Challenging the production function approach as dominant research method to assess the developmental effects of FDI

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1. Introduction

Most traditional theories of FDI activity, are based on Dunning's (1979) eclectic paradigm, and particularly on the concept of ownership advantages. Such firm specific advantages are often characterised as technology based, relating to economies of scale, capital intensity and R&D. From a theoretical point of view, it is traditionally assumed that foreign firms possess a centrally accumulated technological advantage over domestic firms. Given a sufficient level of absorptive capacity and human capital, domestic firms in host economies are able to benefit from externalities stimulated by the presence of foreign or multinational enterprises (MNEs). Given a sufficient level of absorptive capacity and human capital, domestic firms in host economies are able to benefit from externalities stimulated by the presence of foreign or multinational enterprises (MNEs). Much of the empirical literature over the past 15 years has followed Barrell and Pain's (1997) analysis of the UK, where they estimated that around 30% of the productivity growth in UK manufacturing between 1985 and 1995 could be associated to the impact of inward investment.

The approach to estimating spillovers from FDI.

The most common approach to this problem is one that is based on the initial analysis of Caballero and Lyons (1992; 1990; 1989). This approach is a production function approach, developed in order to determine the scale of output spillovers in manufacturing sectors – in other words whether if one industry increased its output, this lead to positive externalities in other sectors.

Thereby, the focus was on the identification of non-pecuniary externalities i.e. technological or knowledge spillover from foreign owned firms to domestic firms. However, the empirical results remained ambiguous and sometime contradictory. In addition, the production function approach in its current form is not able to disentangle non-pecuniary technological externalities from pecuniary externalities or other competition related effects.

However, in practice, the issue of whether there exist spillovers from inward investment (or to be more precise whether inward investment generates productivity growth in the host country) as discussed in detail in

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Blomstrom & Kokko, (1998), Driffield & Love, 2007; Görg & Strobl (2001) or ; Haskel, Pereira & Slaughter, (2007), the search for spillovers from FDI flows is based on a wholly empirical literature. In order to have confidence in the apparent results, one has to therefore consider a number of important factors:

Firstly, one must have a measure of total factor productivity, not a proxy such as labour productivity. The essential approach taken by all of the literature is to start with a relatively simple production function. One starts by obtaining an estimate of total factor productivity by estimating the following:

$$tfp_{it} = \ln Q_{it} - \hat{\beta}_L \ln L_{it} - \hat{\beta}_K \ln K_{it} \qquad (1)$$

where Q, L and K represent output, labour and capital of the firm, and the estimates of the β terms are derived either through estimation or (more commonly) simply from the relative factor shares of the two inputs. Ideally, the measure of total factor productivity should allow for the endogeneity of the investment decision by the firm, in the face of potential changes in productivity. The most common in recent years is the semi-parametric approach suggested by Levinsohn and Petrin (2003). This method allows for firm specific productivity differences that exhibit idiosyncratic changes over time by controlling for the endogeneity of input selections (Javorcik & Spatareanu, 2008).

Secondly, one must employ firm level data. As Gorg and Strobl (2001) show, many industry level studies have overstated the apparent spillover effects, due to the fact that more productive sectors are more likely to attract inward investment, perhaps motivated by technology sourcing (Driffield & Love, 2007). As such, while a correlation between inward investment and productivity growth can be established at the industry level, this is not necessarily indicative of spillovers. Thirdly, one must have panel data, not merely a cross section. This allows the researcher to not only distinguish between mere correlation (more productive sectors attracting FDI), but to also impose a dynamic element to the specification, thereby allowing FDI on one year to impact on total factor productivity in subsequent years, for example. Panel data also allows the researcher to allow for firm level heterogeneity, which has been shown to have a significant impact on the results from estimating (productivity) growth models (Lee, Kim & Heo, 1998). Fourth, one must allow for both within and

across industry effects, not merely rely on within industry effects to capture spillovers. An extension to this, highlighting the requirement for longitudinal data, is the requirement to capture the interactions between inward investors and domestic firms, and also to allow heterogeneity in this within the domestic sector.

Given these considerations, the estimate of total factor productivity can then be regressed against the externality terms within a fixed effects model, including a time trend (or alternative measure of exogenous technical progress) and other explanatory variables:

$$\ln tfp_{it} = \alpha + \sum_{p=1}^{r} \mu_p X_{it} + \omega_{it} \qquad (2)$$

where the X_{it} terms captures all of the spillovers terms, measures to capture inter-industry and intra-industry effects, interaction terms, and control variables. The specification is estimated with firm level data (with firms indexed by i) within a ~~fixed effects~~panel framework[i], controlling for both firm(i) and time specific effects (t), while our measures of potential FDI spillovers are measured at the industry level (j). Time dummies are included to allow for period specific effects on the productivity shock that is common to all firms but not attributable to explanatory variables in the equation, while firm dummies allow for cross firm variation in TFP levels.

It is clear from the above analysis, that any inferences derived from the magnitudes or significance of μ are estimates of the net effect of a number of competing effects, including spillovers, direct technology transfer effects, competition effects and crowding out effects. As a result of this, the measurement of FDI flows becomes crucial.

3. Moving beyond the state-of-the-art

Measurement Issues.

In order to carry out this type of analysis, linking inward investment to productivity growth, a suitable measure of inward investment must be found. Foreign penetration may be measured as the increase in foreign sales, employment or net capital investment, for example. Of these, sales (or value added) have the most

intuitive appeal, in the spirit of the most general formulation of Caballero and Lyons (1990) may be more appealing. It is important to allow for the relative size of the penetration, rather than merely the absolute level, which will vary with absolute industry size. This highlights one of the problems with previous literature in this area, where absolute levels of investment or sales are often employed as measures of inward investment, one suspects due to the lack of more appropriate data.

This emphasis on an indirect approach to assessing inter-firm knowledge transfer is understandable given the difficulties of gathering data on the internal operations of MNEs, but has led to some weaknesses in the literature. First, the emphasis on the spillovers literature tends to be on technology flows, and firm-specific assets have typically become characterised as technological capacity (see for example Cantwell 1989). However, this dismisses a wide range of other firm-specific assets, including managerial knowledge or competence. These are often ignored in the international technology transfer literature, despite these alternative measures of ownership advantage (and potential sources of international knowledge transfer) being discussed in detail in the conceptual analysis (e.g. Caves 1986). Second, the spillovers literature naturally tends to focus on technology and knowledge flows from parents to subsidiaries, and fails to allow fully for the capacity of subsidiaries to self-generate knowledge even in the absence of intra-firm technology flows (Bell and Marin 2004).

It seems important to acknowledge that the production function approach is just one possible quantitative method to investigate the developmental effects of FDI in host economies. Its objective is to measure the incidence and magnitude of FDI induced externalities that impact upon domestic firms' productivity. We demonstrated a number of empirical challenges that need to be addressed in the future. For example, we need to find ways within the production function approach to disentangle properly technological externalities from competition or crowding out effects. A possible way out here is the combination of a competitive fringe framework on entry and exit of firms with a production function approach (see Kosova 2010).

However, quantitative approaches are only a first step. It should be emphasised that it is not possible to understand developmental effects of FDI as black 'box' phenomenon in production function applications. It is important to account for recent theoretical thinking on the role of the heterogeneity of foreign firms or the nature of linkages between foreign and domestic firms. This type of theorising requires also increased application of qualitative research methods to understand the underlying mechanisms and processes. This includes theoretical generalisation from contrasting case studies as well as standardised survey evidence. This type of qualitative methods enables us to follow the 'trace of knowledge' that is not captured in the production function approach. Finally, from a methodological point of view it is important to underline the complementarity of quantitative and qualitative research methods to advance the state-of-the-art.

Improvements of the underlying data

The methodological challenges require an improvement in the underlying quality of data used to assess the developmental effects of FDI in host economies. This applies to data used in quantitative and qualitative methods alike. With regard to production function

approach as one quantitative method it seems promising to enhance existing large panel data with other data sources. In order to account for FDI heterogeneity, it is possible to match firm level information on productivity with firm level information on R&D and innovation. The latter exists in standardised and internationally harmonised format such as the Community Innovation Survey (CIS). Eurostat as agency in charge of the CIS tries to facilitate access to non-anonymised micro data. However, substantial legal obstacles remain for matching non-anonymised micro data in an international comparative context. Therefore, most of the existing studies following this route are limited to single country (see for example Castellani and Zanfei 2006). In order to disentangle pecuniary and non-pecuniary effects, it would be possible to add information on values and quantity of inputs and outputs at product level. So far, this is only possible for selected countries such as Chile, where firm level data sources on inputs, information on values and quantity of goods produced and exported at product level, as well as information on R&D and innovation can be matched (see Alvarez et al. 2010). Consequently, legal obstacles need to matching non-anonymised micro data need to be addressed by national and international statistical agencies in charge.

It seems also important to enhance the research potential of existing surveys that capture more of the qualitative aspects of developmental effects from foreign firms or MNEs. International agencies such as the World Bank (Productivity and Investment Climate Private Enterprise Survey) or UNIDO (Africa Foreign Investor Survey) collect firm level information in an internationally harmonised way. However, this type of data is only to a limited extent accessible by researchers outside the respective agencies. Furthermore, the data is often only available in a cross-section rather than panel format which is also related to a sometimes rapidly changing policy focus. Finally, such firm level survey data is only to a limited extent harmonised with existing standards for technological indicators offered by other international agencies (Frascati or Oslo Manuals).

Moreover, the bulk of firm level surveys on the developmental effects of FDI are undertaken outside internationally agencies by academic researchers. Yet these surveys suffer from many deficits: they are usually cross-section, cover only one or few countries, and lack reference to established standards. Finally, there is no unified standard for new and appropriate survey indicators that could be applied to collect indicators for the assessment developmental effects of foreign or multinational firms. A recent initiative by UNCTAD to establish a corresponding 'manual' could by a possible remedy. However, it should be the task of national and international research funding agencies to create an appropriate research infrastructure that pools financial and human resources to overcome the remaining limitations to advance survey based research on the developmental effects of FDI in the midterm.

It is also important to see spillovers estimates in a wider context. Driffield et al (2009) for example compare spillovers results with Barrel and Pain (1997) factor demand models, to show that spillovers are not independent of labour market effects, or upskilling. As theory predicts, inward FDI motivated by technology sourcing considerations leads to no productivity spillovers, and the same is true of 'efficiency seeking' inward FDI. Inward FDI by relative technology laggards[2] which is also motivated by accessing cheaper labour costs in

[2] Or by MNEs seeking either to diversify their knowledge portfolios or to access economies of scale in R&D (Chung and Yeaple 2004)

the UK can actually lead to reduced domestic productivity presumably through market-stealing competition effects.

Importantly, these effects provide a link between the standard explanations of FDI based on Dunning's eclectic paradigm, and more recent work highlighting the importance of technology sourcing (Cantwell 1999; Chung and Yeaple 2004; Pearce 1999; Shan and Song 1997). FDI that can be explained in terms of inward investors possessing technological advantages over domestic firms introduces new technology to the source country, which importantly generates a productivity effect over and above the simple 'batting average' effect.[3] This phenomenon, outlined perhaps for the first time in Caves (1982), has formed the basis for much of the work seeking to evaluate the technology spillover effects of FDI (Blomström and Kokko 1998; Liu et al 2000). In contrast to the impacts of FDI associated with technological advantages, FDI motivated by technology sourcing or efficiency seeking generates little in the way of technology transfer, and in the short term can even cause domestic productivity to decline. In simple terms, this suggests that the more careful analysis of spillovers generates results that are consistent with IB theory, and that that spillovers can be observed, but only if the researcher is looking in the correct place.

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[3] The batting average effect arises from the tendency for inward investing companies to be more productive than their indigenous UK counterparts (Oulton 2001), thus raising the average level of productivity in the UK merely by the fact of entry.

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[i] ~~Empirically, this means testing the restriction of fixed effects over the more general random effects specification using a Hausman test.~~