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Outward foreign direct investment and technical efficiency: Evidence from Taiwan's manufacturing firms

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ABSTRACT

This paper uses firm-level panel data from Taiwan's manufacturing industries from 1987 to 2000 to investigate the impact of outward foreign direct investment (OFDI) on the technical efficiency of the OFDI firms. Propensity score matching is used to construct an appropriate group of non-OFDI firms to compare with OFDI firms, and a metafrontier framework is subsequently used to calculate comparable technical efficiencies for both groups of firms. Our empirical results reveal that the technical efficiencies of Taiwan's manufacturing firms were increasing over the entire sample period. In addition, our results suggest that the technological advances and the technical efficiency of Taiwan's manufacturing firms are positively correlated with their OFDI activity.

1. Introduction

The considerable appreciation of Taiwan's currency and rapid increases in labor costs have pushed many Taiwanese firms in traditional industries to move to low-cost developing countries since the late 1980s.[1] Taiwan has become a major investor around the world, particularly in mainland China. The possibility of industrial hollowing-out induced by this direct oversea investment has become a great concern in Taiwan. However, theoretical research regarding this issue is limited, and extant empirical evidence remains mixed.[2]

Most previous studies on the home country effects of outward foreign direct investment (OFDI) in general and technical efficiency in particular ignore two important evaluation problems. First, because firms consciously choose whether to become an OFDI firm, the self-selection problem will confound the effects of OFDI with other characteristics when the efficiency changes of OFDI firms are compared to those of non-OFDI firms. Second, firms might face distinct environments; therefore, their managers may adopt heterogeneous technologies or strategies. Simply combining all the observations from different groups and estimating a common frontier for the evaluation of technical efficiency may be invalid.

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[1] See Chen, Rau, and Lin (2006) and Lin, Chen, and Rau (2010) for recent evidence about the determinants of Taiwan's outward FDI.

[2] Caves (1996) provides a comprehensive survey of earlier literature about the determinants of multinational enterprises and their impacts. Lipsey (2002) and Kokko (2006) are two recent surveys about the home country effects of FDI.

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The purpose of this paper is to employ Taiwanese firm-level panel data to investigate the relationship between OFDI activity and the technical efficiency of the investing firms. To correct for selection bias, the propensity score matching method is used to construct an appropriate comparison group from the non-OFDI firms to compare the efficiency between these two groups. In addition, to solve the heterogeneous technology problem, the *metafrontier* approach developed by Battese, Rao, & O'Donnell (2004) and O'Donnell, Rao, & Battese (2008) is used.

The rest of the paper is organized as follows. The next section provides a brief literature review. Section 3 illustrates the evaluation problems in measuring the impact of OFDI on domestic performance and presents the propensity score matching approach. Section 4 introduces the *metafrontier* framework and the stochastic frontier analysis (SFA) method used to calculate comparable efficiencies of firms in different groups. Section 5 describes the data set, constructs a matched sample, and presents our empirical results. The last section provides brief concluding remarks.

2. Literature review

While earlier literature, such as Singh (1977) and Thirlwall (1982), suggests that a firm's OFDI may replace its domestic investment and affect a firm's development in the home country, many recent studies indicate that overseas investment may benefit the technology of the investing firms and their home countries. The investing firms exploit their unique assets and additionally develop their firm-specific advantages or acquire necessary strategic assets in a host country (Cantwell, 1995; Chung & Alcacer, 2002; Dunning, 1998; Kuemmerle, 1999; Makino, Lau, & Yeh, 2002), which might benefit the investing firms and their home country. In other words, a two-way linkage exists between foreign direct investment and the productivity of the investing firms.

Helpman, Melitz, & Yeaple (2004) developed a formal model to demonstrate the relationship between the choice of entry modes of multinational enterprises (MNEs) and productivity. These researchers find that firms with lower productivity stay in the home country, firms with higher productivity export and the firms with the highest productivity engage in OFDI. This idea is consistent with the traditional theory that suggests that firms with ownership advantages are more likely to invest abroad. Head and Ries (2003) extend the model developed in Helpman et al. (2004) and show that the order can be reversed if the host country is a low cost production site. These researchers show that if the host country wage is lower than the home country wage, and the foreign plant is not used to serve the home market, the exporters can be more productive than the foreign direct investors.

Ferrett (2004) notes two possible channels of reverse causality, i.e., the impact of OFDI on productivity of the investing firms. One channel is the internal development of a better technique via investment in research and development (R&D), and the other is to receive superior technical knowledge from other firms (that is, "spillovers"). Navaretti and Venables (2004) additionally indicate that OFDI will lead to a relocation of activities within a multinational firm; if this change leads to a more efficient use of resources, efficiency and profits at home will increase.

Li and Hu (2004), however, hypothesize that there are magnification and substitution effects involved in the influence of OFDI on domestic technical efficiency. These effects depend on whether the OFDI and domestic R&D strategies are complementary or substitutive. If OFDI and domestic R&D are complementary, then OFDI will benefit the investing firms' technical efficiency; otherwise, the effect will be ambiguous.

As for empirical evidence regarding the relationship between foreign direct investment and the productivity of the investing firms, Bitzer and Görg (2005), using industry and country level data for 17 OECD countries, show that a country's stock of OFDI is, on average, negatively related to productivity. However, AlAzzawi (2012) demonstrates that the results vary by the investing country. For newly industrializing countries, the OFDI has a strong, positive effect on productivity, while the OFDI from developed countries does not have a significant effect on productivity.

Driffield and Love (2003) use industry-level panel data from the UK to test for the existence of the reverse spillover effect. They find that investment by the domestic manufacturing sector generates productivity growth for foreign investors in relatively R&D-intensive industries. Driffield and Love (2005) show that the MNEs could derive substantial productivity spillovers from both indigenous firms and other foreign investors. van Pottelsberghe de la Potterie and Lichtenberg (2001) find that a country's productivity increases if the country invests in R&D-intensive foreign countries. Vahter and Masso (2007) additionally find that OFDI is positively related to the productivity of the parent firm. However, there is no robust evidence for substantial beneficial effects via productivity spillovers to other firms in the home country.

Using 1989–1996 panel data on FDI by Taiwanese firms, Li and Hu (2004) show that for those Taiwanese firms investing in China, OFDI serves as a substitute for domestic R&D and therefore harms the firms' technical efficiency. In contrast, Cheng, Li, & Huang (2006) find that FDI diversification in general and horizontal diversification in particular improves technical efficiency. However, firms in the traditional industries or firms investing in China are less efficient.

In sum, the evidence regarding the relationship between OFDI and productivity remains mixed. Moreover, there are several limitations in the abovementioned empirical studies. First, their samples usually cover only a limited period, meaning that it is difficult to identify the long-run effects of OFDI. Second, given the considerable differences in the characteristics between the OFDI firms and the national firms, most previous studies have not considered selection bias in their empirical analysis. To fill this gap, this study investigates the impact of OFDI on the technical efficiency of the Taiwanese investing firms with a large firm-level panel dataset for the period from 1987 to 2000. In addition, this study adopts propensity score matching to construct an appropriate group for efficiency comparison.