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Does foreign direct investment improve the productivity of domestic firms? Technology spillovers, industry linkages, and firm capabilities

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ABSTRACT

This paper explores how industrial linkages, firm capabilities, and the geographic location of domestic firms affect the diffusion of technology brought by foreign direct investment. I hypothesize that local firms are more likely to improve efficiency when they receive better product inputs from foreign suppliers and technology support by foreign customers, and such transfer of knowledge is more effective when the recipient has high absorptive capacity and is located near the source of knowledge. Empirical test using China's manufacturing firms finds positive productivity spillovers between foreign suppliers and their domestic customers. However, there is no positive spillovers from foreign-owned customers or competitors. Domestic firms' in-house R&D capital facilitates learning from foreign firms. Local firms learn from both joint ventures and wholly-owned foreign subsidiaries and the effects are larger from wholly-owned subsidiaries.

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1. Introduction

Policymakers in many developing countries spend considerably in an effort to attract foreign direct investment, by giving costly tax holidays, building infrastructure, and issuing regulatory exemptions. These policymakers expect foreign-invested facilities to bring new technology, capital, and management expertise and therefore improve the productivity of domestic industries. However, evidence remains limited whether and how domestic firms actually benefit from technology spillovers from the inflow of foreign investment. For example, [Aitken and Harrison's \(1999\)](#) study on Venezuela finds foreign-invested joint ventures actually have negative effects on the productivity of domestic firms in the same industrial sector. A recent study on Chinese firms ([Lin et al., 2009](#)) finds the horizontal spillover effects depends on the origin of the foreign direct investment, and the aggregate effect is mixed.

Several recent studies point out that positive productivity spillovers are more likely to happen between vertically linked industries, rather than within the same industry sector. This is because multinational firms have an incentive to prevent knowledge leakage to competitors, but may transfer technology to local suppliers to get higher quality inputs at lower prices. Local firms

could also improve efficiency for the same reasons when dealing with multinational suppliers. [Javorcik \(2004\)](#) finds positive spillovers from foreign-invested joint ventures to domestic firms in Lithuania in upstream industries, but not in horizontal or downstream industries. [Blalock and Gertler \(2008\)](#) find evidence of productivity gains and lower market prices among Indonesian firms supplying industrial sectors with a large foreign presence. Lin and coauthors (2009) find positive spillover effects on value-added productivity from upstream and downstream foreign investment in China.

Other factors beyond industrial linkages may affect the effectiveness of technology spillover. These factors include firm capabilities, the geographic locations of the source and the recipient of knowledge, and the ownership structure of foreign-owned firms, among others. [Blalock and Gertler \(2009\)](#) find domestic firms with previous R&D investment and highly educated work forces are more likely to adopt the technology brought by foreign firms. [Jaffe et al. \(1993\)](#) use patent citation data as a measure of spillovers and show the spillover effect is more evident at the local level. [Keller \(2002\)](#) finds the productivity benefit from R&D expenditures decreases with geographic distance between technology sender and recipient. [Javorcik \(2004\)](#) suggests that joint ventures are more likely than wholly-owned foreign subsidiaries to source locally and thus transfer technology to local suppliers.

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This study builds on the above research and examines whether the productivity of domestic firms is associated with the presence of foreign firms in the downstream, upstream, and horizontal industrial sectors, and whether this relationship is affected by firm capabilities, geographic distance, and types of foreign ownership. Understanding the channels and moderating factors of firms' learning from foreign technology has important policy implications, as the current empirical evidence on the welfare effects of foreign investment is mixed. A clearer understanding of the exact mechanisms of learning via foreign investment will allow policymakers to better target appropriate forms of FDI.

This study hypothesizes that local firms are more likely to improve efficiency through forward linkage and backward linkage to foreign invested firms, for example, when they purchase higher quality inputs from foreign suppliers or when they receive technology support from foreign customers. It's also contended that learning from foreign presence is more effective in improving productivity when the local firm has higher absorptive capacity, when the recipient is close to the source of knowledge, and when the multinational firm is a joint venture rather than a wholly-owned subsidiary.

This study contributes to the existing literature by exploring how the heterogeneity of firms and other microeconomic factors influence the spillover effects between local firms and foreign firms via industrial linkages. Although existing literatures have addressed different factors related to spillover separately, they don't always provide a comprehensive view of how different channels work together, and how firm level capabilities affect the impact of these channels. This study examines these questions using detailed firm-level data on production, finances, and R&D activities from census-type enterprise surveys conducted by the National Bureau of Statistics of China that covers all large- and medium-sized firms in China over the years. The panel structure of the data set and the rich information on firm production and R&D activities provide several advantages for this study. First, panel data allows within firm estimation to control for unobserved firm-level variations and better identification of efficiency improvement than cross-sectional data. Second, detailed information on firms' R&D activities allows accurate measure and analysis on the absorptive capacity of firms. Such firm-level capability is one of the major factors determining whether domestic firms can actually benefit from foreign presence. Third, China itself provides a salient context for this research. The country has received the largest amount of foreign direct investment among developing countries, and the investment is distributed unevenly across regions due to the country's semi-landlocked geographic feature and vast size. In addition, the privatization process in the country has introduced different incentives to domestic firms and led to fierce competition and a shake-out in many industrial sectors.

Another contribution of this study is the novel empirical finding and its managerial and policy implications. The study finds strong evidence of positive spillovers from foreign suppliers in the upstream sectors to local firms. A one-standard-deviation increase in foreign presence in the upstream sector, or an increase of 6.4 percentage points in the supplying FDI output share, is associated with a rise of 0.7 percent in the output of domestic firms in the supplied sector. But there is no evidence of positive spillovers from horizontal or downstream sectors, after controlling for firm level R&D activities. In other words, the productivity of Chinese firms is positively correlated with the presence of multinational suppliers, but not with foreign customers and competitors. This result is contrary to the findings of previous studies on technology spillovers set in other developing countries that find positive spillovers from foreign customers (Blalock and Gertler, 2008; Javorcik, 2004), but is consistent with the findings on China's manufacturing firms in recent years (Chang et al., 2007), indicating that the findings in previous

research might have been confounded by the selection based on firm capabilities. Lin et al. (2009) also found larger spillover effects from upstream foreign presence and smaller spillover effects from downstream foreign presence. Firm capabilities, measured as R&D capital stock, are found to be positively associated with spillovers from foreign suppliers, but have little effect on spillovers from horizontal or downstream sectors. The positive spillover effects on productivity are larger when the source of the spillover is wholly owned foreign subsidiaries rather than joint ventures, contrary to the findings in previous research (Javorcik, 2004).

These findings have important implications for managers and policy makers in developing economies. At firm level, investment in research and development might help the firm absorb and utilize the production technology it obtains from equipment suppliers, or better utilize input material and improve product quality, while simply relying on exporting to foreign market or selling to multinational firms might not improve firm efficiency significantly, especially when there is fierce competition between domestic firms in the exporting market. At national level, policy makers should reduce restrictions on foreign direct investment and trade barrier to encourage inflow of advanced production technology and input brought about by foreign-owned firms or through imports. These measures might be more effective to improve the efficiency and competitiveness at national level than merely focusing on export driven growth. This policy implication is supported by other studies on foreign direct investment in China. For example, Du et al. (2011) found that imposing input tariff is negatively associated with firm level productivity, and Brandt et al. (2008) found reducing final output tariff leads to increase in productivity.

The paper is structured as follows: Section 2 gives an overview of the literature on the channels and moderating factors of technology spillovers. Section 3 discusses FDI inflows into China, the data, and the estimation strategy. Section 4 presents results and Section 5 concludes.

2. Literature review on the channels of spillover and moderating factors

Multinational firms investing in manufacturing facilities in foreign countries are believed to possess advantages that enable them to compete with better informed domestic firms. These advantages include intangible productive assets, such as technology know-how, management skills, reputation, etc. Since these assets are gained through experience in operation or related to tacit knowledge, they cannot be easily replicated by local firms, but can be transferred via several channels and increase the productivity of a local firm. These channels include: 1) foreign customers may directly transfer knowledge to local suppliers; 2) foreign customers may have higher quality requirement and better supply-chain management skills that prompt domestic firms to improve production technology and management; 3) local firms may observe and imitate the technology and management practice of the multinationals; 4) local firms may recruit employees trained by multinationals or benefit from interaction with the personnel in multinationals; 5) local firms may benefit from the externalities brought by multinationals, such as higher quality input from the upstream foreign suppliers, larger demand from foreign customers and the economy of scale, better infrastructure subsidized by the government to attract foreign investment, etc.

2.1. Industrial linkage

The spillover effects on productivity from these channels depend crucially on industrial linkage. As previous studies suggest, there is little evidence of horizontal spillovers from foreign

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