



The impact of technology transfer and R & D on productivity growth in Taiwanese industry: Microeconometric analysis using plant and firm-level data [☆]

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Received 31 August 2005

Available online 15 December 2005

Branstetter, Lee, and Chen, Jong-Rong—The impact of technology transfer and R & D on productivity growth in Taiwanese industry: Microeconometric analysis using plant and firm-level data

This paper conducts a comparative empirical analysis of the impact of R & D spending and purchases of foreign technology on output and productivity in Taiwanese industry. We employ data from two different sources, providing an econometric perspective on this question at two different levels of aggregation. We first conduct empirical analysis using data from the Taiwanese government's industrial census of technological activities at the *plant* level. This study is, to the best of our knowledge, the *first* empirical analysis using these data. We complement these results with analyses of data at the *firm* level. The results of our regression analyses generally support the conclusion that both R & D spending and purchases of foreign technology have contributed positively to Taiwanese productivity growth. *J. Japanese Int. Economies* **20** (2) (2006) 177–192. Columbia Business School, Uris Hall, Room 815, 3022 Broadway, New York, NY 10027, USA; Graduate Institute of Industrial Economics, National Central University, Taipei, Taiwan.

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JEL classification: F1; L0; O3

Keywords: Taiwan; Technology imports; Technological development

[☆] The views expressed in this paper are solely those of the authors, not the NBER, the OECD, or any branch of the government of the Republic of China on Taiwan.

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1. Introduction

Recent analyses have emphasized the skill of Taiwanese firms in obtaining and successfully utilizing technology developed abroad. This “absorptive capacity” is believed to be a key element in Taiwan’s export success in increasingly technology-intensive manufacturing industries. Our paper undertakes an empirical study of formal technology purchases from foreign sources in Taiwanese industry, in an effort to better understand the role this foreign technology has played in Taiwanese technological development and economic growth. We also examine the role played by the R & D spending of Taiwanese firms. Using data from the Taiwanese government’s industrial census of technological activities, we conduct empirical analyses of these issues at the *plant* level, with a focus on Taiwan’s dynamic and competitive electronics industry. This study is, to the best of our knowledge, the first empirical analysis using these data. We also examine these issues using data at the *firm* level, drawing upon a sample of publicly traded firms that is not limited to, but heavily populated by electronics firms. Our empirical results to date suggest that the impact of foreign technology imports on productivity growth at the plant level have been positive and significant. Furthermore, the industries and plants that spend the most on R & D also tend to spend the most on technology imports.

We acknowledge at the outset that formal technology purchases from foreign firms are only one of the means by which Taiwanese firms have acquired foreign technology. Other important channels include the technical information provided by foreign purchasers through “OEM” contract manufacturing agreements, the firms’ own efforts at reverse engineering and those undertaken by government-affiliated research institutes, and the “embodied human capital” which thousands of Taiwanese students brought with them when they returned to Taiwan after graduate study abroad. Unfortunately, none of these other channels leave a “paper trail” by which economic analysis might hope to measure knowledge flows and estimate their effects. Formal technology purchases *do* leave such a paper trail, and we exploit that fact in this paper.¹

We believe this paper will contribute to the empirical literature on purchases of foreign technology by industrial firms in developing countries. Earlier work by Braga and Willmore (1991) examined the cross-sectional determinants of technology imports in a sample of Brazilian establishments, using data drawn from a survey undertaken in a single year. The study also examined the impact of technology imports on “technological effort” and quality control. Because data were only available for a single year, this study was unable to include firm fixed effects in its analysis. The study by Basant and Fikkert (1996) examined the impact of R & D, formal purchases of foreign technology, and a number of other variables on the productivity of Indian firms from the mid 1970s through the early 1980s. While the Basant and Fikkert study possessed many advantages over the Braga and Willmore study in terms of data availability, it is also set in the context of a country whose government intervened heavily in the market for technology. Both Brazil and India placed significant limits on the activities of foreign firms. Furthermore, the intellectual property regime in both countries was intentionally designed in ways that limited the ability of incumbent patent holders to negotiate from a position of strength with licensees. The

¹ Our paper is related to earlier work that seeks to estimate the determinants and impact of *Japanese* firms’ purchases of foreign technology. Examples of contributions to this literature include Wakasugi (1997), Montalvo and Yafeh (1994), Goto (1993), and Odagiri (1983). Analyses of these issues outside Japan include the study by Basant and Fikkert (1996), who examined the relative impact of licensed foreign technology and R & D on the productivity of Indian firms, and the study of Braga and Willmore (1991) on Brazilian firms. Ashish Arora (1995, 1996) has examined international technology transfer in the chemicals industry.

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