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Erratum

Firm heterogeneity and location choice of Taiwanese multinationals

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A R T I C L E   I N F O

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A B S T R A C T

This paper examines the extent to which production location decisions of Taiwanese multinationals reflect underlying patterns of firm productivity. In our theoretical model, heterogeneous firms in a middle-income country decide on the optimal production locations for serving three geographically separate markets: domestic, foreign high-income and foreign low-income. The model shows that the equilibrium decision of a firm depends on the fixed investment costs of establishing foreign subsidiaries, production costs, transportation costs, market size and its own productivity level.

Using firm-level data in 2000, Taiwanese electronics firms are divided into four different categories: non-FDI, investors in China only, investors in the U.S. only, investors in both China and the U.S. We use a multinomial logit model to link firms' location choices with their productivity, controlling for country, industry and other firm characteristics. Our empirical results are consistent with the predictions of the theoretical model. We show that more productive firms engage in outward FDI, with the most productive ones investing in both China and the U.S. We also provide evidence indicating that Taiwanese multinationals investing only in the U.S. are more productive than those investing exclusively in China due to smaller fixed investment costs in China relative to the U.S.

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1. Introduction

In the decade of the 1990s, worldwide sales of multinational firms expanded at rates that outpaced the rapid growth of trade in manufactured goods.[1] By 2001, the gross product of foreign affiliates accounted for more than 11% of world GDP. This rapid expansion has triggered much research into the factors underlying the investment patterns of multinational firms. However, the bulk of recent research on outward foreign direct investment (FDI) has been at the aggregate level and restricted to developed countries (DCs) like the U.S. and Japan.[2] This paper uses micro-level data for Taiwan, a developing country that has experienced extraordinary growth in outward FDI since 1990, to shed light on the extent to which production location decisions of Taiwanese multinationals reflect underlying patterns of firm productivity.

A rapidly growing area of research in the literature on FDI in recent years has been in incorporating firm heterogeneity within industries into simple models of international investments. In particular, Helpman et al. (2004) focus on heterogeneous firms serving consumers in foreign markets through exports or horizontal FDI. They model a firm's decision between exports and FDI as driven by the proximity-concentration trade-off whereby FDI incurs higher fixed costs but involves lower transportation costs relative to the export activity. Their model predicts that the least productive firms serve only the domestic market, the relatively more productive firms export and the most productive firms engage in FDI. The authors provide empirical evidence at the industry

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[1] Sales of multinational firms exceeded that of exports by about 7% per year from 1990 to 2000 (UNCTAD, 2002).
[2] An exception is Debaere's (2004) discussion on FDI in Newly Industrialized Economies (NIEs) in the 1990s.

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level to support the sorting pattern predicted by their theoretical model. Yeaple (2007) takes the Helpman et al. paper one step further by incorporating firm heterogeneity as well as geographic sorting into the structure of U.S. multinational activity across industries and countries. He shows that more productive firms are more likely to invest abroad, but firm productivity plays a smaller role when the destination country is large.[3]

This paper is based on a very recent theoretical paper by Grossman et al. (2006) in which the authors develop a complementary strategy model incorporating firm heterogeneity as a determinant of horizontal and vertical FDI. They show that even within the same industry where each firm faces the same market size, fixed costs and transportation costs, firms differing in productivity have different optimal strategies. In their model, a firm performs intermediate stages of production in a country with low production costs and subsequent stages (such as assembly) in another country close to the final market to save on transportation costs. Their model has two identical Northern countries and one Southern country with low production costs and small market size. Each firm chooses the production sites for intermediate and assembly stages in serving the global market. Grossman et al. conclude that the least productive firms produce in the home market, firms engaging in FDI are more productive, and the most productive firms will move both intermediate and assembly stages into the South. Integration strategies depend on the scale of trading costs and the relative fixed costs of the intermediate and assembly stages. In the case where trading/transportation costs of final goods are low, firms will not produce in the North. As the transportation costs on final goods increase, firms are going to spread out assembly into all final markets. Finally, when there are transportation costs on intermediates, firms prefer to combine these two stages in the same country.

We develop a modification of the Grossman et al. (2006) framework to explain integration strategies of multinational firms, headquartered in a middle-income country, choosing production locations in developed countries (North) or developing countries (South) for their global sales. Existing models which focus on FDI flows from the North to the South or between Northern countries cannot adequately explain the outward FDI activities of multinational firms in middle-income countries such as Taiwan and South Korea, where wages are sandwiched between those in the North and South.[4] We introduce a simple one-stage production model where firms investing in and serving the Northern market are able to save on transportation and trading costs while those investing in and selling in the market in the South conserve on both production and trading costs. This model captures both market-seeking and resource-seeking incentives for multinational firms. In particular, it focuses attention on the trade-off in the costs associated with domestic production for export versus moving the production overseas to locations with varying set-up costs. Our theoretical model shows that a firm's location decision depends on industry characteristics, such as fixed investment costs of building a foreign plant, market size, transportation and trading costs, as well as firm productivity.

Given that fixed investment costs and product substitutability are likely to differ most significantly across industries, we estimate the location decision model separately for the Taiwanese Computer and Telecommunications Equipment industry and the electronic Parts and Components industry within the electronics subsector. The empirical findings of the paper are consistent with the predictions of our theoretical model. We show that more productive firms engage in outward FDI, with the most productive ones investing in multiple countries. We also provide evidence indicating that Taiwanese multinationals investing only in the U.S. are more productive than those investing exclusively in China due primarily to smaller fixed investment costs in China relative to the U.S.

This paper makes two main contributions to the literature. First, we develop a three-country model that accounts for the interdependence between host country and other final consumption countries. Our model resembles those of Ekholm et al. (2007) and Helpman et al. (2004). The key difference is that we explicitly model the effects of firm heterogeneity and the effect of country characteristics on firms' location choices. By introducing firm heterogeneity into Ekholm et al.'s framework, we allow firms with different productivity levels to choose different production locations based on factor price differentials, fixed investment costs and market size across countries. In contrast to Helpman et al. (2004), we introduce the strategy of exporting from a third country.

Second, unlike existing empirical work which primarily focuses on investments flowing from North to South countries, or among countries in the North, we introduce a middle-income country that is just as likely to invest in the South as it is to invest in the North. More specifically, by simplifying Grossman et al.'s (2006) two-stage production model to a one-stage model, we concentrate on the production destinations of firms from Taiwan to China and the U.S. This model allows us to take full advantage of the unique information in the data set on the destination of outward FDI among Taiwanese firms. Given Taiwan's middle-income status, one of our objectives here is to provide insights into the economic rationale for the growing trend towards outward FDI among firms in a rapidly growing developing country.

Section 2 presents some background of Taiwanese FDI in the 1990s and the data used for the empirical estimation. Section 3 develops a theoretical model for firms' production location choices. The empirical counterpart to the theoretical model is presented in Section 4. Section 5 reports the estimation results. The summary and conclusions are presented in the final section.

2. Data description and the pattern of Taiwanese outward FDI

This paper is based on plant-level data of the Taiwanese manufacturing sector in the year 2000. This data was collected by the Ministry of Economic Affairs (MOEA) in Taiwan. In addition to reporting revenue, total employment, and R&D expenditures, the data set also includes a unique firm identification number for each plant so that we can identify the owner of each plant. While this

[3] Other recent papers include Girma et al. (2005) on U.K. firms and Head and Ries (2003) on Japanese firms.

[4] Debaere (2004) illustrates how explicitly accounting for a middle income country (South Korea in his case) in the decision of Korean multinationals involves different incentives and yields interesting results regarding the effects of the reallocation of their activities between the labor abundant South and capital abundant North.

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