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Time-period and industry heterogeneity of innovation activity in Japan

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ABSTRACT

This study examines time-period and industry heterogeneity of innovation activity in Japan from 1964 to 2006 using patent data and non-consolidated firm data. This study focuses on the following three periods, based on changes of the Japanese patent system, in and non-manufacturing industries: (I) before 1976; (II) 1976–1987; and (III) after 1988. Specifically, for each degree of patent protection in each industry, this study examines how innovation activities are affected by the following determinants found in the innovation literature: size, market competition, and search variety (depth and scope). Empirical results show that when using the entire sample from 1964 to 2006, the size effect on innovation is significantly positive. In addition, the effects of market competition and search variety on innovation are inverse-U. When considering time-period heterogeneity, the effects of size and search variety are similar to the entire period; however, the inverse-U effect of market competition is broken after 1988. On the other hand, when considering industry heterogeneity, the effects of size and search variety are similar to the entire sample, but differ between manufacturing and non-manufacturing industries. In addition, the effect of market competition is not statistically significant in either industry.

1. Introduction

Understanding corporate innovation activities is a key topic, not only in the academic field, but also for industry and government. From the standpoint of competition policy, it is important to question how the degree of patent protection (i.e., appropriability condition) affects innovation activities. In Japan, from 1964 to the early 2000s, although there were more than a dozen revisions, key changes in patent filing activity took place three times: single claim system (before 1976); multiple claim system (1976–1987); the improved multiple claim system (after 1988) (Goto and Motohashi, 2007; Motohashi, 2004; Sakakibara and Branstetter, 2001). When focusing on patenting activities during the period, the number of patent application and registration tends to increase over time (Goto and Motohashi, 2007). Apparently, the strengthening of intellectual property protection encourages innovation activities in Japan. Based on this background, this study aims to

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further examine whether there is time-period and industry heterogeneity in innovation activities (i.e., patenting activities), focusing on the basic determinants discussed in the innovation literature.

The motivation of this study is to examine whether changes in the degree protections in Japan's patent system affect Japanese firms' innovation activities. Since the last half of 1990s, following developments in the US and other developed countries (such as effect of Agreement on Trade-Related Aspects of Intellectual Property Rights in the Uruguay Round of General Agreement on Tariffs and Trade in 1995), patent policy in Japan has shifted from an anti-patent policy toward a pro-patent policy (i.e., "IP-based Nation" was formulated in 2002 by Former Prime Minister Junichiro Koizumi). After the enactment of the Science and Technology Basic Law in 1995, the Intellectual Property Basic Act was enacted in 2002, and Intellectual Property Strategy Headquarters and Intellectual Property High Court were established respectively in 2003 and 2005. From these enforcements of policy, Japan is considered to progressively reinforce intellectual property protection. Against this pro-patent policy, however, the current trend of innovation in the world is moving toward the era of open innovation, and strict protection of intellectual property also has a harmful effect on innovation. Therefore, Japan will need to review this series of pro-patent policies sooner or later. To examine what type of effect on innovative activities will be caused by further protection of intellectual property, as at the first onset, this study aims to empirically investigate how the effects of innovation determinants in the literature have historically changed in Japan along with the changes in the degree of patent protection.

Corporate innovation studies have a long history beginning with Schumpeter (1942). Many studies in this field are associated with the Schumpeterian hypothesis, although test results for the Schumpeterian hypothesis are still considered inconclusive (for a comprehensive literature review, see Cohen and Levin, 1989; Gilbert, 2006 and Cohen, 2010). Instead of the Schumpeterian view of innovation activity, in recent years, innovation search processes have focused on evolutionary economics. Laursen (2012) discusses that firms often need to access a variety of inputs to achieve successful innovation. Specifically, in this context, it is important to examine how firms manage exploitative search (or local search) and exploratory search (boundary-spanning or non-local search).

This study examines how and what types of determinants affect innovation activities in manufacturing and non-manufacturing industries, focusing on time-period and industry heterogeneity across the three periods: (I) before 1976; (II) 1976–1987; and (III) after 1988. Specifically, this study uses firm data from 1964 to 2006, which consist of non-consolidated financial data and Institute of Intellectual Property Patent Database (IIP-DB). IIP-DB is based on the Japan Patent Office standardized data, and was developed by Institute of Intellectual Property[2] and Goto and Motohashi (2007).

This study aims to contribute to the literature in two ways: by using longitudinal data and analyzing basic determinants in the literature. When empirically examining determinants of innovation, as described above, inconsistent results are often found (Cohen and Levin, 1989; Gilbert, 2006; Cohen, 2010). This suggests that empirical results may depend largely on the sample conditions such as country, industry, or time-period. Among statistical or empirical studies examining innovation activities in Japan, representative studies are Ijichi et al. (2004, 2010), Inui et al. (2012), and Motohashi (2011, 2012). While these studies focus on short-term samples, this study uses longitudinal data from 1964 to 2006, divided into manufacturing and non-manufacturing industries. Inconsistent results in the literature also suggest that determinants of innovation may vary widely and be composite. However, to deepen the debate on the determinants, it will be more appropriate to use popular determinants in the literature than a wide variety of ad-hoc determinants. Therefore, this study uses basic and popular determinants. Concretely, they are size and market competition, which are classic factors in the industrial organization and exploitative and exploratory searches (search depth and scope, respectively), which has begun to garner attention in the evolutionary economics.

A short summary of this study follows. In terms of the entire sample during 1964–2006, size effect on innovation is positive. The size elasticity is approximately 0.22. In addition, the effects of Herfindahl–Hirschman Index (HHI; as proxy for market competition) and search depth and scope on innovation are inverse-U. When considering time-period heterogeneity, the effects of size and search depth and scope are similar to that of the entire period. The inverse-U effect of HHI, however, is broken after 1988. On the other hand, when considering industry heterogeneity, effects of size and search variety are also similar to the entire sample, but slightly different between manufacturing and non-manufacturing industries. In addition, the effect of HHI is not statistically significant in both industries.

The structure of this paper is as follows. Section 2 reviews the background of this study. This section firstly introduces the Japanese patent system and IIP-DB. Secondly, it discusses size and competition as innovation factors in the industrial organization and reviews Japanese studies. The section then introduces search variety in the evolutionary economics. Section 3 describes the empirical strategy and model, and Section 4 shows the data. Section 5 shows estimated results, and carefully checks each of determinants. Finally, Section 6 holds the conclusion.

2. Backgrounds

2.1. Patent system and innovation activity in Japan

From the standpoint of competition policy, it is important to question how the degree of patent protection (i.e., appropriability condition) affects innovation activities. Although Japan's patent laws have been revised multiple times, Japan's patent

[2] http://www.iip.or.jp/e/e_patentdb/.