI	−0.005	−0.005	−0.007	−0.007	−0.005	−0.001

Note: Bias-corrected bootstrap 95% CI for instantaneous indirect effects.

(Hypothesis 3). Third, we checked whether collective turnover has a curvilinear relationship with replacement hiring. As shown in Model 8 in Table 5, the quadratic term of collective turnover has a significant positive effect ($\beta = 0.12$, $p < 0.001$) with its significant negative linear effect ($\beta = -0.21$, $p < 0.001$). The Sasabuchi test of U-shape in turnover rate is significant ($p < 0.001$) (Fernhaber & Patel, 2012) and its extreme point (0.83) and 95% CI (from 0.65 to 0.99) are within the data limits (Hirschberg & Lye, 2005). Therefore, replacement hiring qualifies as a mediator of the curvilinear relationship between collective turnover and innovation. We also conducted structural equation modeling (SEM) and found a significant medicating effect as reported in Section 3.4. In sum, Hypothesis 4 is supported.

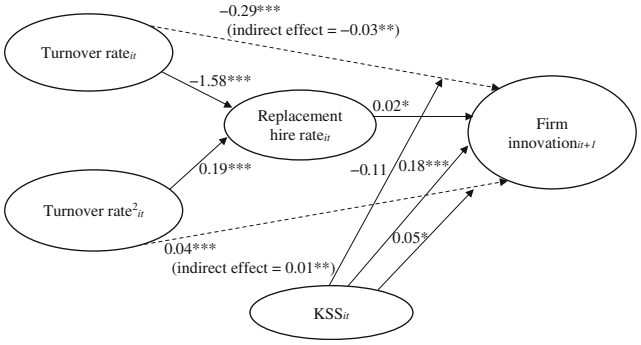

FIGURE 2 Supplementary analysis results using the structural equation modeling. $N = 3966$ firm-year observations. A variable$_{it}$ (e.g., KSS$_{it}$) denotes the variable of interest measured on firm i in year t. Maximum likelihood estimates (standardized) are displayed. Control variables are included in the structural model but not drawn in this figure. KSS, knowledge-sharing system. *$p < 0.05$; **$p < 0.01$; ***$p < 0.001$.

3.4 | Supplementary analysis

We performed supplementary analyses to provide additional insights into the current findings (all result tables are available upon request) by conducting SEM to test the robustness of our model. The structural model, including all hypothetical paths, is depicted in Figure 2, where only the paths among the key latent variables are shown for simplicity (i.e., the indicators, controls, and error terms were omitted). As shown in Table 7, the hypothesized model fits well to the data (e.g., $\chi^2(3) = 3.51$, $p = 0.32$). Specifically, the path between the quadratic term of turnover rate and firm innovation is significant and positive ($\beta = 0.04$, $p < 0.001$) with a significant negative linear effect ($\beta = -0.29$, $p < 0.001$), thus supporting Hypothesis 1. In addition, the interaction between the quadratic term of turnover rate and KSS is a significant predictor of firm innovation ($\beta = 0.05$, $p < 0.05$), thereby further confirming Hypothesis 2. The path between replacement hire rate and firm innovation is positive and significant ($\beta = 0.02$, $p < 0.05$), thus supporting Hypothesis 3. The indirect effect of the quadratic term of turnover rate on firm innovation via replacement hire rate is significant and positive ($\beta = 0.01$, $p < 0.01$) with a significant negative linear indirect effect ($\beta = -0.03$, $p < 0.01$), thereby confirming Hypothesis 4.

We also tested two alternative nested SEM models. One model omits the direct relationship between turnover and firm innovation (indirect effects model in Table 7), and the other model excludes the indirect relationship between turnover and firm innovation (direct effects model in Table 7). As shown in Table 7, the hypothesized model exhibits a significantly better fit to the data compared with the alternative models according to the results of chi-square difference tests, thereby further demonstrating the robustness of our findings. We also compared the hypothesized model with an unnested model that includes an additional path of the joint effect of KSS and replacement hiring. Although KSS positively moderates the linear effect of replacement hire rate on firm innovation ($\beta = 0.02$, $p < 0.001$), this model exhibits poor fit ($\chi^2(4) = 87.38$, $p = 0.001$; CFI = 0.88; RMSEA = 0.73; SRMR = 0.01).

KSS may moderate the indirect effect of collective turnover on firm innovation via replacement hiring (i.e., moderated mediation effect). The conditional indirect effects were obtained by multiplying the coefficients from the SEM model along with selected values of the moderator (i.e., KSS) and were tested by performing bootstrapping procedures with 500 bootstrapped samples (Hayes &

TABLE 7 Goodness of fit indices of the hypothesized model and alternative models.

Model	$\chi 2$	*df*	*p*	CFI	SRMR	RMSEA	$\Delta\chi 2$	Δdf	*p*
Hypothesized model	3.507	3	0.320	0.998	0.001	0.007	–	–	–
Indirect effects model	17.838	5	0.003	0.980	0.002	0.025			
Difference with proposed model							14.330	2	0.001
Direct effects model	12.944	4	0.012	0.986	0.002	0.024	–	–	–
Difference with proposed model							9.440	1	0.002

Note: $N = 3966$ firm-year observations. Indirect effect model (without a direct path from turnover to firm innovation) and direct effect model (without an indirect path from turnover to firm innovation) are nested in our hypothesized model. Chi-square difference test is conducted when comparing nested models.

Preacher, 2010; Wang et al., 2017). Specifically, we computed the bias-corrected CIs (95%) for the conditional indirect effects of turnover rate at low (−1 SD) and high (+1 SD) levels of KSS. Most CIs overlap zero: the indirect effect of the *quadratic term* of turnover rate at low KSS ($b = -0.001$, bias-corrected CI = −0.011–0.007) and high KSS ($b = 0.010$, bias-corrected CI = −0.012–0.029); indirect effect of turnover rate at low KSS ($b = 0.005$, bias-corrected CI = −0.028–0.027) and high KSS ($b = -0.069$, bias-corrected CI = −0.106–−0.011). The results indicate that the moderated mediation effect is insignificant.

4 | DISCUSSION

This study develops a theoretical framework to explain how and when collective turnover predicts firm innovation by adopting KBV, which accounts for the changes in knowledge insourcing. The current analysis affirms not only the costs of collective turnover but also its potential benefits for firm innovation, particularly under certain firm contingencies that may buffer the harm and turn the human resource loss into a benefit for knowledge insourcing. Accordingly, this study offers important theoretical and practical insights, although several limitations should be considered in further research.

4.1 | Theoretical implications

The utmost significance of the current theoretical and empirical analysis lies in its framing of the effect of human capital changes from the knowledge perspective. In effect, this study validated the potential of KBV toward innovation as implied by Grant (1996): "An interesting feature of the knowledge-based approach is that it offers a theoretical basis for understanding a number of recent organizational innovations" (p. 120). As KBV views firms as institutions for the application and integration of the specialist knowledge of employees (Grant, 1996), the increasing mobility of the contemporary workforce with distinct knowledge bears significance for firm operations, particularly innovation management. Our framework further reinforces the KBV assumption that knowledge integration and application can be achieved through (a) existing employees or (b) new members joining the organization (Grant, 1996; Li et al., 2022). Further elaborations and investigations can be targeted at distinct knowledge processes (e.g., exploitative vs. explorative learning) and innovation outcomes (e.g., incremental vs. radical innovation) initiated by existing versus new members. Beyond these general and broad theoretical insights, the current empirical analysis and findings provide several specific contributions to the literature.

First, this study reveals how the changing workforce of a firm affects its innovative performance. The current theoretical propositions offer critical insights beyond the prevailing belief on the dark sides of turnover, which may be inapplicable to innovation (Hancock et al., 2013; Shaw et al., 2013). We integrate KBV (Grant, 1996; Teece et al., 1997) and CET theory of human capital flow (Call et al., 2015) to provide a comprehensive and balanced framework that considers turnover cost and benefit in relation to knowledge insourcing for firm innovation (Li et al., 2022; Stephan et al., 2019). This balanced consideration is particularly important for understanding performance domains, such as innovation and creativity, which can be nurtured by a dynamic workforce that encourages variation and flexibility rather than by stable membership, consistency, and inertia (Hale Jr et al., 2016; Ostergaard et al., 2011). Such potential knowledge-related benefits of turnover can offset its detrimental effects on innovation as reflected in its attenuating negative effect along with increasing turnover rates.

Second, to further inform the innovation management literature, our findings highlight the benefit of replacement hiring that introduces external knowledge and diversifies the knowledge base of a firm, particularly in the face of a high collective turnover. Our analysis corroborates the findings of previous studies highlighting innovation gains from new recruits and star scientists (Mawdsley & Somaya, 2016; Müller & Peters, 2010). Although organizational turnover consequences have long been investigated, only few studies have explored the intervening mechanism (Hancock et al., 2013). In this

respect, scholars speculate that introducing new hires translates turnover effects into organizational outcomes (Raffiee & Byun, 2019). Unfortunately, such a possibility has yet to be investigated (for an exception, see Call et al., 2015). We fill this research gap and demonstrate that firm-level turnover consequences can be explained by considering the outflow and inflow of human resources. The knowledge brought in by new hires enhances knowledge insourcing, which validates KBV in explaining the function of human resource inflow for innovation.

Third, the current analysis offers new insights by isolating a critical firm-level contingency that informs when turnover can promote innovation. A theoretical logic for the positive potential of turnover toward innovation involves introducing and exchanging heterogeneous knowledge and ideas, which are critical determinants of firm innovation (Horwitz & Horwitz, 2007; Ostergaard et al., 2011). Accordingly, we introduce KSS as a key firm-level contingency. Our analysis confirms that the U-shaped curvilinear effect of turnover on firm innovation is significant only when KSS is high (Figure 1). KSS should facilitate the accumulation and transformation of the individual knowledge of existing and new employees into a collective knowledge reservoir, thereby upgrading the knowledge insourcing quality of their firms (Grant, 1996). Previous studies have treated HRM investment (e.g., selective staffing, training, and compensation) as a hindrance moderator that exacerbates the turnover–performance relationship by increasing the risk of loss from turnover (Shaw et al., 2013). By contrast, drawing from KBV, we theoretically argue and find that the moderating effect of organizational system or infrastructure can be positive, thus complementing the prevailing negative view based on human capital loss.

Fourth, this study enriches the innovation management literature from the strategic HRM perspective by introducing collective turnover as an antecedent of innovation. Notably, the nomological network of firm innovation is different from that of other performance measures. The collective turnover effect observed in the current analysis contradicts those observed in previous studies showing that turnover reduces productivity and financial performance (Hancock et al., 2013). Unlike such organizational outcomes that are prone to the downsides of turnover, adaptive performance, including innovation and organizational change, can be stimulated by turnover and/or subsequent replacement. To complement previous studies that only report a simple negative effect of turnover on performance (Pissaris et al., 2017; Revilla et al., 2020), our analysis reveals the attenuating negative and U-shaped curvilinear effects of turnover on innovation. Such unexpected and previously unobserved benefits of turnover may result from the nature of innovation that is distinct from productivity (Ko & Choi, 2019). Unlike executing current procedures efficiently, searching for new opportunities and generating innovative solutions require variability and fluidity in task processes (Chen et al., 2021), which can be enhanced by a dynamic workforce reconfiguration prompted by collective turnover. The current theoretical and empirical investigations of turnover based on KBV can be further extended to firm-level knowledge stock and flow and consequential performance.

4.2 | Practical implications

Our findings also hold interesting insights into practice. First, managers pursuing innovative performance should be warned of the common misconception that turnover is negative and must be avoided if possible. Our analysis demonstrates that high turnover rates and the resulting human capital changes do not necessarily reduce the innovation performance of firms. In reality, innovation is even facilitated by informational externalities or knowledge outsourcing resulting from turnover (Cooper, 2001). Hiring talented but "risky to leave" workers is often more valuable than hiring immobile and "safe" candidates (Lazear, 1998). Thus, managers should understand that turnover must be carefully managed to contain its damage and maximize its benefit by considering the different performance domains that favor the stability over the flexibility of human capital.

Second, our analysis reveals that turnover contributes to firm innovation partly by promoting replacement hiring, which replenishes the human capital losses caused by turnover. New hires are sources of heterogeneous ideas (Raffiee & Byun, 2019) that stimulate new knowledge combinations and reconfigurations. However, all new hires are not equal, and those with limited work experience fail to contribute to firm innovation. With the caveat in mind, recruiting managers should consider a mix of new and experienced workers given their disparate values toward various performance domains.

Third, managers should take proactive measures to maximize the positive potential of collective turnover instead of taking defensive actions to avoid turnover. Specifically, the turnover cost toward innovation can be mitigated by systematic organizational support and knowledge management, such as communication structures, trainings, standardized work procedures and manuals, mentoring programs, and on-boarding routines (Rollag et al., 2005). These practices facilitate knowledge sharing and transferring among employees, thus diminishing knowledge loss associated with turnover. In addition, such practices facilitate a prompt and efficient integration of newly introduced human capital and

minimize the time and cost of replacement. Given the prevalent and increasing turnover levels, instead of avoiding knowledge loss by trying to reduce turnover, a proactive coping strategy to minimize the loss through KSS may be a promising alternative (Ton & Huckman, 2008). KSS may augment not only the benefits of collective turnover but also its economic significance. Accordingly, firms with high turnover rates should build a systemic structure to promote the knowledge flow accompanying human resource inflow and revitalize their knowledge stock despite the knowledge outflow to generate innovation.

4.3 | Limitations and future research

This study has several limitations. First, this work cannot exclude the alternative relationships between turnover and innovation. Certain reverse causality possibilities were mitigated in the research design by using relatively large-scale, multisource, time-lagged data with a number of covariates evaluated at year *t* to exclude potential alternative accounts (Hancock et al., 2013; Hom et al., 2017). Although previous studies show that turnover effects on firm performance are stronger than reverse effects (Glebbeek & Bax, 2004), this firm-level relationship can evolve in a complex manner and may be shaped by many factors beyond those theorized and controlled in this study. Further theoretical and empirical endeavors should elaborate on the complex relationships between workforce characteristics (e.g., occupations, hierarchical levels) and innovations across different industries.

Second, our analysis is based on firm-level data, which prevents us from further exploring potentially different turnover and hiring effects at the team level. Turnover impacts vary across teams performing different functions. For instance, collective turnover and replacement hiring may be more impactful for innovation in R&D teams that perform exploratory tasks than in finance and accounting teams that perform routine jobs. Seemingly, the value of members' KSAs and their contributions to knowledge insourcing can be more salient for innovation in R&D teams than in other teams. Conducting comparative analyses across different parts of organizations to determine which of these parts are strongly affected by turnover and hiring is an interesting addition to the innovation literature.

Third, although the multi-wave and multisource data archived from the WPS offer a concrete basis for our analyses, future research may expand our findings using alternative measures for the key constructs. For example, we operationalized KSS by mostly focusing on the formal systems and IT infrastructure that enable and promote knowledge flow often initiated by the management. Our measure can be limiting in that it may not fully capture informal interpersonal interactions and deep-level exchanges of specialist knowledge residing within employees (Grant, 1996). Future studies may consider including more interactive knowledge sharing practices such as offline communication channels, team-building workshops, and mentoring programs. In addition, although our measure of firm innovation based on OECD survey items is reliable and provides time-lagged data, firm innovation can also be operationalized using objective indicators (e.g., the number of patents or the revenue from new products or services).

Fourth, human capital changes resulting from turnover and replacement hiring may have complicated meanings and functions that cannot be fully captured by the total number of leavers and new hires (Call et al., 2015). The significance and functions of replacement hiring may depend on the human capital quality of newcomers and what happens subsequently. Moreover, the effectiveness of replacement hiring can be affected by the urgency, speed, decision procedure, and post-hiring care that characterize new hires (Call et al., 2015). These qualitative and process-related parameters may lead to the dramatically different innovation implications of turnover and replacement hiring (Hancock et al., 2013). To advance on this topic, further studies may draw on Hausknecht and Holwerda's (2013) turnover capacity perspective that identifies five turnover properties or qualities, namely, leaver proficiency, time dispersion, positional distribution, remaining member proficiency, and newcomer proficiency.

Fifth, Western contexts should be considered in future research to confirm the generalizability of our findings. Although the Korean context provides an appropriate setting for our research, the Korean culture is characterized by hierarchical order and conformity based on high power distance; moreover, Korean firms typically value stability, loyalty, and group cohesion (Khanna et al., 2011; Lee & Lee, 2014). In such a group-oriented culture, firms have a group-based compensation system, and people are inclined to handover their tasks to others. Therefore, the Korean context may be a conservative setting for testing collective turnover effects. By contrast, the Western management system is characterized by high dependence on an external labor market, open recruitment (of the best candidates), merit-based promotion, and individualized incentive (Khanna et al., 2011). Further research is needed to examine the collective turnover effect on innovation and the KSS contingency across different cultural contexts.

4.4 | Conclusion

Our study extends the understanding of the relationship between human capital changes and firm innovation. By

integrating the KBV of firm innovation into CET theory that combines human capital inflow and outflow, we theorize and empirically verify that collective turnover is curvilinearly related to firm innovation. The attenuating negative effect becomes a U-shaped curvilinear effect when KSS is high, revealing the positive potential of collective turnover toward firm innovation. In addition, the replacement hire rate accompanying collective turnover exhibits a positive effect and mediates the collective turnover effect on firm innovation. Our research contributes to the innovation literature by revealing the implications of human capital changes toward knowledge insourcing for innovation and by identifying a critical contingency involving the knowledge-related context of KSS. By elaborating how and when collective turnover affects firm innovation, our work offers new research directions and managerial lessons for accruing innovation-targeted benefits from increasing workforce mobility triggered by the recent technological and societal changes.

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CONFLICT OF INTEREST STATEMENT

The authors declare that they have no conflict of interest.

ETHICS STATEMENT

The authors have read and agreed to the Committee on Publication Ethics (COPE) international standards for authors.

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