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Does Foreign Direct Investment Drive Technological Upgrading?

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Summary. — This paper evaluates whether inward foreign direct investment stimulates technological upgrading, and if its impact depends on an economy's level of social capability. FDI inflows exert a positive influence on technological upgrading over a lengthy time period for a large and diverse sample of countries. This effect is conditioned by an economy's level of social capability, as well as its income. Among poor countries the effect of FDI on upgrading is bolstered for those endowed with higher levels of social capability. The effect of FDI on upgrading in rich countries remains positive but is weaker, and social capability exerts little disparate influence among these similarly socially capable economies.

Key words — knowledge spillovers, social capability, technology, innovation, diffusion

1. INTRODUCTION

Technology gaps account for a significant part of the large differences in *per capita* income that distinguish rich from poor economies (Abramovitz, 1986; Easterly & Levine, 2001; Fagerberg, 1994; Gerschenkron, 1962; Hall & Jones, 1999; Klenow & Rodriguez-Clare, 1997; Schumpeter, 1949). One important proximate cause of these technology gaps is that rich and poor countries invest differently in the production of knowledge. For instance, countries in the former Group of Seven (G7) accounted for 84% of the world's expenditures on research and development (R&D) in 1995 (Keller, 2004), leaving nearly 190 countries to account for the remaining 16%. Those same G7 countries took out 92% of all patents filed with The United States Patent and Trademark Office in 1995. [1]

This unequal distribution of technological sophistication is not, however, written in stone. Developing countries could introduce greater investments in innovation, although this is unlikely to be the most productive use of their resources, given their distance from the technological frontier. Instead, their central challenge is to learn about, acquire, and master technologies produced elsewhere (Bell & Pavitt, 1993; Lall, 1992). Technology is a quasi-public good, and thus agents in developing countries can, in theory, transform knowledge spillovers into local technological upgrading. This upgrading could help close international technology gaps, and thereby permit developing countries to catch up to income levels enjoyed in richer economies.

If it were so straightforward, of course, technology gaps would rapidly dissipate. There is much we do not understand about the spread and absorption of technology. Vital and widely debated questions include: how is technology disseminated? Through what channels is economically meaningful knowledge spread? What determines an economy's ability to learn and upgrade? This paper examines these topics by focusing on one extensively researched potential conduit for the dissemination of technology: foreign direct investment (FDI). Scholars believe that agents may learn from the more-sophisticated activities of multinational corporations (MNCs) in their midst, and this learning will result in an increase in the aggregate level of technology in the host country (Aitken, Hanson, & Harrison, 1997; Haddad & Harrison, 1993). Empirical tests of this hypothesis provide mixed evidence. In certain specifications and contexts, FDI appears strongly positively related to firms' and countries' productivity gains and *per capita* income growth. Other studies uncover no significant relationship.

Inconclusive results might indicate that FDI is not among the primary pathways through which technologies are disseminated (Hanson, 2001). If this is true, policymakers in host countries that seek technological advancement are better served focusing their efforts elsewhere. Another possibility, however, is that upgrading does not flow automatically from FDI. Instead, FDI might stimulate technological learning only when agents in the host economy possess the ability to "recognize the value of new, external information, assimilate it, and apply it to commercial ends" (Cohen & Levinthal, 1990, p. 128). Technological advancement, in this view, demands not merely access to spillovers, but also certain societal and institutional competencies, that have been labeled "social capability" (Abramovitz, 1986), or "absorptive capacity" (Cohen & Levinthal, 1990). Cross-national empirical tests generally conclude that FDI stimulates productivity growth only when countries have reached a certain threshold of social capability (Alfaro, Chanda, Kalemli-Ozcan, & Sayek, 2004; Borensztein, De Gregorio, & Lee, 1998; Xu, 2000), although some sophisticated econometric evidence suggests that the relationship does not survive appropriate modeling of endogeneity and omitted variables (Carkovic & Levine, 2005). Still another view is that social capability is itself not enough. Rather, FDI and social capability may interact differently depending on the development level of the country in question (Blonigen & Wang, 2005).

The primary goal of this article is to provide robust estimates of the exogenous contribution of FDI and social capability to macroeconomic technological upgrading. I address the following research questions:

1. Is foreign direct investment associated with technological upgrading?

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2. Does the relationship between technological upgrading and foreign direct investment depend on an economy's level of social capability?
3. Do foreign direct investment and social capability affect upgrading differently for rich and poor economies?

I add value to existing empirical work in three main ways. First, I employ a novel measure of technology. One major limitation of the existing econometric work is the use of distant proxies for technology, primarily GDP or total factor productivity (TFP). The measure employed in this article evaluates the technology level of an economy by gauging the sophistication of each product it exports to the United States, and captures changes as economies learn to produce new goods at a globally-competitive level. The measure consists of two primary components. First, each narrowly-classified product is assigned an "revealed productivity" score, which is the revealed-comparative-advantage-weighted average of the incomes of its exporters. Second, each economy's export of a product is assigned a quality level based on relative unit prices. Quality and productivity scores for individual products are combined and summed across each economy's export basket to yield an annual technology level for that country. I construct this measure, which I call *TECH*, for 119 countries at various levels of development during 1975–2000.

Second, I include a broader measure of social capability than is typically used to explore the relationship between spillovers and growth. While most econometric work conflates social capability with mean years of schooling, I use confirmatory factor analysis to construct a composite indicator of social capability that is more in line with theory. The indicator is built from data describing educational, infrastructural, social and political dimensions of social capability, and captures quinquennial changes in each economy over the time period covered by the technology index.

Third, I use advanced panel econometric techniques to robustly estimate the relationship between technological upgrading, spillovers and social capability. I employ a generalized method of moments (GMM) approach that permits me to control for endogeneity and unobserved heterogeneity. While issues of omitted variables can be dealt with using simpler panel estimation techniques, GMM efficiently permits the inclusion of lagged predictors as instruments in a dynamic panel. I use these instruments to address concerns about endogeneity, which plague both the relationship between FDI and productivity, as well as technology and social capability. With this method I am able to construct consistent and efficient estimates of the exogenous contributions of trade, FDI and social capability to macroeconomic technological upgrading.

Main findings are as follows. First, FDI inflows exhibit a positive relationship with technological upgrading over a lengthy time period for a large and diverse sample of countries. This effect is conditioned by an economy's level of social capability, as well as its income. FDI inflows generate the most technological upgrading for those among the group of poorer economies that are endowed with high levels of social capability. Poor countries with low levels of social capability learn and upgrade considerably less for a given quantity of FDI. Most rich economies possess high levels of social capability, but FDI's more modest effect on technological upgrading in these countries does not appear to be strongly conditioned by social capability over the period studied. Similar to the findings in Blonigen and Wang (2005), I show that these complex relationships are concealed when the sample of countries is pooled to include countries at all levels of development. Pooling, therefore, obstructs our view of the different roles FDI plays in countries at various levels of development, and with diverse levels of social capability. Future research and policy regarding the macroeconomic impact of FDI need to take into account the degree of social capability as well as the income levels of host countries.

The remainder of this paper is structured as follows. I review the theoretical and empirical literature on FDI, social capability and technological learning in Section 2. Section 3 lays out my empirical framework, and describes the data. I present results in Section 4. Section 5 concludes.

2. SPILLOVERS, CAPABILITIES AND UPGRADING: THE LITERATURE

Technologies are rules and ideas that direct the way goods are produced. A large majority of mainstream and heterodox economists agree today that (a) some economies are more technologically advanced than others, and (b) these differences explain a great deal of the international variation in income levels (Easterly & Levine, 2001; Fagerberg, 1994; Hall & Jones, 1999; Klenow & Rodriguez-Clare, 1997; Lall, 1992; Lucas, 1986; Romer, 1986; Verspagen, 1993).

If the affliction that poorer countries suffer is a dearth of technological know-how, one remedy is for them to seek out knowledge spillovers from today's leaders. Spillovers exist because technology is to some extent a public good. Technology is non-rival, such that one agent's use of a technology does not prevent its use by another. It is also somewhat non-excludable, which means that agents who have not invested in the creation of a technology can still exploit it at no additional cost. If technologies are fully non-excludable, then agents in economies from Austria to Zimbabwe should have equal awareness of new technologies, and should be equally capable of implementing those most appropriate to the task at hand. Some formal models assume, for the sake of tractability, that technology is fully public. But most studies of technology diffusion assume some degree of excludability, typically considering that ideas are disseminated through specific channels.

Inward FDI is among the most widely studied conduits through which countries might learn about and adopt technology. The following argument predicts that inward FDI will stimulate host-country technological upgrading. Multinational corporations (MNCs) are more productive than local firms in developing countries, and their technology is at the global frontier (Lipsey, 2006). When they set up a location abroad, they bring with them the fruits of their extensive R&D, advanced physical capital, efficient marketing and management know-how, as well as other assets. MNCs desire to protect their technological advantage, because that is what gives them market power. But knowledge can spread as former MNC employees subsequently circulate throughout the economy, carrying with them some of the advanced methods and conceptual tools accumulated through their work experiences (Saggi, 2002). The intensified competition that results from MNC entry into a local market could also stimulate host-country productivity. When faced with new challengers, less-advanced local producers might be forced to upgrade their technologies by reverse-engineering (Görg & Greenaway, 2004; Wang & Blomström, 1992). They may also learn to use existing equipment more efficiently in order to remain competitive.

A wealth of cross-sectional evidence points to a positive relationship between inward FDI and domestic industries' productivity (Blomström & Persson, 1983; Blomström, Kokko, & Zejan, 1994; Globerman, 1979). But this finding could reflect several underlying processes. MNCs may simply choose to enter