Japan and the World Economy 43 (2017) 1–13

Contents lists available at ScienceDirect

Japan and the World Economy

journal homepage: www.elsevier.com/locate/jwe

Why did technical knowledge fall out of favor during Japan's Lost Two Decades?☆

Tatsuyoshi Miyakoshi

Department of Industrial and System Engineering, Hosei University, 3-7-2, Kajino-cho, Koganei, Tokyo, 184-8584, Japan

ARTICLE INFO

Article history:
Received 1 November 2016
Received in revised form 14 July 2017
Accepted 14 July 2017
Available online 23 July 2017

JEL classification:
O47
O57

Keywords:
International R&D transfer
Japanese technical knowledge
Absorptive capacity of knowledge
Asian output efficiency
Japan's Lost Two Decades

ABSTRACT

This paper investigates why Japanese technical knowledge fell out of favor by estimating stochastic frontier functions using 13 Asian developing countries. We find that the rate of absorption of technical knowledge from imported Japanese products was lower than that of imported US products. Seven countries that imported more from Japan than the US during the period 1994–2011 experienced a decrease in output efficiency, four countries changed their pattern of imports from Japan in favor of the US, and the two countries that retained a high level of US imports attained a high level of efficiency. The countries using US technical knowledge comprise a frontier country and catching-up countries, while the remaining countries using Japanese technical knowledge could not catch up to the frontier country. These findings suggest that during Japan's Lost Two Decades, Japanese technical knowledge fell out of favor in line with Japanese imports.

1. Introduction

The *output frontier* depends on both the stock of physical capital and the level of technical knowledge, which is similar to the relation between labor and human capital.[1] As technical knowledge (or the stock of R&D) created by advanced countries is embodied in their manufactured products, it can be internationally transferred through the import of manufactured products from advanced countries to developing countries and this then influences the *output frontier* of these countries. See Coe and Helpman (1995), Coe et al. (1997), Cameron et al. (2005), and Fracasso and Vittucci Marzetti (2015) for a discussion.

However, Henry et al. (2009, p. 238) argued that access to leading-edge technologies through transfers may not of itself lead to productivity improvements if these technologies are not absorbed. Therefore, the absorptive capacity of a country for technical knowledge is a critical factor in its ability to catch up with frontier countries. Thus, greater absorption of technical knowledge in a country improves *output efficiency* (the distance actual output is from the output frontier). In addition, Henry et al. (2009, p. 241) suggested that the higher the level of imports, given a constant absorption rate, the greater the absorption of foreign technical knowledge. Therefore, it is interesting to consider whether absorption rates differ depending on whether the imports are from Japan or the US. When importing firms investigate the imported good and understand the associated technology, the absorption rates will depend on issues such as knowledge, familiarity, attractiveness, and having a global standard. We account for this in our concepts of output efficiency. Thus, the rate of absorption of technical knowledge becomes a more important factor when we consider productivity. See Kneller and Stevens (2006), Henry et al. (2009), Mastromarco and Ghosh (2009), Wang and Wong (2012), and Danquah and Ouattara (2015) for details.[2]

☆ I am very grateful to the associate editor and reviewers for constructive comments. An earlier version of this paper was presented at the Japan Society of International Economics Conference held in Osaka in June 2015 and the Asian Meeting of the Econometric Society held in Kyoto in August 2016. The author is very grateful for constructive comments by Takayuki Tsuruga and Kazuo Mino. Grant-in-Aid No. 26380403 from the Japanese Ministry of Education, Culture, Sport, Science, and Technology (MEXT) supported this research.

E-mail address: miyakoshi@hosei.ac.jp (T. Miyakoshi).

[1] An empirical study by Coe et al. (1997, p. 147) reported, "On average, a 1% increase in the R&D capital stock in the industrial countries raises output in the developing countries by 0.06%".

[2] Some recent papers have estimated the effect of R&D spillovers from developed countries to the total factor productivity in production functions with physical capital and labor input of developing countries, which can simplify the framework and the then discussed R&D spillovers. See Chang et al. (2016), and Bengoaa et al. (2017).

http://dx.doi.org/10.1016/j.japwor.2017.07.003
0922-1425/

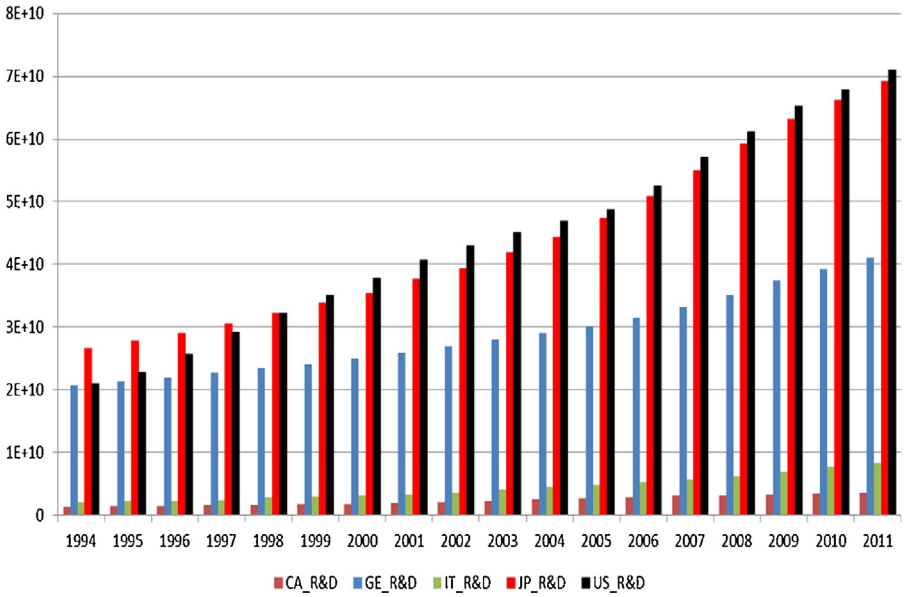

Fig. 1. R&D investments in machinery and equipment by G7 OECD country (excluding France and the UK).
Notes: STAN R&D expenditures in Industry (ISIC Rev. 4), D28: Machinery and equipment n.e.c., and US$ current PPPs. E + 10 is 10^{10} US$. CA_R&D is R&D investment by Canada: GE = Germany, IT = Italy, JP = Japan, US = United States. See Appendix A.

This paper investigates why Japan's technical knowledge fell out of favor in line with Japanese imports during the period corresponding to Japan's Lost Two Decades. We identify whether the technical knowledge embedded in imported goods from Japan or the US is the main driver of *output efficiency* through knowledge absorption. We also examine which source of technical knowledge (which import) each Asian country uses and how each country dynamically improves its output efficiency.

Our main findings are as follows. First, the *output frontier* of Asian countries depends on not only the stock of physical capital but also on the technical knowledge transferred from the advanced countries. In particular, US technical knowledge is better absorbed and is a key driver of *output efficiency* in Asian countries. Of the 13 countries analyzed, seven countries using Japanese technical knowledge in the period 1994–2011 experienced a decrease in output efficiency, four countries changed their pattern of imports in favor of the US in the period 2000–2011, and two countries retaining US technical knowledge during the period 1994–2011 either recovered or attained a high level of efficiency. The countries using US technical knowledge comprise a frontier country and catching-up countries in the period 2000–2011, while the remaining countries using Japanese technical knowledge could not catch up to the frontier country. These findings suggest that during Japan's Lost Two Decades, Japanese technical knowledge fell out of favor in line with Japanese imports. Interestingly, US R&D investment greatly exceeded that of Japan during the Lost Two Decades.

The remainder of the paper is structured as follows. Section 2 describes the overview of Japanese technical knowledge and Asian productivity. Section 3 details our methodology and Section 4 describes the equations estimated and discusses the data. Section 5 investigates which country is the main driver of output efficiency and Section 6 provides the dynamics of Asian output efficiency. In Section 7, we investigate the order of the efficient Asian countries in 1994–1999 and 2000–2011. Section 8 details a robustness check for the results. Section 9 provides some concluding remarks.

2. Overview of Japanese technical knowledge and asian productivity

In the 1970s and 1980s, Japanese technical knowledge (i.e., the stock of R&D) embedded in Japanese imported goods triumphed throughout Asia, characterized by mass production, high quality products, multiple functions, familiarity, and a common world standard. Indeed, a specific company-oriented technology, the Toyota Production System, exemplifying these characteristics became popular throughout Asia. Japanese electronic appliances, including their embedded technical knowledge, also dominated Asian markets. See Monden (1983), Nakamura (1991), Kaplinsky (1995), Harriss (1995), Muffatto (1998), and Giroud (2000) for details. However, in the last 20 years corresponding to Japan's Lost Two Decades (the long stagnation arising from the bursting of the domestic stock and real estate bubbles in 1990 and corresponding to the period 1990–2006), US technologies such as smartphones and tablets have largely supplanted traditional Japanese strengths in televisions, cameras, cell phones, and personal computers. At the same time, Japanese companies such as Sharp, Toshiba, and Panasonic, which exemplified the traditional technical strengths of the Japanese economy, have fallen into financial difficulty with decreased exports, while Chinese and Taiwanese firms merged their appliance and semiconductor divisions.

Since 1998, Japan's Lost Two Decades have become ever more serious. In response, the Japanese government injected a total of 12 trillion yen into major and medium-sized banks between May 1998 and March 2004, largely as a result of the positive risk of contagion flowing from the financial industry to the manufacturing industry, as discussed in Miyakoshi and Tsukuda (2004a, 2007) and Miyakoshi et al. (2011, 2014). Fig. 1 depicts the rapid collapse in Japanese R&D relative to that in the US. In 1994, Japanese R&D investment (as represented by machinery and equipment R&D expenditure) was about 2.7 billion US dollars whereas that of the US was only 2 billion US dollars. However, since 1999, US R&D investment has greatly exceeded that of Japan. This fact is consistent with the finding in Ogawa (2007) and Kasahara et al. (2014). As one associated outcome, Fig. 2