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Numerical labor flexibility and innovation outcomes of start-up firms: A panel data analysis

Masatoshi Kato[a,*], Haibo Zhou[b,c]

[a] School of Economics, Kwansei Gakuin University, 1-155 Uegahara Ichiban-cho, Nishinomiya, Hyogo 662-8501, Japan
[b] NIKOS – UTs Research Group for Entrepreneurship, Strategy and Innovation Management, Faculty of Behavioural, Management and Social Science, Univeristy of Twente, PO Box 217, 7500 AE Enschede, The Netherlands
[c] Nottingham University Business School, University of Nottingham Ningbo, China

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ABSTRACT

Using a panel data set based on repeated questionnaire surveys of Japanese start-up firms, this study examines the effects of numerical labor flexibility on the innovation outcomes of start-up firms, a topic on which there is currently insufficient research. Here, numerical labor flexibility is defined as the external labor turnover of regular employees and the proportion of non-regular employees, and innovation outcomes include product innovation and patent applications. The estimation results of a random-effects probit model indicate that an inverted U-shaped relationship exists between the external labor turnover of regular employees and the probability of patent applications. Moreover, a similar U-shaped relationship exists between the proportion of non-regular employees and the probability of product innovation. These results are interpreted in light of the organizational characteristics of start-up firms. The implications of the findings are discussed.

1. Introduction

This study investigates the role of numerical labor flexibility in promoting the innovation outcomes of start-up firms. In general, scholars and policymakers consider the emergence of start-up firms to be important for economic development because of their role in spurring innovation, creating new industries, creating jobs, and generating wealth (e.g., Acs and Audrestch, 1987; Audrestch, 1995; Folster, 2000; Reynolds, 1997; Rickne and Jacobsson, 1999), especially in modern entrepreneurial economies (Thurik et al., 2013). In particular, innovative start-up firms play a significant role in the economy by boosting regional development and growth through knowledge spillovers (Audretsch et al., 2008; Block et al., 2013; Bos and Stam, 2014; Fritsch and Mueller, 2004). Start-up firms that achieve innovation outcomes are valorized positively by external providers of finance, such as venture capitalists (Block et al., 2014; Hsu and Ziedonis, 2008; Zhou et al., 2016), which may improve their post-entry performance. However, scholars and practitioners agree that limited resources and experience constrain start-up firms in terms of successful innovation (Honjo et al., 2014). Therefore, understanding the determinants of innovation outcomes during the start-up period may help to guide future economic policy aimed at supporting innovation activities in start-up firms.

Building upon the resource-based view of the firm, several studies have found that internal resources and capabilities are critical for innovation (Del Canto and Gonzalez, 1999). Others have found that the qualifications of entrepreneurs (i.e., their human capital) can explain innovation in start-up firms (Baron and Tang, 2011; Kato et al., 2015; Marcati et al., 2008; Marvel and Lumpkin, 2007). However, the role in innovation of employees, who also form part of human capital, is currently insufficiently studied in the context of start-up firms. Employees play a more important role in start-up firms, which have a limited labor force, than they do in established firms (Bamberger et al., 1989). This also means that the innovation performance of start-up firms is more vulnerable to the performance of individual employees (Bamberger et al., 1989). Therefore, employee management is an important strategic issue that start-up firms need to resolve in order to overcome their resource constraints and achieve innovation effectively.

One of the fundamental relationships between an employer and employees is the contractual relationship, which is influenced by the flexibility of the external labor market. The ability of firms to use the external labor market is referred to as *numerical labor flexibility*, which has been identified in the literature as an important determinant of innovation. Numerical labor flexibility can affect innovation through its influence on knowledge processes (Amabile et al., 1996; Guest, 1997; Khedhaouria et al., 2017). The degree of flexibility of the contractual

* Corresponding author.
E-mail addresses: mkato@kwansei.ac.jp (M. Kato), h.zhou-1@utwente.nl (H. Zhou).

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labor relationship may influence the motivation and commitment of employees toward their employer, subsequently affecting innovation at the firm level (Naastepad and Storm, 2006; Ng and Feldman, 2008). Therefore, managing contractual relationships with employees, defined by firms' flexibility in using the external labor market, seems to be a highly relevant topic for start-up firms.

The present study argues that numerical labor flexibility is an important aspect of start-up firms' innovation. This flexibility reflects the ability of firms to use the external labor market to replace regular employees and/or to use temporary employees on fixed-term and part-time contracts, often through temporary employment agencies. Numerical labor flexibility allows the firm to respond quickly to changes in the environment (Beatson, 1995; Michie and Sheehan, 2003; Zhou et al., 2010). Given the inherent risk in pursuing innovation (Eisenhardt and Martin, 2000; Galloway et al., 2017), start-up firms need a high degree of flexibility to respond to the market and to the progress of their own innovative activities. Ensuring a positive cash flow is of primary importance (Bamberger et al., 1989). Therefore, by utilizing numerical labor flexibility, start-up firms can complement their limited resources and experience without incurring a large financial burden (Cardon, 2003). Indeed, some scholars have argued that flexibility may be critical for firms during the start-up period (Autio, 2005; Baughn and Neupert, 2003; Baughn et al., 2008). Information asymmetries tend to make it difficult for start-up firms to obtain financing from external providers of finance and to recruit employees in the job market. Therefore, numerical labor flexibility might be critical to counteracting both of these difficulties.

Using a panel data set based on original questionnaire surveys conducted annually in Japan between 2008 and 2011, this study explores the role of numerical labor flexibility in the innovation outcomes of firms during the start-up period. Specifically, this study examines the effects of numerical labor flexibility (measured as the external labor turnover of regular employees and the proportion of non-regular employees) on product innovation and patent applications by start-up firms. This study uses the terms "regular employee" and "non-regular employee" because the distinction between these two employee types is common in the Japanese context and is used in the *Labor Force Survey* by the Ministry of Internal Affairs and Communications in Japan (e.g., Kuroda and Yamamoto, 2011; Japan Institute for Labor Policy and Training, 2016).

The empirical results from random-effects probit models identify two strong non-linearities. First, the external labor turnover of regular employees shows an inverted U-shaped relationship with patent applications. Second, the proportion of non-regular employees has an inverted U-shaped relationship with product innovation only.

The present study contributes to the literature in the following ways. First, this study introduces numerical labor flexibility within the context of start-up firms. Although this flexibility is considered a determinant of innovation in established firms, it is rarely seen as a factor affecting innovation in start-up firms. Here, this study provides evidence on whether and how numerical labor flexibility affects the innovation outcomes of start-up firms and, thus, the study demonstrates the effectiveness of numerical labor flexibility as a strategic tool in such firms.

Second, by distinguishing between regular employees and non-regular employees as the two dimensions of numerical labor flexibility, and by using product innovation and patent applications as innovation indicators, the present study aims to identify ways in which start-up firms can achieve innovation outcomes efficiently through numerical labor flexibility.

Third, Japanese start-up firms may be of interest to scholars and policymakers in other countries. To date, few studies have investigated innovation in start-up firms in Japan, with the exception of Honjo et al. (2014), Kato et al. (2015), and Lynskey (2004). The Japanese economy has experienced low economic growth since the early 1990s (Fukao and Kwon, 2006). At the same time, the start-up ratio is relatively low, at around 3%, which is lower even than the exit ratio over a long period (Honjo, 2015). In this context, the current government in Japan advocates increasing the start-up ratio to 10% in order to improve the sluggish economy through entrepreneurship, particularly via innovative firms with growth potential. The government is also trying to achieve innovation by enhancing labor mobility within industries, because the size of the working population is decreasing in Japan. By explaining how to nurture innovation in firms during the start-up period via numerical labor flexibility, this study shows how a government can support innovative start-up firms that impact the economy in countries similar to Japan.

The remainder of the paper is organized as follows. Section 2 reviews the current literature on the relationship between numerical labor flexibility and innovation and identifies and addresses the limitations of previous studies. Section 3 presents the hypotheses in the context of start-up firms, and Section 4 explains the data and model. Section 5 presents the results, which are then discussed in Section 6. Section 7 concludes the paper.

2. Numerical labor flexibility and innovation

The question of whether to make the labor market flexible has been a topic of political debate in most developed countries over the past two decades, and a rich stream of literature in favor of flexible labor markets has emerged. Recent firm-level analyses of data from established firms in European countries have suggested that flexible labor contracts have a significant impact on innovation through their influence on knowledge processes (e.g., Amabile et al., 1996; Guest, 1997; Khedhaouria et al., 2017). Whereas functional labor flexibility, achieved by reallocating regular employees in a firm's internal labor market, is generally considered good for innovation (e.g., Arvanitis, 2005; Chadwick and Cappelli, 2002; Kleinknecht et al., 2006; Michie and Sheehan, 1999, 2001; Zhou et al., 2011), the effects of numerical labor flexibility are rather mixed. The inconsistent results are explained by two dominant theoretical views.

On the one hand, mainstream economists tend to favor the "Anglo-Saxon" labor market model, which allows for the easy replacement or turnover of regular employees (Kleinknecht et al., 2014; Zhou et al., 2011). A number of arguments have been presented in favor of greater numerical labor flexibility. First, the easy replacement of regular employees enhances the inflow of new ideas and networks. Ichniowski and Shaw (1995) show that long-tenured employees are more conservative and are reluctant to adopt significant changes or to implement innovations. This reluctance might be attributable to the "lock-in" effect caused by a past investment in education. Second, redundant employees can be replaced easily, which may encourage labor-saving process innovations (Bassanini and Ernst, 2002; Nickell and Layard, 1999; Scarpetta and Tressel, 2004). Third, easy replacement allows firms to replace poor and underperforming employees with better and more productive staff. The (latent) threat of being replaced can also prevent shirking by employees (Zhou et al., 2011). Fourth, easy replacement can help to keep wages low, thus reducing fixed labor costs (Storey et al., 2002; Zhou et al., 2011). Fifth, without strong protection against dismissal, employees have less power in negotiating high wages based on the profits from innovation, which may stimulate investment in innovation activities.

On the other hand, Schumpeterian economists, emphasizing firms' stability, continuity of learning, and firm-specific knowledge generation, argue against high levels of numerical labor flexibility (Zhou et al., 2011). They argue that high external labor turnover can diminish the trust, loyalty, and commitment of employees to their firms (Naastepad and Storm, 2006). Employees expecting a short stay in a firm will not be motivated to acquire firm-specific knowledge or to share information about knowledge related to their work. Therefore, there is less likelihood of continuity in organizational learning in the firm (Belot et al., 2007; Chadwick and Cappelli, 2002; Michie and Sheehan, 1999, 2001). Consequently, firms find it difficult to store firm-specific and innovative knowledge, as well as to implement innovations in the labor-saving