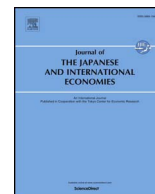




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## South Korea's transition from imitator to innovator: The role of external demand shocks

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### ABSTRACT

South Korean manufacturing firms have rapidly increased research and development (R&D) expenditure and the number of patent applications since the 1980s. This paper empirically argues that the increase in external market demand resulting from exchange rate changes had significant impacts on R&D expenditure of manufacturing firms in South Korea. Empirical analyses using South Korean firm-level panel data from 1981 to 1995 show that the exchange rate change was a significant driver of increased R&D expenditure. The South Korean firms whose exporting goods were similar to those produced in Japan were more sensitive to the exchange rate changes (especially Japanese yen's appreciation) than the firms whose exporting goods were less similar to Japanese exports. The result suggests a causal relationship between external demand and R&D expenditure.

### 1. Introduction

South Korea, officially the Republic of Korea, received the third largest number of patents in the United States in 2015 according to The United States Patent and Trademark Office (USPTO), followed by Germany and Taiwan.<sup>1</sup> Considering the fact that Korea was considered a technological *imitator* until the 1980s, this statistic is quite surprising. The number of patent applications filed by South Korean assignees in the United States (USPTO) started increasing sharply in the late 1980s. Fig. 1 illustrates this growth in U.S. patent applications by South Korean assignees, a shift which parallels the growth in the domestic patents of Korean firms.

The mid-to-late 1980s mark a clear trend break in Korea's technological development. What factor or factors powered Korea's rapid transition from imitator to innovator? There can be several possible explanations, including trade liberalization and wage increases.<sup>2</sup> In this paper, we emphasize the role of an *external demand shock* in driving increased demand for technological innovation within South Korean firms.

The primary goal of this paper is to explore the reasons for the surge in R&D expenditure by South Korean manufacturing firms in the late 1980s and early 1990s. We highlight the *role of exchange rate changes* in increasing the potential for South Korean firms to profit

from sales to foreign markets. The main hypothesis of this paper is that an important motivation for South Korean manufacturing firms (hereafter simply Korean firms) to become innovators was an increase in foreign demand for their goods resulting from exogenous movements in exchange rates. A sharp appreciation of Japanese yen created a significant potential opportunity for Korean firms to increase their exports to large external markets. This opportunity was greatest for Korean firms that were already producing products similar to those of their Japanese rivals. This sudden exchange rate shift conferred upon Korean firms a cost advantage over Japanese firms in large external markets, which allowed the firms to have higher mark-up for their exports. To fully realize this advantage, and to meet the demands of foreign customers for higher quality goods, Korean firms needed to invest in R&D and technology upgrading. To flourish in markets with strong intellectual property rights regimes, they also needed to acquire U.S. patents (which also required R&D expenditure). Korean firms' lower production costs (in dollars and other destination market currencies) dramatically raised the likelihood that Korean firms would be able to realize positive returns from these costly investments. This paper presents strong empirical evidence in support of this hypothesis.

Other scholars have argued that a shift toward stronger intellectual property rights (IPR) inside Korea was a primary driver of greater

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<sup>1</sup> The first and second places went to the United States and Japan, respectively.

<sup>2</sup> Liberalization can increase competition by inviting more foreign firms to South Korean domestic market. When the labor wage increases, firms can shift from low technology industries to high technology industries.

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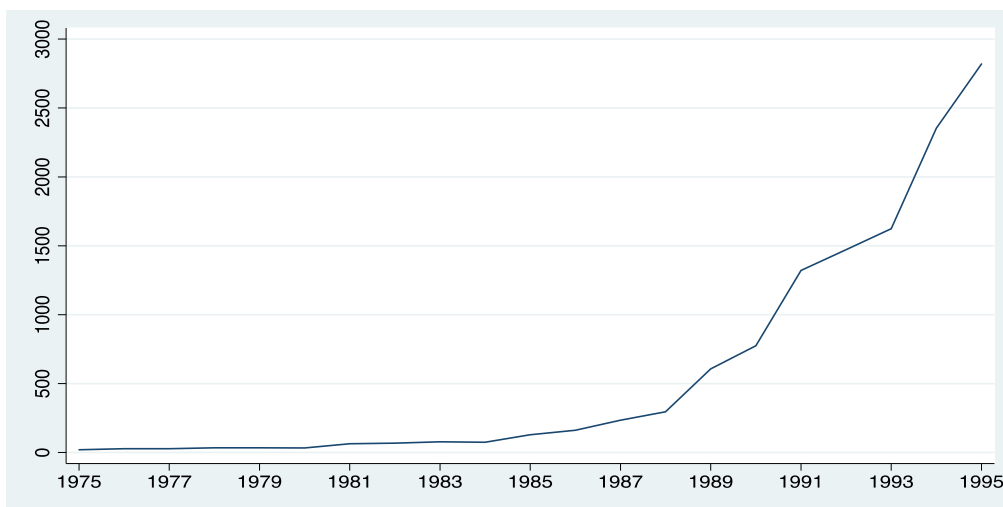


Fig. 1. Number of utility patent applications filed in the United States – South Korean assignees (1975–1995). The United States Patent and Trademark Office (USPTO).

technological innovation in the mid-to-late 1980s.<sup>3</sup> Song (2006) argues that the Korean patent law reform of the mid-1980s was a primary cause of the increased R&D. This argument is limited by the reality that the Korean domestic market was relatively small compared to the size of the external markets to which Korea exported. Moreover, the big export-oriented firms were the major patentees in the 1980s. These firms already faced strong incentives to apply for patents in their major foreign markets such as the United States and Europe. Even in theory, it seems unlikely that the strengthening of patent protection in the small domestic market would have such a large effect on the behavior of Korean firms (Grossman and Lai, 2004). Furthermore, our empirical evidence strongly supports the idea that the exchange rate channel highlighted in our theoretical work has a clear impact on firm behavior.

In principle, technology promotion policies by the South Korean government could have driven the R&D surge in the late 1980s and early 1990s. We do not deny the possibility that public policies such as R&D subsidies and tax incentives can promote firm R&D expenditure. However, we put less importance on the role of these policies mainly for two reasons. First, there was no significant change in the direction or incidence of these government policies in the 1980s that was consistent with the striking trend break in innovative activity. Choi (1988) argues that the climate for firms to invest in R&D was mature enough in the mid-1970s – subsequent changes in technology promotion policy were less important than the ones that came before. It is therefore hard to attribute a dramatic change in firm behavior to modest changes in policy. Second, firms do not decide to increase R&D solely because of government policies, such as financial incentives. They almost certainly would require a dramatic increase in expected payoffs (sales or profits) to successful R&D, before they would engage in a dramatic increase in the volume of R&D investment. Subsidies alone were not large enough to induce the huge increase in R&D investment that was actually observed. Finally, Kim and Dahlman (1992) insist that the South Korean government policies encouraging R&D investment in private sectors came into effect in the 1980s because of increased market demand for technological innovation – in other words, the policy regime changed because firms had already decided to increase their R&D expenditure. So, causality runs in the opposite direction from what advocates of the importance of industrial policy assert.

The remainder of this paper is organized as follows: Section II introduces some background information on the Korean economy, the similarities of the Korean economy and the Japanese economy, exchange rate changes, and Korean patent law reform. Section III briefly

reviews the related previous research. Section VI describes the data used in this paper. Section V explains the key variables and econometric models used in the paper, and discusses several possible alternative hypotheses. Section VI presents the empirical results, and Section VII concludes with a summary of the key results and their policy implications.

## 2. Background

### 2.1. The economic growth of South Korea

South Korea achieved exceptionally rapid economic growth for about three decades after 1960. The highly accelerated economic growth of South Korea is referred to as the ‘economic miracle on the Han River.’ South Korea was one of the poorest countries in the world after the Korean War (1950–53). The economy of South Korea experienced a slow recovery from 1953 to 1961 that relied heavily on foreign aid. Rapid, sustained economic growth began with the introduction of the Five-Year Economic Development Plans introduced by Park Chung-hee’s authoritarian government.<sup>4</sup> The first and second Five-Year Economic Development Plans (1962–66 and 1967–71) focused on building infrastructure and light industries such as textiles and footwear. The central aim of the third and fourth Five-Year Economic Development Plans (1972–76 and 1977–81) was to transform the light industries into heavy and chemical industries (HCI).

As the four Five-Year Economic Development Plans were implemented, they revealed many characteristics of economic growth in postwar South Korea. First, Park’s military government was quite interventionist, exercising strong influence over the national economy. The military regime could be described as a “hard state,” since it set national macroeconomic goals/policies and utilized direct interventions to influence individual firm’s economic decisions, including the choice of products and markets.<sup>5</sup> In doing so, the military government centralized its political power in the office of the president.<sup>6</sup> The president

<sup>4</sup> The Chang Myeon government was formed by the street demonstrations against illegal election for Rhee’s fourth term, referred as the ‘4.19 revolution’. The Chang Myeon government, however, was ousted by a military coup in 1961 by General Park Chung-hee. Park’s military government implemented four Five-Year Economic Development Plans (1962–66, 1967–71, 1972–76, and 1977–81).

<sup>5</sup> The military government gave significant incentives, such as tax exemptions and subsidies, to the firms which achieved the goals set by the government. For example, the military government awarded substantial financial benefits to the firms which met their export quota for the year.

<sup>6</sup> The President was Park Chung-hee.

<sup>3</sup> Empirical results are mixed.

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