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Estimating direct and indirect effects of foreign direct investment on firm productivity in the presence of interactions between firms

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ABSTRACT

We implement a method to estimate the direct effects of foreign-ownership on foreign firms' productivity and the indirect effects (or spillovers) from the presence of foreign-owned firms on other foreign and domestic firms' productivity in a unifying framework, taking interactions between firms into account. To do so, we relax a fundamental assumption made in empirical studies examining a direct causal effect of foreign ownership on firm productivity, namely that of no interactions between firms. Based on our approach, we are able to combine direct and indirect effects of foreign ownership and calculate the total effect of foreign firms on local productivity. Our results show that all these effects vary with the level of foreign presence within a cluster, an important finding for the academic literature and policy debate on the benefits of attracting foreign owned firms.

1. Introduction

When considering the impact of inward foreign direct investment on host country productivity, researchers and policy makers generally think about two aspects. The first is the direct effect of foreign ownership, boiling down to the question as to whether affiliates of foreign multinationals in a host country are more productive than comparable domestic firms. The second aspect is "spillovers", i.e., whether there is any effect from the presence of foreign firms on the productivity of domestic or other foreign-owned firms. These two questions have been pursued in, for the most part, two separate literatures.

One research strand (e.g., Harris and Robinson, 2002; Girma and Görg, 2007a; Arnold and Javorcik, 2009) implements methods from microeconometric programme evaluation to estimate the direct treatment effects for firms receiving the "treatment" of being foreign compared to non-treated domestic firms (without considering "spillovers"). This literature appeals to theoretical models of multinationals, either in the tradition of the knowledge capital model as in Markusen (2001), or the more recent models of heterogeneous firms (e.g., Helpman et al., 2004), which assume that foreign owned multinationals have firm specific assets which translate into a productivity advantage. The second research strand (e.g., Aitken and Harrison, 1999; Haskel et al., 2007; Keller and Yeaple, 2009) looks at indirect effects through productivity "spillovers" (while largely neglecting direct treatment effects). The theoretical intuition is that domestic firms can learn from the presence of foreign multinationals in their vicinity, e.g., because workers move from a foreign firm to a domestic competitor (e.g., Fosfuri et al., 2001).

Examining direct effects and spillovers in isolation leads to potentially biased estimates and policy conclusions, however. When evaluating the direct treatment effect of foreign ownership, the econometric approaches assume that the productivity of the control group is independent of foreign ownership – an assumption in contrast with the idea of spillovers.[1] In the "spillovers literature", identification of the effects of foreign ownership at the industry level on domestic firm productivity is problematic because of endogeneity concerns – there are industry or region specific shocks that positively affect domestic firms' productivity and raise the attractiveness of the location for foreign multinationals.

In this paper, we bring the two strands of literature together and propose and implement a unified framework to estimate direct and indirect effects from foreign ownership on firm level productivity which allows for interaction between foreign and domestic, and foreign and foreign firms. Our approach, detailed in the following sections, allows us to estimate consistently a number of different treatment effects. In particular, we can distinguish the direct effect of foreign ownership on the treated firms and two types of indirect effects of the treatment, namely the indirect effects on treated and non-treated firms. These indirect effects, thus, capture externalities or learning effects from foreign

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[1] This is known as the Stable Unit Treatment Value Assumption (SUTVA), which states that an individual outcome does not depend on the treatment status of others.

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firms on other foreign (i.e., treated) or domestic firms (i.e., non-treated). Furthermore, combining the direct and indirect effects we can calculate a total effect of foreign firms on local productivity.

Distinguishing these effects is not only of academic merit but also highly policy relevant, as it allows us to provide much richer and sharper insights on the nexus between foreign ownership, proximity to foreign-owned firms, and firm productivity. Hence, the approach suggested here provides a very useful tool for policymakers to understand better the benefits of encouraging foreign direct investment.[2]

We implement our econometric framework using firm level data for Chinese manufacturing. Following, Hudgens and Halloran (2008) our approach to take into account the role of interactions among firms when evaluating the effects of foreign ownership on firms' productivity is to use the proportion of foreign firms within well-defined clusters at the industry-region level. Thus, the potential outcomes depend not only on the firm's treatment status, but also on the fraction of foreign firms in a particular cluster.

Our empirical results show that the direct effect of the treatment on the treated firms is not homogenous across industry-region clusters, but rather differs strongly across such clusters. In particular, we find that the direct effect of foreign-ownership on the treated (i.e. foreign-owned) firms is positive and increases strongly with the overall level of foreign-owned firms in a cluster. This suggests that the standard approach of estimating direct treatment effects, which neglects interactions between firms, fails to uncover potentially important heterogeneity in the effect across clusters.

We also find a consistently negative indirect effect of foreign-ownership on non-treated firms, indicating negative "spillovers" from foreign presence on domestic firms. Also, in contrast to much of the literature on spillovers cited above, our approach shows that the strength of this negative spillover is not constant but differs significantly with the level of foreign ownership in a cluster. Spillovers are more negative with increasing presence of foreign firms up to a threshold of around 40 percent foreign-owned firms, after which they become less negative.

In terms of the indirect impact of foreign ownership on the treated (i.e. the spillovers from the presence of foreign firms on other foreign firms in the same cluster), we also find a negative effect up to a level of 40 percent foreign-owned firms in a cluster. However, after reaching this threshold these effects turn positive. This has important implications for arguments favouring the agglomeration of foreign-owned firms in a cluster, as this shows that the benefits from such agglomerations might only become positive once a certain threshold is reached.

The remainder of the paper is structured as follows. Section 2 presents the theoretical motivation of the paper. Section 3 discusses our identification strategy and introduces the different types of effects we aim to estimate. Section 4 presents the data set that we use to illustrate our arguments, while Section 5 gives a detailed explanation of the empirical implementation of our econometric approach. Section 6 discusses the main findings of the paper, and Section 7 concludes.

2. Theoretical motivation

In this section we sketch out a simple theoretical framework in order to motivate the empirical analysis. The model is closely related to Guadalupe et al. (2012) (GKT), who look at the impact of foreign investment on firms' innovation activities in a model of firm heterogeneity. They, however, only look at a direct causal effect of foreign acquisition, implicitly assuming no spillover effects. To capture such spillovers, our theoretical sketch essentially re-interprets their model for a case in which firms' productivity enhancing activities also depend on the presence of other foreign firms in a cluster and the capacity of foreign and domestic firms to absorb spillovers from FDI.

As in GKT we work with a model with heterogeneous firms in a monopolistic competition setting and a CES demand function. Firm i has an initial productivity level of φ_i and it can make a productivity enhancing investment, γ_i. In GKT this investment is considered to be innovation. We take a broader view and consider this to be any activity that is productivity-increasing at the firm level, and that will lead to a measurable increase in productivity as a result of firm level foreign investment.

Firm i profits are given by

$$\pi_i = B_i \tau_i \phi_i \tag{1}$$

where $B_i = A_i\left(\frac{1-\rho}{\rho}\right)\rho^{\sigma}$ with A being market size and ρ defining the elasticity of substitution between varieties $\sigma = 1/(1-\rho)$.[3] For ease of exposition we define $\tau_i = (\gamma_i)^{\sigma-1}$ and $\phi_i = \varphi_i^{\sigma-1}$ which are transformed measures of productivity-enhancing investments and initial productivity, respectively. Firms must engage in costly investments in order to increase their productivity level. As in GKT we assume that the cost of such investments (C_i) include a fixed and a variable component, as follows:

$$C_i = a_i + \frac{b_i}{\alpha_i N_r} f(\tau_i) \tag{2}$$

with f denoting a general positive function of τ_i without specific assumptions about its functional form.

In GKT, foreign ownership impacts innovation only by affecting the parameters a_i and b_i. We follow their approach and assume that these parameters are positive and lower for foreign (F) than for domestic firms (D): $0 \le b_F < b_D$ and $0 \le a_F < a_D$. This reflects the foreign multinational's access to better technology, or lower costs of financing, which imply that the firm has lower costs for implementing productivity enhancing investments. We interpret this as the *direct effect* of foreign ownership on firms' productivity, which we attempt to identify in our empirical analysis.

To capture the *indirect effects* from other foreign firms, we extend GKT by allowing the variable cost of productivity enhancing investment also to depend on: i) the number of foreign firms in a cluster (N_r), and ii) a firm specific constant, capturing its capacity to absorb spillovers from foreign firms (α_i). The assumption that the cost of productivity enhancing technologies depends on the number of foreign firms (N_r) captures the notion of spillovers. These are generally expected to be positive due to learning effects. While we do not model the exact underlying mechanism (which we also cannot measure in our data), one reasonable interpretation for such positive effects is worker movements. As discussed by Fosfuri et al. (2001), domestic workers may be hired by foreign firms (which possess superior technology) and then trained to be able to use the up-to-date technology.[4] After a period of training, they may then either remain in the foreign-owned firm or move to a domestic competitor. In the latter case, they take with them some knowledge about technology, which then makes it easier for the domestic firm to implement this new technology. A domestic firm without a foreign-trained worker is not able to do so. Hence, the costs of improving technology are, in this case, lower for the domestic firm with foreign-trained worker than for the domestic firm without. We assume that the chance

[2] We outline the main reasons why a simple linear model where the direct and indirect effects of FDI are estimated within a single framework is unlikely to be an adequate empirical tool in Appendix D.

[3] Guadalupe et al. (2012) allow the parameter A to vary across foreign and domestic firms. Their idea is that foreign firms may have access to larger markets than domestic firms. We simplify this model and abstract from this market size effect in order to be able to focus on the effect we find more relevant, namely, the effects of foreign ownership on the cost of productivity enhancing investments.

[4] Görg and Strobl (2005) provide empirical evidence from firm level data for Ghana.

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